KCE REPORT 289

Federaal Kenniscentrum voor de Gezondheidszorg
Centre Fédéral d'Expertise des Soins de Santé
Belgian Health Care Knowledge Centre

REQUIRED HOSPITAL CAPACITY IN 2025 AND CRITERIA FOR RATIONALISATION OF COMPLEX CANCER SURGERY, RADIOTHERAPY AND MATERNITY SERVICES





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HEALTH SERVICES RESEARCH

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2017 www.kce.fgov.be

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Acknowledgements: Griet Ceuterick (FOD Volksgezondheid – SPF Sante Publique), Luc Dal (Université catholique de Louvain), Stephan Devriese (KCE), Thierry Eggerickx (Université catholique de Louvain), Frank Hulstaert (KCE), Jon Magnussen (Norwegian University of Science and Technology, Norway), Ingrid Mertens (FOD Volksgezondheid – SPF Santé Publique), Julien Regnart (SPF Santé Publique – FOD Volksgezondheid), Jean-Paul Sanderson (Université catholique de Louvain), Sabine Stordeur (KCE), Hans Van Brabandt (KCE), Nancy Van Damme (Stichting Kankerregister), Gigi Veereman (KCE), Leen Verleye (KCE), France Vrijens (KCE)

Reported interests: All experts and stakeholders consulted within this report were selected because of their involvement in the topic of the organisation of the hospital landscape. Therefore, by definition, each of them might have a certain degree of conflict of interest to the main topic of this report.

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- **The external experts were consulted about a (preliminary) version of the scientific report. Their comments were discussed during meetings. They did not co-author the scientific report and did not necessarily agree with its content.**
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Publication date:	30 June 2017
Domain:	Health Services Research (HSR)
MeSH:	Health Care Reform; Hospital Planning; Hospital Bed Capacity
NLM Classification:	WX 100
Language:	English
Format:	Adobe® PDF™ (A4)
Legal depot:	D/2017/10.273/45
ISSN:	2466-6459

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How to refer to this document?

Van de Voorde C, Van den Heede K, Beguin C, Bouckaert N, Camberlin C, de Bekker P, Defourny N, De Schutter H, Devos C, Gerkens S, Grau C, Jeurissen P, Kruse FM, Lefèvre M, Lievens Y, Mistiaen P, Vaandering A, Van Eycken E, van Ginneken E. Required hospital capacity in 2025 and criteria for rationalisation of complex cancer surgery, radiotherapy and maternity services. Health Services Research (HSR) Brussels: Belgian Health Care Knowledge Centre (KCE). 2017. KCE Reports 289. D/2017/10.273/45.

This document is available on the website of the Belgian Health Care Knowledge Centre.

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LIST OF ABBREVIATIONS

ABBREVIATION	DEFINITION
ACM	Authority for Consumers and Markets (the Netherlands)
ACSC	Ambulatory Care Sensitive Conditions
ADF	Augmented Dickey-Fuller test
ADH – HJA	Hospital day-care billing data ('Anonieme daghospitalisatie'/'Hospitalisation de jour anonyme')
AHRQ	Agency for Healthcare Research and Quality (United States)
AIC	Akaike Information Criterion
AICc	Corrected Akaike Information Criterion
ALOS	Average length of stay
AP-HP	Assistance Publique – Hôpitaux de Paris (France)
APR-DRG	All Patient Refined Diagnosis Related Group
AR	Admission Rate
ARH	Regional Hospital Agency ('Agence Régionale de l'Hospitalisation') (France)
ARIMA	Auto-Regressive Integrated Moving Average
ARS	Regional Health Agency ('Agence Régionale de Santé') (France)
ASA	American Society of Anaesthesiologists
ATIH	Technical Agency for Hospital Information ('Agence Technique de l'Information sur l'Hospitalisation') (France)
AUGIS	Association of Upper Gastrointestinal Surgeons
AWBZ	Exceptional Medical Expenses Act (the Netherlands)
AZV – SHA	Hospital inpatient billing data ('Anonieme Ziekenhuisverblijven'/'Séjours Hospitaliers Anonymisés')
BCR	Belgian Cancer Registry
BFM	Budget of Financial Means

BIC	Bayesian Information Criterion
BVRO – ABRO	Belgische Vereniging voor Radiotherapie-Oncologie vzw
CCGs	Clinical Commissioning Groups
CCORE	Collaboration for Cancer Outcomes Research and Evaluation
CH	General Hospital (‘Centre Hospitalier’) (France)
CHART	Continuous Hyperfractionated Accelerated Radiotherapy
CHR	Regional Hospital (‘Centre Hospitalier Régional’) (France)
CHT	‘Communauté Hospitalière de Territoire’ (France)
CHU	Teaching Hospital (‘Centre Hospitalier Universitaire’) (France)
CI	Confidence Interval
CMA	Competition and Markets Authority
COPD	Chronic Obstructive Pulmonary Disease
COS	Strategic Orientation Framework (‘Cadre d’Orientation Statégique’) (France)
COV	Coefficient of Variation
CPOM	Multiyear Contract for Targets and Resources (‘Contrat Pluriannuel d’Objectifs et de Moyens’) (France)
CR	Crude all ages Rate
CRG	Clinical Reference Group
C-section	Caesarean delivery
cStage	Clinical stage
CT	Computed Tomography
DBC	Diagnosis Treatment Combination
DC	Day care

DGOS	General Directorate of Care Provision (‘Direction Générale de l’Offre de Soins’) (France)
DHMA	Danish Health and Medicines Authority
DPCA	Dutch Pancreatic Cancer Audit
DREES	‘Direction de la Recherche, des Etudes, de l’Evaluation et des Statistiques’ (France)
DRG	Diagnosis Related Group
DUCA	Dutch Upper GI Cancer Audit
EBRT	External Beam Radiotherapy
EC	Endoscopic
ED	Emergency Department
ENT	Ear, Nose, and Throat
ERCP	Endoscopic Retrograde Cholangiopancreatography
ERNs	European Reference Networks
ESRG	Extended Service Related Groups
ET	Endocrine Tumour
EU	European Union
EUS	Endoscopic ultrasound
FANC – ACFN	Federaal Agentschap voor Nucleaire Contrôle/Agence Fédérale de Contrôle Nucléaire/
FDP-PET	Fluorodeoxyglucose - Positron Emission Tomography
FOD – SPF	Federal Public Service Health, Food Chain Safety and Environment (‘Federale overheidsdienst Volksgezondheid, Veiligheid van de Voedselketen en Leefmilieu’/’Service public fédéral Santé publique, Sécurité de la Chaîne Alimentaire et Environnement’)
FPS	Federal Public Service

GCS	'Groupement de Cooperation Sanitaire' (France)
GCS-ES	'Groupement de Cooperation Sanitaire – Etablissement de Santé ' (France)
GdS	Générale de Santé (France)
GHT	'Groupement Hospitalier de Territoire' (France)
GI	Gastrointestinal
GIST	Gastrointestinal Stromal Tumours
GP	General Practitioner
HAD	Hospitalisation at Home ('Hospitalisation à Domicile') (France)
HAS	High Authority of Health ('Haute Autorité de Santé') (France)
HBP	Hepato-Pancreato-Biliary
HCUP	Healthcare Cost and Utilization Project
HERO	Health Economics in Radiation Oncology
HIV	Human Immunodeficiency Virus
HPST	Hospital, Patients, Health and Territories ('Hôpital, Patients, Santé et Territoire') (France)
HRG	Healthcare Resource Group
ICD-10-BE	International Classification of Diseases, Tenth Revision, Belgian modification
ICD-9-CM	International Classification of Diseases, Ninth Revision, Clinical Modification
ICU	Intensive Care Unit
IGRT	Image Guided Radiation Therapy
IGZ	Health Care Inspectorate (the Netherlands)
IMA – AIM	Intermutualistic Agency
IMRT	Intensity-modulated radiotherapy
INCa	National Cancer Institute ('Institut National du Cancer') (France)

INSEE	National Institute of Statistics and Economic Studies (‘Institut National de la Statistique et des Etudes Economiques’) (France)
IORT	Intraoperative Radiation Therapy
IPA	Activity Monitoring Indicators (‘Indicateurs de Pilotage de l’Activité’) (France)
ISHMT	International Shortlist for Hospital Morbidity Tabulation
IT	Information Technology
KCE	Belgian Healthcare Knowledge Centre
KPSS	Kwiatkowski-Phillips-Schmidt-Shin test
LAPC	Locally Advanced Pancreatic Cancer
LINAC	Linear Accelerator
LOS	Length of stay
MAE	Mean Absolute Error
MAIA	Home for the Integration and Autonomy for Alzheimer patients (‘Maison pour l’Autonomie et l’Intégration des malades Alzheimer’) (France)
MAPE	Mean Absolute Percentage Error
MCO	Medical care, Surgery and Obstetrics (‘Médecine, Chirurgie et Obstétrique’) (France)
MDC	Major Diagnostic Category
MIC	Maternal Intensive Care
MOC	Multidisciplinary Oncological Consultation
MoU	Memorandum of Understanding
MR	Magnetic Resonance
MRCP	Magnetic Resonance CholangioPancreatography
MRI	Magnetic Resonance Imaging
MZG – RHM	Hospital discharge dataset (‘Minimale Ziekenhuis Gegevens’/’Résumé Hospitalier Minimum’)

NAO	National Audit Office
NCCN	National Comprehensive Cancer Network
NHS	National Health Service (UK)
NIC	Neonatal Intensive Care
NPoC	National Programmes of Care
NRZV – CNEH	'Nationale Raad voor Ziekenhuisvoorzieningen'/'Conseil National des Etablissements Hospitaliers'
NSCLC	Non-Small-Cell Lung Cancer
NSSN	National Social Security Number
NVALT	Nederlandse Vereniging van Artsen voor Longziekten en Tuberculose
NVCO	Nederlandse Vereniging voor Chirurgische Oncologie
NVMO	Nederlandse Vereniging voor Medische Oncologie
NVRO	Nederlandse Vereniging voor Radiotherapie en Oncologie
NVT	Nederlandse Vereniging voor Thoraxchirurgie
NVvH	Nederlandse Vereniging voor Heelkunde
NZa	Dutch Health care Authority (the Netherlands)
ODN	Operational Delivery Networks
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
OR	Odds ratio
OR	Operating Room
OUP	Optimal Utilisation Proportion
P10	10^{th} Percentile
P75	75^{th} Percentile or 3rd Quarter

P90	90th Percentile
PAERPA	'Personnes Agées En Risque de Perte d'Autonomie' (France)
PCT	Primary Care Trusts
PET	Positron Emission Tomography
PET-CT	Positron Emission Tomography - Computed Tomography
PMSI	'Programme de Médicalisation des Systèmes d'Information' (France)
PP	Phillips-Perron test
PRISMA	Project and Researches on Integration of Services for the Maintenance of Autonomy (France)
PSRS	Regional Strategic Health Plan ('Plan Stratégique Régional de Santé') (France)
PSS	Prescribed Specialised Services
pStage	Pathology stage
Q1	1st Quarter or 25th Percentile
Q3	3rd Quarter of 75th Percentile
R^2	Coefficient of determination
RC	Reference Centre
RCT	Randomized Clinical Trials
RD	Royal Decree
RIVM	National Institute for Public Health and the Environment (the Netherlands)
RIZIV – INAMI	National Institute for Health and Disability Insurance ('Rijksinstituut voor Ziekte- en Invaliditeitsverzekering'/'Institut National d'Assurance Maladie-Invalidité')
RO	Radiation Oncology
ROB – MRSA	'Rustoorden voor bejaarden'/'Maisons de repos pour personnes âgées'
ROM	Risk of Mortality

RT	Radiotherapy
RTT	Referral to Treatment
RVT – MRS	'Rust- en verzorgingstehuizen'/'Maisons de repos et de soins'
SARIMA	Seasonal Auto-Regressive Integrated Moving Average
SBRT	Stereotactic Body Radiation Therapy
SCLC	Small-Cell Lung Cancer
SIOS	Interregional Health Organisation Scheme ('Schéma Interrégional de l'Organisation des Soins') (France)
SLA	Service Level Agreement
SOI	Severity Of Illness
SONCOS	Foundation of Oncological Collaboration ('Stichting Oncologische Samenwerking') (the Netherlands)
SRG	Service Related Group
SROS	Regional Health Organisation Scheme ('Schéma Régional d'Organisation Sanitaire' from 1994 to 2011; 'Schéma Régional de l'Organisation des Soins' since 2011) (France)
SRS	Stereotactic RadioSurgery
STP	Sustainability and Transformation Plan
STZ	Collaborating Specialised Clinical Care Training Hospitals ('Samenwerkende Topklinische opleidingsZiekenhuizen') (the Netherlands)
T2A	Activity-Based Tariffs ('Tarification à l'Activité') (France)
TBI	Total Body Irradiation
TCT	Technical Cell ('Technische Cel voor de verwerking van de gegevens met betrekking tot de ziekenhuizen'/'Cellule Technique de traitement de données relatives aux hôpitaux')
TNM	Tumour-Node-Metastasis

TR	Transplant recipients
TSEB	Total Skin Electron Beam Radiotherapy
UK	United Kingdom
UMCs	University Medical Centres (‘Universitaire Medische Centra’) (the Netherlands)
US(A)	United States (of America)
VWS	Ministry of Welfare, Health and Sport (the Netherlands)
WBMV	Special Medical Procedures Act (the Netherlands)
WFZ	Foundation Health care Sector Guarantee Fund (the Netherlands)
WHO	World Health Organization
WMG	Health Care Market Regulation Act (the Netherlands)
WSR	Age-standardised rates according to the world population
WTZi	Health Care Institutions Admission Act (the Netherlands)
WZC	Woonzorgcentra
ZBC	Independent Treatment Centres (the Netherlands)
ZiNL	National Health Care Institute (the Netherlands)
ZN	Netherlands Health Insurers (‘Zorgverzekeraars Nederland’) (the Netherlands)
Zvw	Health Insurance Act (the Netherlands)

SCIENTIFIC REPORT

INTRODUCTION AND BACKGROUND

How to use this document?

This Scientific Report is not intended to be read as a stand-alone document, but as a complement to the Short Report of this study. It gives a detailed account of the methods and results of each of the scientific building blocks underpinning the messages rendered in the Short Report.

The context, problem description, as well as the discussion of the results, the conclusions and policy recommendations are to be found in the Short Report.

The Short Report is published as a separate document on our website. It can be accessed from the same referral page as the current document.

Scope and aim of the report

In April 2015, the Federal Minister of Social Affairs and Public Health (Minister De Block) launched an 'Action Plan for a reform of the hospital payment system'[1] defining the 'healthcare landscape 2025' as a landscape with the following characteristics:

- Population needs should determine the hospital capacity planning (beds, equipment, care programmes, etc.).
- More collaboration initiatives between hospitals and between hospitals and other care settings are needed.
- Hospitals/hospital services (including expensive equipment and infrastructure) should be part of a network. Payments and the permission to perform certain activities should (increasingly) be granted to networks instead of to individual hospitals.
- More task division between hospitals is needed.

The Action Plan also mentions the objectives of a reform of the current healthcare landscape (and possible approaches to realise these objectives): improvement of care quality (by centralisation of complex, expensive or technology-intensive services); care provided in the most appropriate care setting (by supply based on population needs); accessible care (by basic care in the proximity of patients); long-term affordability of healthcare (by division of tasks between hospitals, reduction of capacity (beds, wards), reduction of the number of hospital stays, shorter length of stay).

The current study fits in the reform plans of Minister De Block, and more specifically in the capacity planning and programming part of the reforms. The report has been commissioned by the minister and has two main objectives. The first objective concerns overall hospital capacity planning with horizon 2025, which can be operationalised by the more concrete question: **how many hospital beds will be needed by 2025**?

The second objective is to **assess the required hospital capacity for a selection of care assignments**, on the basis of criteria for programming or conventions with the National Institute for Health and Disability Insurance (RIZIV – INAMI). The selected care assignments are: **maternity services, radiotherapy centres and complex surgery for pancreatic, oesophagus and lung cancer**. The selection was done in consultation with the policy department of the minister. It follows the political priorities of the capacity planning and programming part of the reforms.

The focus is on general hospitals; psychiatric hospitals are out of scope.

Research methods and overview of the report

The recommendations (see Short Report) are based on **an extensive data analysis, a review of the literature and national or international evidence and experience**. The current report consists of four parts. In Part I the required hospital capacity at the macro-level is assessed by means of trend analysis. Part II explores the hospital use by patients with dementia and provides a review of the literature on the effectiveness of interventions to avoid or reduce hospital use by these patients. In Part III a comprehensive country analysis is performed for England, France and the Netherlands. In Part IV the required hospital capacity for the selected care assignments is assessed.

Given the broad range of topics covered in this report, each with a specific scope and research methods, a detailed description of the scope and methods is provided in the respective chapters of this report.

PART I: HOSPITAL CAPACITY PLANNING WITH HORIZON 2025

HOW MANY HOSPITAL BEDS WILL BE NEEDED BY 2025?

1 PROJECTED FUTURE TRENDS OF HOSPITAL USE IN BELGIUM

1.1 Introduction

Anticipating future needs for health services in general and for hospital services in particular presents a challenge for health planners, both in terms of (the lack of) available data on population needs and in terms of factors affecting the demand for hospital services. The hospital sector is a dynamic system that evolves at fast pace stimulated by, amongst others, medico-technical innovations, developing medical practices, demographic, societal and epidemiological changes and policy reforms. Moreover, along with the role of hospitals in the healthcare landscape, also the metric to measure hospital service use changes over time. Countries increasingly move towards service volume and activity to plan hospital capacity. However, in many countries bed capacity is still the preferred unit for planning hospital care. Projecting future bed need can serve as lead to quantify hospital capacity.

The central question of this chapter is 'How many hospital beds will be needed in 2025?'. A previous study, conducted in 2005, tried to answer the same question with the end of the time horizon in 2015.[2] We used this report as a starting point of the analyses conducted in the current chapter. Section 1.2 provides the theoretical background of the analyses and section 1.3 details the data sources that were used. The methodological choices and results of the 2005 report, called the 'report Cannoodt' (which is the name of the first author of the report), are described and evaluated in section 1.4. Potential methodological improvements are identified. Subsequently, the projection model developed for this report is presented in section 1.5; results are shown in sections 1.6 to 1.9.

1.2 Trend analysis

This section draws on Diebold (2007), Hyndman and Athanasopoulos (2013), Makridakis, Wheelwright and Hyndman (2003), and Nau (2014).[3-6]

Statistical forecasting is a commonly used technique to plan into the future and guide decision making. The idea is to identify long-run statistical time patterns in currently available (historical) data that are assumed to continue into the future. Forecasting therefore starts by building a statistical model and estimate the model's parameters using observed historical data. Historical data are considered as a combination of signal and noise. The signal (or the pattern) is the predictable element that one wants to detect with the model, whereas the noise is random variation obscuring the pattern. Once the dynamic pattern is mathematically described, it can be extrapolated to project future outcomes.

Remark that this is a rather mechanistic approach to project the future. Once past changes are quantified in mathematical terms by a suitable forecast model, future evolutions are merely a continuation of these past trends. The latter should be interpreted broadly, it includes the perpetuation of epidemiological trends (e.g. an increase in the prevalence of obesity, cancer or dementia), the steady improvement in expected healthy life-years at age 65, the ongoing development in medical practice, the substitution between inpatient care and day care, the substitution between hospital care and other care settings, the influence of financial incentives etc.

Statistical trend analysis incorporates in an indirect way the combined effects of an extensive range of influential factors, but assumes that their effect on the evolution of hospital services remains constant in the future. Hence, in order to generate valid projections, one does not only need to choose appropriate forecast models that fit the data, but additionally, research effort should go to further refining and complementing the trend analysis with input from the literature and experts. The latter is necessary to deal with changes in the driving forces of hospital service usage. Therefore, a number of care services and disease types, e.g. maternity services, radiotherapy, dementia, and complex surgical treatment of cancers are scrutinized in Part IV of this report.

The underlying rationale of our projection methodology is to reduce the potential risks when predicting the future. A first risk is the presence of a high level of noise that masks the actual signal. The random noise that is beyond explanation can be measured by error statistics such as the standard deviation of the errors. Its magnitude can be brought down by classifying hospital care in forecast groups that have low statistical noise, and remain relevant in the Belgian setting (see section 1.5.1.3). In addition, one can opt for more complex forecast models that explain more of the variability in the data. This brings us to a second threat, the risk of specifying the wrong forecasting model. This will lead to a misinterpretation about how the future resembles the past. We tackle this challenge by allowing for a large number of trend models and using an elaborated model selection procedure. The selection procedure evaluates for each model the validity of the underlying assumptions, its compliance with a set of selection criteria and its ability to predict the future. In the end, a combination of the best trend models is made to generate the final projection.

The projection model is described in detail in section 1.5. The forecast results of the trend analysis, which were validated by medical, data and organisational experts, are presented in section 1.7. We explore thoroughly the impact of an enhanced substitution from hospital inpatient care to day care on the global need for acute hospital services in section 1.8. In section 1.9, the effect of an accelerated ageing of the population on hospital capacity needs is explored. The effects on projected hospital capacity of an enhanced reduction in ALOS for caesarean and vaginal deliveries in line with international benchmarks are further detailed in the in-depth study concerning maternity services (see Chapter 8). The added value of using international benchmarks is that – contrary to the previous trend estimations – they depart from the Belgian situation, i.e. they present attainable targets but in a setting that is somewhat 'disruptive' with respect to hospital organisation, financing, and medical practices in Belgium.

1.3 Data

1.3.1 Population data

Population data are important to quantify the change in usage of hospital services generated by the changing demographic composition of the population. Past demographic information is necessary to analyse hospital service usage by socio-demographic group over time. The observed population size by age and sex at the level of the region over the period 2003 to 2016 is provided by Statistics Belgium (*'Algemene Directie Statistiek'/'Direction générale Statistique'*).

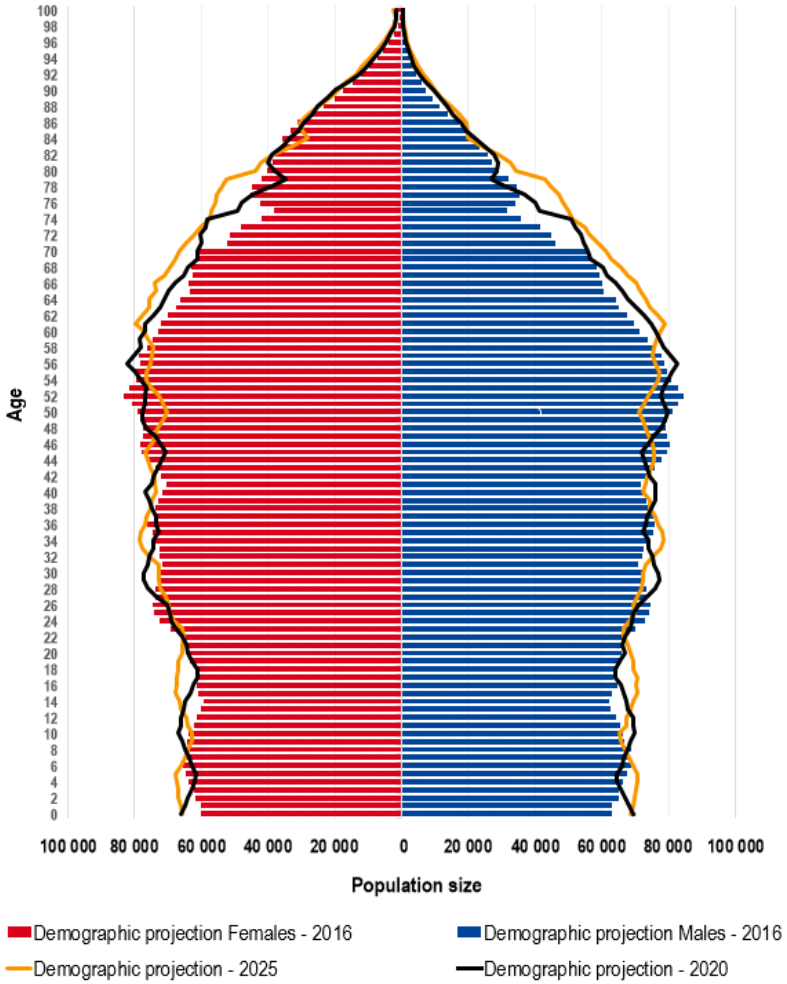
The future evolution of the population is projected in a joint effort by the Federal Planning Bureau (*'Federaal Planbureau'/'Bureau federal du Plan'*) and Statistics Belgium. We use the latest available data that were released in March 2017.[7] The projections range from 2017 to 2061 and take into account international migration, domestic relocation, and the future evolution in fertility and mortality.

The data are composed of yearly cross-sections indicating the projected size of the population residing on the Belgian territory on 1 January. The population can be further decomposed by age, by sex and by region of residence. The Federal Planning Bureau and Statistics Belgium also provide the population projections at different geographic levels, i.e. the provincial level and district level. If a finer geographic granularity is desirable, – e.g. to evaluate demographic changes in the catchment areas of loco-regional hospital networks once these will be delimited – population projections at the level of the municipality level are made available for Flanders by the Research Centre of the Flemish Government *('Studiedienst van de Vlaamse Regering')*, for Wallonia by the centre for demographic research (DEMO) of the Université catholique de Louvain and for Brussels by the Brussels Institute for Statistics and Analysis (*'Brussels Instituut voor Statistiek en Analyse'/'Institut Bruxellois de Statistique et d'Analyse'*).[8-11] The population projections at the municipality level are not as frequently updated as the projections of the Federal Planning Bureau and Statistics Belgium. In addition to the forecast results presented in section 1.7, we have examined forecast results using demographic evolutions at a finer geographical granularity than the regional level. However, this had no noticeable effect on projected hospital care needs in 2025 aggregated at the national or regional level.

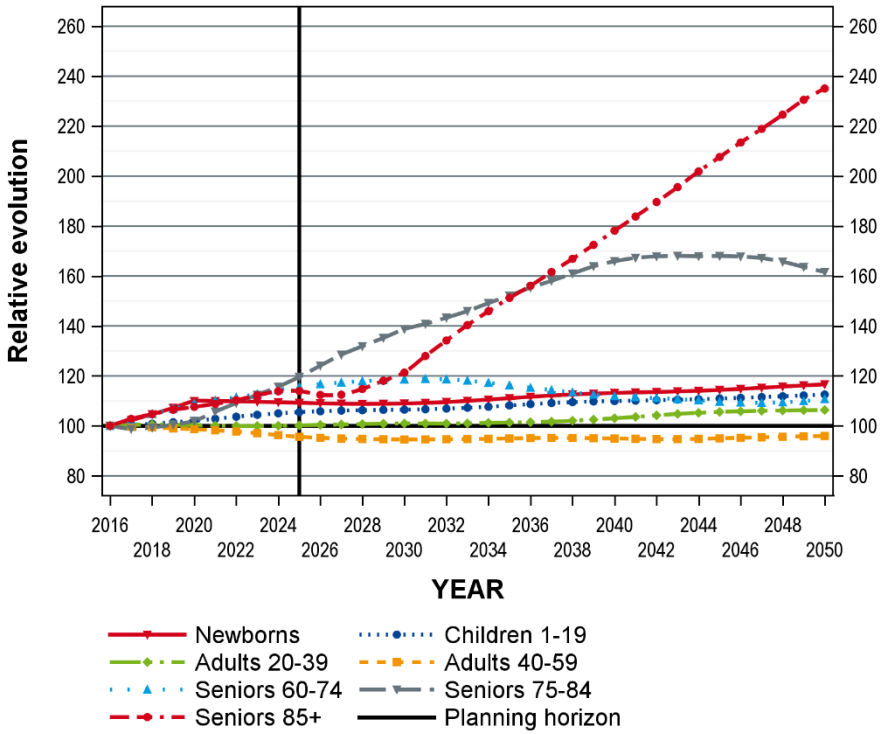
Throughout the report, the population projected on 1 January of year t+1 is used to predict care utilisation in year t. Figure 1.a shows the projections for Belgium in 2016, 2020 and 2025. The population pyramid shows that there is an expected increase in size for infants (age 0 to 5), teenagers (age 10 to 20), young adults (age 28-40) and seniors (age 55-80). The top of the pyramid (aged 80 or more) shows no important growth in absolute terms. This age group will increase at rapid pace from 2030 onwards, beyond the planning horizon applied in this report (see Figure 1.b). The groups of persons in their twenties (age 20-28) and of middle aged adults (age 40 to 55) are expected to contract between now and 2025.

Figure 1 – Population projections for Belgium

a) Population pyramid (2016, 2020 and 2025)



b) Relative evolution (Reference = 2016)



1.3.2 Hospital data

Minimal Hospital Data (MZG – RHM)

All Belgian general, non-psychiatric hospitals are legally bound to submit twice a year a large, standardized set of data on all inpatient and day-care hospital stays and emergency room contacts which are transferred to the Federal Public Service (FPS) for Health, Food Chain Safety and Environment: the Minimal Hospital Data (MZG – RHM).

Day-care stays include all surgical and non-surgical stays for which one of the following lump sums can be charged: maxi lump sum, mini lump sum (up to January 2014), lump sums for chronic pain (3 groups) and one of the 7 groups of lump sums introduced in 2007; or are of a specific type (currently geriatric, paediatric, oncological). On January 2014, the interventions allowing hospitals to charge a mini lump sum (emergency bed occupation or intravenous infusion) were included in the hospital budget and it since then hospitals are no longer allowed to separately charge the lump sums.[12] Throughout the report, we continue to refer to the interventions involved as mini lump sums.

For a limited number of interventions performed in day-care units no specific lump sum is attributed, e.g. the removal of totally implantable venous access devices used for chemotherapy administration. These stays need to be recorded to have full information on the hospital activity in day-care units.

A more elaborate discussion of the data and manipulations of the data can be found in the Data Manual (which is available upon request).

Main variables

Important variables for this chapter are the *clinical information* provided by All Patient Refined-Diagnosis Related Group (APR-DRG) classification, and severity of illness (SOI) (see Box 1); the *patient characteristics* such as age, sex and residence; and the *stay type information* such as bed type, length of stay (LOS) at bed type granularity, hospital characteristics, urgency, and mortality.

Box 1 – APR-DRG classification system

Belgium imported the 3M™ **APR-DRG** (All Patient Refined-Diagnosis Related Group) grouper to assign hospital stays to an APR-DRG. The basic DRG structure is extended by adding two sets of subclasses to each APR-DRG, namely severity of illness (SOI) and risk of mortality (ROM).[13]

Patients are allocated to an APR-DRG-SOI group on the basis of principal diagnosis, secondary diagnoses and procedures, age and sex of the patient and, for some APR-DRGs (e.g. burns) type of discharge.

Severity of illness is defined as the extent of physiologic decompensation or organ system loss of function and introduces four categories for SOI: 1=minor, 2=moderate, 3=major, 4=extreme.

Risk of mortality is defined as the likelihood of dying in the admission, also classified as minor, moderate, major and extreme.

Hospital stays are classified into one of 320 APR-DRGs (version 28), each with 4 SOI-classes, and two 'residual' APR-DRGs grouping hospital stays whose medical record abstracts contain clinically atypical or invalid information, thus rendering SOI classification irrelevant (APR-DRG 955 – Invalid principal diagnosis and 956 – Ungroupable stay). Hence, the number of distinct groups amounts to 1 282.

Source: Devriese et al. (2016)[14]

Data set at start

At the time of this study, MZG – RHM data are available up to 2014. We set the start of the data observation period in 2003 for inpatient stays. This moment is deliberately chosen after the important hospital payment reform of 1 July 2002. Registration in the year 2002 was affected by the reform and may contain some irregularities. Financial incentives have thoroughly changed in consequence of the hospital payment reform, so that data recorded before 2002 are most likely less representative to produce forecasts of hospital service usage. Hence, the analysis data set for hospital inpatient services is based on the Minimal Hospital Data stays for 2003 to 2014.

The data observation period for day-care activity starts in 2006. The main reason is that certain information is only available from 2006 onwards.

An APR-DRG is assigned to all inpatient and to all day-care stays. Between 1 July 2002 and 2013, the APR-DRG classification system version 15 was used, in 2014 version 28 was introduced to group hospital stays. More information on the differences between both classification systems can be found in Pincé (2012) and FPS for Health, Food Chain Safety and Environment (2013).[15, 16] In order to remain consistent with the new APR-DRG classification, the FPS for Health, Food Chain Safety and Environment has agreed to apply the algorithm of version 28 on the hospital records from preceding years.

Registration issues mini lump sums

As discussed in more detail in the Data Manual, the registration of mini lump sums in 2006 and 2007 in the hospital data is incomplete. The records concerned are mini lump sums attributed to an APR-DRG group comprising mini lump sums without additional pathology information. While the billing information of the mini lump sums was registered, the record cannot be coupled to patient characteristics and other complementary information. Since patient characteristics are necessary in our estimation strategy, the incomplete registrations are excluded. The consequence is an unrealistic evolution of mini lump sums between 2006 and 2008: 0 stays in 2006, 173 857 stays in 2007 and 574 662 stays in 2008. This affects the appraisal of the past evolution of the global day-care volume. Therefore, when analysing the evolution of day care, information is provided with and without including mini lump sums.

1.4 Evaluation of the report Cannoodt

In September 2004 a research project 'Future need for acute hospital services in Belgium' was commissioned by the then Minister for Social Security and Health.[2] The study was carried out by researchers from the university hospital of Leuven, the University of Mons and the University of Ghent. Within the scope of the project, future needs were based on observed usage of acute hospital services.

The project delivered two reports. An intermediary report discussed the necessary capacity for inpatient acute hospital beds in 2005. Short term extrapolations of health services usage were made using Minimal Hospital Data from 2000 to 2002 and the demographic change between 2002 and 2005. The imbalance in bed types between supply, approximated by the number of licensed beds and future usage of services, was calculated. The final report estimated future needs on a longer time horizon, i.e. 2010 and 2015. Projections of future inpatient bed need were made using Minimal Hospital Data from 1996 to 2002 and the demographic change between 2002 and 2015 (a more detailed explanation follows in section 1.4.1). The researchers formulated different hypothetical scenarios on the substitution between inpatient care and day care aiming to examine the sensitivity of the projection results to the future substitution potential between both care settings. The estimations were made at the national level and elaborated in more detail for the region Ghent. In this section, we evaluate the accuracy of the national long-term projections made in the final report to which we will refer as the 'report Cannoodt' in what follows.

1.4.1 Projection model

The aim of the report Cannoodt was to project the use of inpatient acute hospital services ten years into the future, taking into account factors that are quantifiable and expected to affect inpatient use. A statistical trend analysis was applied to forecast the future volume of hospital services based on the historical change in usage of hospital services and the projected demographic evolution. The methodology in the report Cannoodt built on previous research on long-term capacity planning of hospital beds (report Groot, 1986).[17]

1.4.1.1 Scope of the planning study

Inpatient acute hospital services were defined as all inpatient stays of individuals residing in Belgium from category «H»[a]. Inpatient stays recorded in acute and categorical hospitals were considered, hence excluding stays in psychiatric hospitals. In addition, stays of newborns aged 29 days or less who were only registered in bed type M (maternity) were removed to avoid double counting with the stay of the mother. When other bed types were registered, e.g. for neonatal intensive care (bed type NIC), the newborn record was retained.

Hospital inpatient service usage was expressed in number of stays, number of nursing days and number of beds (employing multiple occupancy rates). Requirements in number of staff or medical equipment were not considered as outcome measures.

[a] Category «H» indicates classic stays, to be contrasted with categories «F», «M» and «L» for respectively, the first, intermediate and final registration of long-term stays, categories «C» and «D» for surgical and medical day care activity, category «P» for complete psychiatric stays and category «U» for ambulatory emergency contacts.

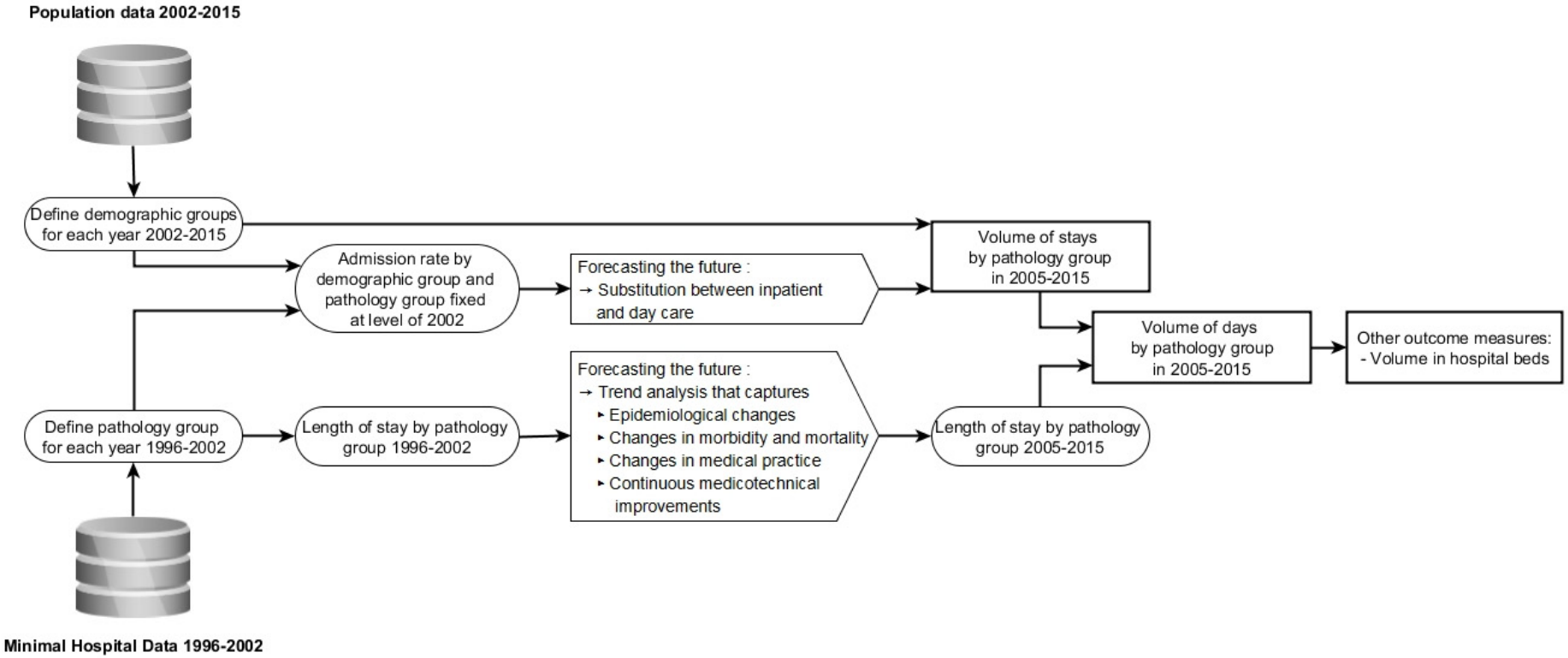
1.4.1.2 Methodological choices and scenario definition

A schematic overview of the projection model is given in Figure 2. Four influential factors are combined to produce forecast results for inpatient hospital care use.

1. **Demographic changes**. Individuals pertaining to different socio-demographic subgroups differ with respect to the type of hospital services they use, their admission rates, their co-morbidities, the length of their stay etc. As the demographic composition of the population changes over time, it is important to translate demographic evolutions into future hospital usage. This was done in the report through static reweighting, a technique that relates the size of a socio-demographic group in a linear way to the usage of hospital services. For example, if the size of a socio-demographic group doubles [halves], this leads to twice [half] as many hospital stays and nursing days for the socio-demographic group and this for all pathologies. In the report Cannoodt, the population was classified in five year age groups. There were two exceptions, one exception at the bottom where the group 0-4 year olds were further subdivided in 0 and 1-4 year olds and one exception at the top where individuals aged 100 or more were joined together. Population projection data for 2005-2015 were provided by Statistics Belgium.
2. **Admission rates**. Admission rates were computed for each age and pathology group using the Minimal Hospital Data from the latest available year, i.e. 2002. All Patient Refined-Diagnosis Related Groups (APR-DRGs) version 15 were used to distinguish between pathologies. Future admission rates were fixed at the level of 2002.

3. **Substitution from inpatient hospital care to day care**. The admission rates are, however, adjusted for substitution between inpatient care and day care. Seven hypothetical scenarios were developed to quantify the shift from inpatient care to day care. Scenario analysis is a commonly applied approach in forecasting to deal with the inherent uncertain future. Each scenario draws up a plausible view of future developments.
   a. Baseline scenario: no substitution between inpatient stays and day care.
   b. Scenario 1: all inpatient stays with length of stay (LOS) of 1 day or less are in the future replaced by day care.
   c. Scenario 2: all inpatient stays with LOS of 2 days or less are in the future replaced by day care.
   d. Scenario 3: all inpatient stays with LOS of 3 days or less are in the future replaced by day care.
   e. Scenario 4: Inpatient stays of specific APR-DRGs with LOS of 1 day or less are in the future replaced by day care. The selection of APR-DRGs is based on:
      i. A negative correlation between inpatient care and day care over time (hence an increase in day care is accompanied by a decrease in inpatient care or vice versa).
      ii. The number of stays in day care constitute at least 1/3 of the sum of (potentially replaced) inpatient stays and day care stays.
   f. Scenario 5: Inpatient stays of specific APR-DRGs with LOS of 2 days or less are in the future replaced by day care (selection criteria see scenario 4).
   g. Scenario 6: : Inpatient stays of specific APR-DRGs with LOS of 3 days or less are in the future replaced by day care (selection criteria see scenario 4.)
   h. Scenario 7: Inpatient stays of specific APR-DRGs are in the future replaced by day care at a rate of 100% for stays with LOS of 1 day or less, at a rate of 60% for stays with LOS between 1 and 2 days, at a rate of 40% for stays with LOS between 2 and 3 days (selection criteria see scenario 4).
4. **Average length of stay (ALOS)**. The ALOS was computed yearly for each pathology group using the Minimal Hospital Data from 1996 to 2002. A deterministic trend regression analysis on the evolution of ALOS was performed separately for each APR-DRG group, using four potential parametric specifications: a linear trend, an exponential trend, a logarithmic trend or a power trend. The specification with the highest R^2 – given that the R^2 is above an arbitrarily chosen threshold of 0.60 – was selected to produce a forecast of future ALOS in 2005, 2010 and 2015. If the R^2 for all specifications fell below the 0.60 threshold, the geometric mean of the ALOS in the period 2000-2002 was used as forecast value in all years. This approach has generated a deterministic time trend for 198 APR-DRGs satisfying the goodness of fit criterion. No time trend was retained for 158 APR-DRGs.

Figure 2 – Overview of projection model in the report Cannoodt



1.4.1.3 [18]Projection outcome measures

Using the four different elements – demographic changes, fixed admission rates, day-care substitution, and the evolution in ALOS – the three outcome measures can be easily computed at any moment in time.

1. The projected total number of *inpatient hospital stays* under scenario (S) is computed as follows (see Eq. (1)). First, one calculates the product of the population growth of age group (A) between 2002 and year Y and the number of inpatient stays selected under scenario (S) in 2002 by pathology group (P) and age group (A). Next, in order to get the total number of stays, the sum of this product over all demographic groups and all APR-DRGs is calculated.

$$\textbf{total number of inpatient stays}_{year\ Y,\ scenario\ S} = \sum_{A}\sum_{P} \frac{\text{size}_{year\ Y,\ \ group\ A}}{\text{size}_{year\ 2002,\ \ group\ A}} \times \text{stays in } 2002_{\ group\ A,\ \ pathology\ P,\ scenario\ S} \quad (1)$$

2. The projected total number of nursing days in year Y under scenario (S) builds upon this results (see Eq. (2)). It is the product of the projected number of inpatient stays by age (A) and pathology group (P) and the forecasted ALOS by pathology group (P) for year Y. The total number of nursing days results from the sum of this product over all demographic groups and all APR-DRGs.

$$\textbf{total number of nursing days}_{year\ Y,\ scenario\ S} = \sum_{A}\sum_{P} \frac{\text{size}_{year\ Y,\ \ group\ A}}{\text{size}_{year\ 2002,\ \ group\ A}} \times \text{stays in } 2002_{\ group\ A,\ \ pathology\ P,\ scenario\ S} \times ALOS_{year\ Y,\ \ pathology\ P} \quad (2)$$

3. The total number of beds in year Y under scenario (S) amounts to the total number of nursing days divided by 365 and a predetermined occupancy rate (see Eq. (3)). No diversification by bed type is made.

$$\textbf{total number of beds}_{year\ Y,\ scenario\ S} = \frac{\text{total number of nursing days}_{year\ Y,\ scenario\ S}}{365\ \times\ \text{occupancy rate}} \quad (3)$$

1.4.2 Comments on the research methodology

We have four main comments on the followed approach.

1. There is no statistical trend estimation for the admission rates. The change in the number of inpatient stays is entirely related to demographic changes and the substitution from inpatient care to day care. It is clear that other drivers explain healthcare usage. A trend analysis, or alternatively the use of expert opinions or a literature review, could have incorporated significant evolutions, such as a change in birth rates, the increase in importance of specific pathologies (e.g. obesity or dementia), the medicalization of society, continuing innovations in medical practice and ongoing shifts between inpatient hospital care and other forms of health care provision, besides day care.
2. There was no assumption with respect to timing in the different substitution scenarios. The substituted inpatient stays are simply left out of the data leading to a somewhat unrealistic immediate drop in the inpatient admission rates and service volume as the results in section 1.4.3.3 show. Scenario results generally attempt to provide a range of projection results in which (ideally) the future realization should be situated. A more gradual implementation of the substitution potential over time would have lend more credibility to the results.
3. In the report Cannoodt, scenario analysis was applied to model an important number of alternative assumptions on the substitution potential from inpatient to day care. The technique was not used to evaluate the disruptive effects of other influential factors. Trend projections based on historical data do not account in any way for disruptive events in the future. Scenario analysis, on the other hand, is well suited to capture the potential effect of policy, technological and organisational reforms, or demographic shocks, having the ability to disrupt the ongoing evolution. The hospital payment reform of 1 July 2002 is a striking example. Since the trend analysis of ALOS was performed on data between 1996 and 2002, the effects on ALOS of the important hospital payment reform of 1 July 2002 were not accounted for. This reform gradually introduced prospective pathology-based funding using the notion of 'justified activities'.[b] Stakeholders indicate that the switch from funding of structures (through licensed beds) to funding based on activities (through justified beds calculated on the basis of justified activities), has created strong incentives to reduce the ALOS.[20] In as far as this effect could have been anticipated, a scenario analysis would have brought added value to the report.
4. The definition of socio-demographic groups that was applied, is very detailed with respect to age, but neglects differences by sex and region. The implicit assumption is that only the size of the age group affects future volume of hospital services, not any other characteristic of the age group such as the ratio between males and females, the distribution over regions, the state of health etc. Regional differences in medical practice can, however, be substantial.[21-25] The inclusion of gender allows to improve the forecasts for gender-specific types of care, e.g. pregnancy and childbirth, and treatments of the reproductive system.

In Table 1 we summarize the four comments and indicate how we deal with them in our own projection model.

b Justified activities, the basic concept in the hospital budget (called the Budget of Financial Means), are generally based on the national ALOS per APR-DRG-SOI further subdivided in categories according to stay characteristics (such as hospitalisation in a geriatric bed or not) and to age, which is then applied to the case-mix of each hospital.[19, 20] Hence, the concept of justified activities is based on average activity and should not be confused with justified as reflecting evidence-based practice.[20]

Table 1 – Comments on the research methodology and proposed adaptations for own projection methodology

Summary of comment	Proposed adaptations for own projection methodology (see section 1.5)
There is no time trend analysis for admission rates. Therefore the effects of important drivers for health care usage are neglected.	Perform a time trend analysis for admission rates.
No assumption on timing of shift from inpatient care to day care.	Explicit consideration of timing in the substitution from inpatient care to day care (see section 1.8).
The potential effect of policy, technological and organisational reforms, or demographic shocks, having the ability to disrupt the ongoing evolution are not accounted for, e.g. the effects of the hospital payment reform of 1 July 2002 were not further examined.	We evaluate the potential effects of a healthcare policy aimed at incentivizing the substitution from inpatient care to day care (see section 1.8), the effects of accelerated population ageing (see section 1.9), and of reduced ALOS for caesarean and vaginal deliveries in line with international benchmarks (see Chapter 8).
Definition of socio-demographic groups only based on age.	The definition of socio-demographic groups is based on age, sex and region of residence (see section 1.5.1.2).

1.4.3 Evaluation of the projection outcomes

In what follows, we elaborate on the accuracy of the forecasts. First we discuss the demographic projections that have served as input for the model. Second, we analyse the national projections for inpatient stays and nursing days. Finally, we scrutinize the trend analysis for ALOS.

1.4.3.1 Population projections

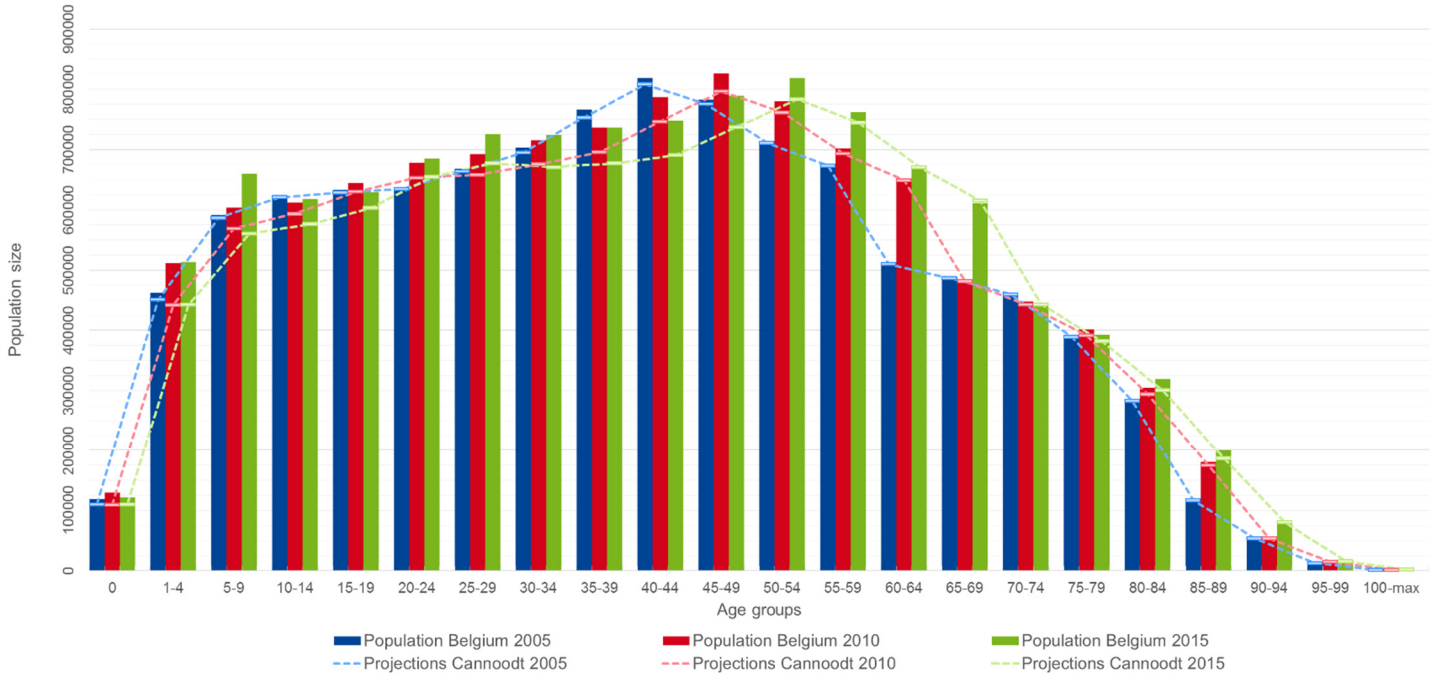
The evolution in population size by age group was used to recalculate the future number of inpatient stays. Population projections for individuals living in Belgium are produced at regular time intervals by the Federal Planning Bureau and Statistics Belgium. However, population dynamics change over time and are difficult to project. This is clearly visualized in Figure 3. It presents the correspondence between the population projections used in the report Cannoodt (i.e. the dotted lines) and the recorded official Belgian population figures (i.e. the bars) in 2005, 2010 and 2015. It is apparent that the population projections underestimated actual population growth. Remark that this should not be interpreted as an inadequacy in the methodology applied by Cannoodt, since the report used the latest available population projections. It merely emphasizes the need for regular updates of planning projection models to the newest available data.

The difference is minor in 2005 with an underestimation of 85 000 individuals or less than 1%, but mounts up rapidly to a discrepancy of about 420 000 individuals or 4% in 2010 and 640 000 individuals or a gap of 6.1% in 2015. The deviation between the projections and the actual population size is most pronounced for newborns and children aged 10 years or less, with an underestimation for these age groups between 10% and 18% in 2015. In fact, it was assumed that the number of children aged 10 years or less would decrease over time, while an increase is observed. Secondly, projections for the group of adults up to age 60 were estimated about 4% to 8% below the actual realizations. The population projections for individuals aged 60 and more, roughly match the observed population size.

Underestimated population growth implies an underestimation of inpatient hospital stays

Given that the population projections have undervalued actual population growth, they may cause an underestimation of hospital stays. The combined usage of health services by the age groups below 60 years (which all were underestimated) amounts to 56% of all admissions and 35% of all nursing days in 2003. The service volume of children younger than 10 years sums to 10% of all admissions and 6% of all nursing days. Remember that these percentages do not include stays of newborns aged 29 days or less who were only registered in bed type M (maternity) (see section 1.4.1.1).

Figure 3 – Projected and observed Belgian population by age, 2005-2015



Note: Population for each year t is determined on 1 January, year t+1. Source: Federal Planning Bureau - Statistics Belgium.[7]

1.4.3.2 *Point of comparison for evaluating the forecast results*

The forecast results in the report Cannoodt for the period 2005-2015 can be compared to the actual recorded inpatient activity over the period 2005-2014 (latest available observation year). The same selection criteria as defined in the report Cannoodt (see section 1.4.1.1 and report Cannoodt chapter 1, p.10) are applied to the population-wide hospital data. This allows us to compute a fully comparable number of inpatient hospital inpatient stays, number of nursing days and length of stay. For the evaluation, the old APR-DRG classification (version 15) was used.

Forecast results in the report Cannoodt were specified at three points in time: 2005, 2010 and 2015. Intermediary forecasts for inpatient stays and days are estimated using a linear interpolation. Intermediary forecast results for length of stay are calculated based on the annexed regression formulae.

Table 2 – Projected and observed total number of inpatient hospital stays and nursing days

	Inpatient hospital stays					Nursing days				
Year	2002	2005	2010	2014	2015	2002	2005	2010	2014	2015
Projections and observations										
Observed	1 701 004	1 705 643	1 759 689	1 800 457		14 417 744	13 953 420	13 403 967	12 907 952	
Baseline scenario		1 732 269	1 788 768	1 834 779*	1 846 282		14 415 171	14 660 112	14 916 036*	14 980 017
Scenario 1		1 372 165	1 422 608	1 463 409*	1 473 609		12 461 294	12 663 147	12 857 602*	12 906 216
Scenario 2		1 146 262	1 191 708	1 228 151*	1 237 262		11 205 658	11 411 044	11 597 995*	11 644 733
Scenario 3		989 824	1 032 062	1 065 696*	1 074 105		10 223 515	10 434 498	10 618 379*	10 664 349
Scenario 4		1 469 722	1 521 821	1 563 907*	1 574 428		13 050 849	13 238 220	13 430 152*	13 478 135
Scenario 5		1 291 374	1 339 553	1 378 271*	1 387 951		12 077 298	12 258 541	12 439 379*	12 484 588
Scenario 6		1 173 421	1 218 977	1 255 539*	1 264 679		11 354 168	11 533 303	11 708 427*	11 752 208
Scenario 7		1 315 532	1 364 230	1 403 432*	1 413 233		12 177 928	12 361 478	12 544 893*	12 590 747

** Linear interpolation of projections in 2010 and 2015. Note: Baseline scenario: no substitution; Scenario 1: LOS ≤ 1 day shifted to day care; Scenario 2: LOS ≤ 2 days shifted to day care; Scenario 3: LOS ≤ 3 days shifted to day care; Scenario 4: subgroup of APR-DRGs + LOS ≤ 1 day shifted to day care; Scenario 5: subgroup of APR-DRGs + LOS ≤ 2 days shifted to day care; Scenario 6: subgroup of APR-DRGs + LOS ≤ 3 days shifted to day care; Scenario 7: subgroup of APR-DRGs + LOS ≤ 3 days shifted to day care but at different substitution rates.*

Source: Projections from report Cannoodt; Observations from Minimal Hospital Data, own calculations.

1.4.3.3 *Forecasts for total number of hospital inpatient stays and nursing days*

Table 2 and Figure 4 provide an overview of the projected and observed number of hospital inpatient stays over time. The projected and observed number of nursing days over time are presented in Table 2 and Figure 5.

Baseline forecast results for inpatient stays closely match actual realization: downward and upward bias cancel out?

Both the baseline and the scenario forecast results projected a positive trend in total hospital stays over time which is confirmed by the actual trend. The projected yearly growth in hospital admissions ranges between 0.63% and 0.82%. The observed percentage of yearly increase amounts to 0.48%. The baseline projection for hospital admissions is a remarkable close match to the observed number of hospital admissions, in spite of an underestimation of the population size and an absence of substitution between inpatient and day care. KCE report 192 shows that clinical intervention groups, i.e. groups of stays joined together around a specific intervention (e.g. eye lens surgery, circumcision etc.) as indicated by nomenclature or pseudo-nomenclature codes, can be classified into three types of substitution groups: no substitution, partial substitution and full substitution.[26] Given that the number of day cases has strongly increased between 2005 and 2015, the assumption of no substitution seems difficult to justify (see also section 1.5.2). One explanation for the close match between the baseline projection and observed inpatient admissions is that the downward bias in projected inpatient admissions caused by the underestimation of population size balances out with the upward bias related to the lack of substitution to day care.

Seven hypothetical scenarios adjust the admission rates with different assumptions on the substitution between inpatient care and hospital day care. All scenario analyses reveal an important reduction in hospital inpatient stays compared to the baseline projection. The projections that do take into account a shift from inpatient care to hospital day care produce forecasts that underestimate the number of hospital stays by 15% to 40%.

Inaccurate assessment of the case mix

At an aggregate level, the baseline projections closely match the observed number of inpatient stays. However, the projected change in case mix in terms of inpatient stays is completely different as is clearly illustrated in Table 3. Fixing the admission rates might at least partly explain the large divergence. A number of striking examples: for MDC 14 pregnancy and childbirth, a reduction by 11.6% was projected while in fact a growth by 9.6% occurred; diseases and disorders of the ear, nose, mouth and throat (MDC 3) was projected to contract by 6.7% while it almost doubled in reality; care related to health status and aftercare was estimated to increase by 1.5% compared to a growth in reality by 41.2%.

Table 3 – Case mix (in terms of inpatient stays) projected versus observed

Top 5 MDC ranked by size (in stays)	Projected change 2002-2015	Observed change 2002-2014	Top 5 MDC ranked by projected growth	Projected change 2002-2015	Observed change 2002-2014	Top 5 MDC ranked by projected decrease	Projected change 2002-2015	Observed change 2002-2014
8	0.7%	9.0%	**5**	6.1%	-2.2%	**14**	-11.6%	9.8%
5	6.1%	-2.2%	**2**	5.1%	-40.3%	**24**	-11.4%	8.4%
6	-0.4%	-0.4%	**16**	4.8%	15.4%	**15**	-9.4%	-1.3%
14	-11.6%	9.6%	**4**	3.5%	7.9%	**3**	-6.7%	47.6%
4	3.5%	7.9%	**0**	3.5%	12.6%	**22**	-6.6%	-24.6%

Label MDCs: 0: Residual group; 2: Eye; 3: Ear, nose, mouth and throat; 4: Respiratory system; 5: Circulatory system; 6: Digestive system; 8: Musculoskeletal system; 14: Pregnancy/childbirth; 15: Newborns and neonates; 16: Blood/related organs; 22: Burns; 24: HIV.

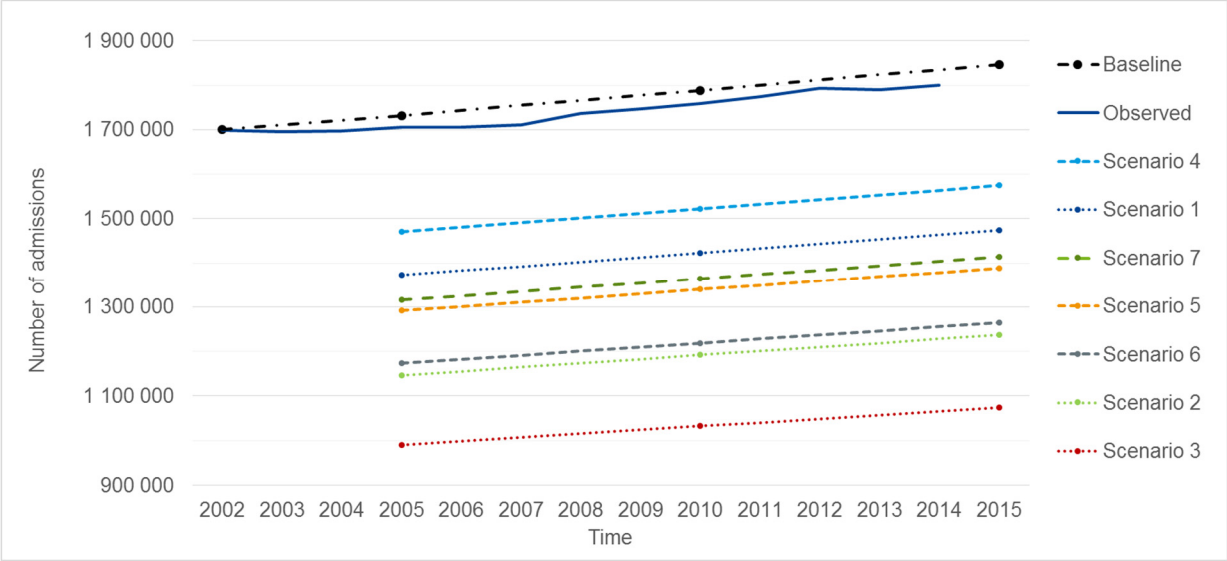
Inpatient days and bed need overestimated

The projected number of nursing days are no good predictor for the observed number of nursing days. The total volume of nursing days was projected to increase in every scenario (annual growth rate between 0.30% and 0.42%), whereas the opposite is observed in the Minimal Hospital Data. We ascertain a decreasing trend in nursing days over time with an annual decline of 0.92%. This implies that a more important overall reduction in ALOS is attained than was projected. We elaborate on this in section 1.4.3.4. The steep decrease in ALOS can be partly explained by the hospital payment reform of 1 July 2002, which was not accounted for. As noted in section 1.4.2, a scenario analysis of the anticipated impact of the reform would have been interesting.

Based on the projection results in Figure 4 and Figure 5, the specification and quantification of the scenarios seem quite rough. First, instead of an immediate shift in admissions, a gradual shift over the planning horizon would have been more appropriate. For example, solely in terms of inpatient days, a gradual implementation of scenario 7 – i.e. inpatient stays of specific APR-DRGs with LOS ≤ 3 days are in the future transferred to day care at different substitution rates – could have been a good forecast. In general, the scenarios tend to overestimate the potential shift towards day care. Scenarios which focus on a selection of pathologies (e.g. scenarios 4, 5, and 7), on stays of short length (e.g. scenarios 1 and 4) and on partial substitution (e.g. scenario 7) seem to produce better forecasts.

Future bed capacity is estimated at an aggregated level, without specifying the required bed types. Hence, they follow the same trend as the projected nursing days.

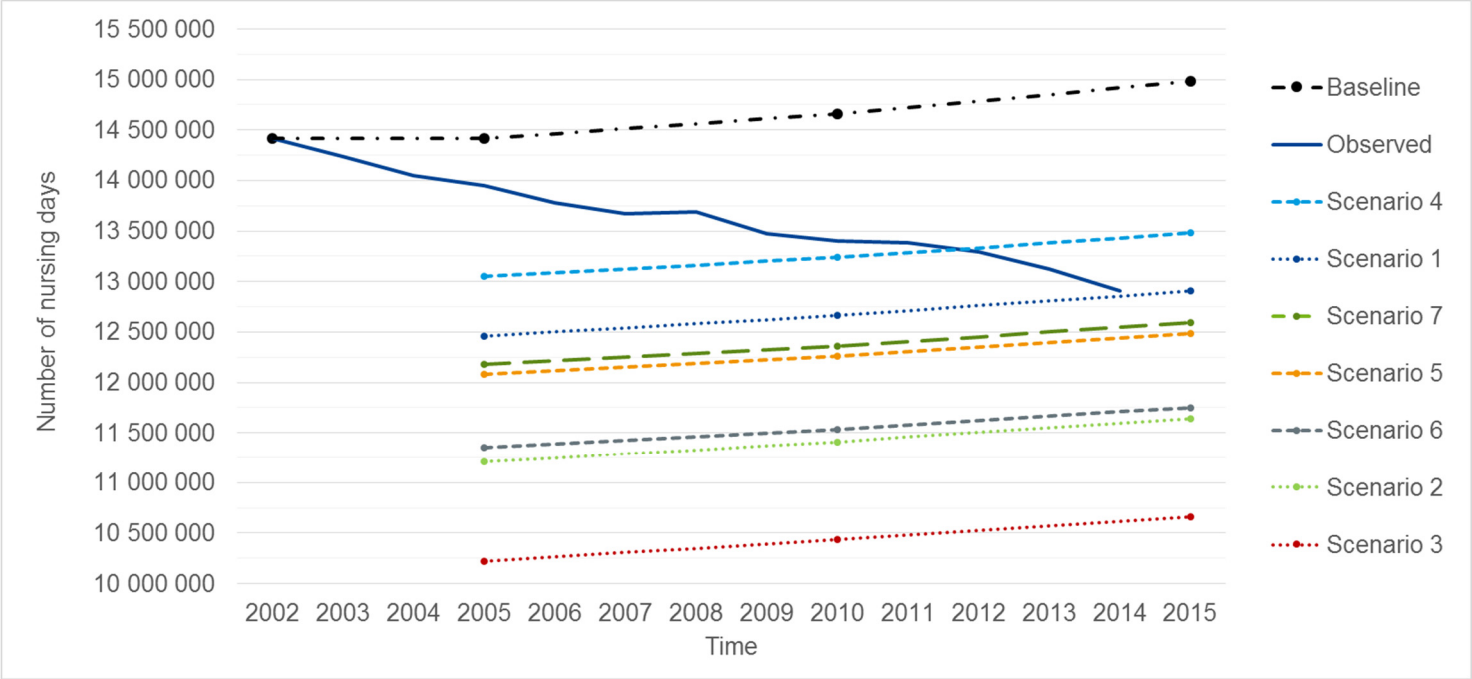
Figure 4 – Projected and observed number of hospital inpatient stays



Note: Baseline scenario: no substitution; Scenario 1: LOS ≤ 1 day shifted to day care; Scenario 2: LOS ≤ 2 days shifted to day care; Scenario 3: LOS ≤ 3 days shifted to day care; Scenario 4: subgroup of APR-DRGs + LOS ≤ 1 day shifted to day care; Scenario 5: subgroup of APR-DRGs + LOS ≤ 2 days shifted to day care; Scenario 6: subgroup of APR-DRGs + LOS ≤ 3 days shifted to day care; Scenario 7: subgroup of APR-DRGs + LOS ≤ 3 days shifted to day care but at different substitution rates.

Source: Projections from report Cannoodt; Observations from Minimal Hospital Data, own calculations.

Figure 5 – Projected and observed number of nursing days



Note: Baseline scenario: no substitution; Scenario 1: LOS ≤ 1 day shifted to day care; Scenario 2: LOS ≤ 2 days shifted to day care; Scenario 3: LOS ≤ 3 days shifted to day care; Scenario 4: subgroup of APR-DRGs + LOS ≤ 1 day shifted to day care; Scenario 5: subgroup of APR-DRGs + LOS ≤ 2 days shifted to day care; Scenario 6: subgroup of APR-DRGs + LOS ≤ 3 days shifted to day care; Scenario 7: subgroup of APR-DRGs + LOS ≤ 3 days shifted to day care but at different substitution rates.

Source: Projections from report Cannoodt; Observations from Minimal Hospital Data, own calculations.

1.4.3.4 Trend in ALOS by APR-DRG

The evolution in ALOS is estimated using a deterministic trend analysis. For 198 APR-DRGs, a time trend was found that satisfies the imposed goodness of fit criterion of a R^2 above 0.60 (see section 1.4.1.2). For 184 out of 198 APR-DRGs, the time trend shows a downward tendency. No time trend was retained for 158 APR-DRGs. As an alternative, the geometric mean over the period 2000-2002 was used as forecast and kept constant over time. These 158 APR-DRGs represent 21% of all admissions and 25% of all nursing days in 2002. Hence, primarily APR-DRGs with relatively few admissions had more unexplained variability so that a regression analysis could not produce a reliable time trend.

We compare the accuracy of the forecasts with observed ALOS at the level of the APR-DRG at three points in time: 2005, 2010 and 2014. The evaluation is made both for all APR-DRGs and subdivided into groups with and without estimated time trend. There are different ways to evaluate the ALOS forecast. One can look at the variation in absolute terms, i.e. the difference between projected ALOS and actual ALOS expressed in days. However, it is evident that a divergence between the forecast and the actual ALOS of 2 days has a different impact for an APR-DRG with an ALOS of 120 days or one with an ALOS of 12 days. Therefore we also examine the variation in relative terms, i.e. the ratio of projected to observed ALOS.

Figure 6 to Figure 8 show the density plots and boxplots of the absolute difference for, respectively, all APR-DRGs, the subgroup of APR-DRGs with a time varying forecast and the subgroup of APR-DRGs with the geometric mean as forecast. A difference value of zero indicates a perfect projection (i.e. the ALOS projection equals the actually observed ALOS), whereas positive and negative values designate, respectively, an over- and underestimation of ALOS. Figure 9 to Figure 11 show the density plots and boxplots of the relative difference for the same groups. A value of 100% signifies a perfect match, whereas values above or below 100% indicate, respectively, over- and underestimations of ALOS.

Forecast inaccuracy increases over time

We can draw several conclusions. First, the variance both in absolute and relative difference increases over time, which could be expected given the inherent uncertainty of the future. This is visible in the declining peak over time at the 0-days-line or 100%-line (left panel) and the increasing spread over time indicated in the boxplots (right panel).

The main difference between the analysis in absolute and relative terms is the P10-Q1 tail in the boxplot. It is much more pronounced for the absolute difference, suggesting that an important underestimation of ALOS in terms of days is made for a limited number of APR-DRGs with a high ALOS, so that the relative difference is smaller.

The overestimation of ALOS increases over time

Second, there is an overestimation of ALOS, both in absolute and relative terms in all evaluation years. This is clearly visible in the mean and median values and the position of the Q1-Q3 square in the boxplot. The average absolute difference in 2005 is the only exception. It is slightly negative given a long negative tail. We conclude that – on average – the projected trend in ALOS declines at a slower pace than the actual evolution. Moreover, the divergence increases over time.

The overvaluation is more pronounced for APR-DRGs without trend forecast

Third, the overvaluation is more pronounced – in terms of the mean, the median and the mode – for APR-DRGs having the geometric mean as forecast. This is true for the absolute as well as for the relative difference. ALOS is fixed because the goodness of fit is below the predetermined threshold, an indication of more unexplained variability in the estimated time series. The use of stochastic rather than deterministic statistical models is another way – compared to fixing ALOS – to generate forecasts for more volatile time series. In this case the future trend can still be estimated, reducing the likelihood for overestimating future ALOS.

For about 15% to 20% of the (weighted) APR-DRGs, there is a close match between forecasts and observations in 2005 (= the percentage at the 0-days-line or 100%-line). In 2010 and 2014, this percentage decreases to 10% to 15%. In absolute terms, the match is better for APR-DRGs with an estimated time trend than those with the geometric mean. With regard to the relative difference, there is no important difference.

Overestimation for ALOS higher in surgical procedures

Fourth, the projected average decrease for surgical and medical procedures between 2002 and 2015 amounts to -6.5% and -8.5%, respectively. In reality the ALOS shortened between 2002 and 2014 with -16.6% and -14.9%. Hence, the predicted evolution is less accurate for surgical procedures.

As for inpatient stays, important differences between projections and observations at the level of the APR-DRG or MDC are found. For a (very limited) number of APR-DRGs, the projected ALOS in 2015 is more than 3 times or less than 1/3 of the observed ALOS in 2002. This is for example the case for APR-DRG 951 'prostatic procedure unrelated to the principal diagnosis' with an ALOS equal to 15.8 days in 1996, 27.7 days in 2002 and a projection of 113.9 days in 2015 compared to an observed ALOS of 20.6 days in 2014. The reason of this drastic increase is the choice of an exponential model as best model, probably due to a (random) large increase between 1998 and 1999 best approximated by the exponential function. We can draw two lessons from this example. First, it might be reasonable to define an upper and lower bound to prevent highly unrealistic estimates. Second, it might not be ideal to put all one's eggs in one basket, i.e. choose only one model – here the exponential model – that performs best on one criterion – R^2 as goodness of fit. Alternatively, one can identify multiple good performing models and combine them into one forecast to average out more extreme projection results.

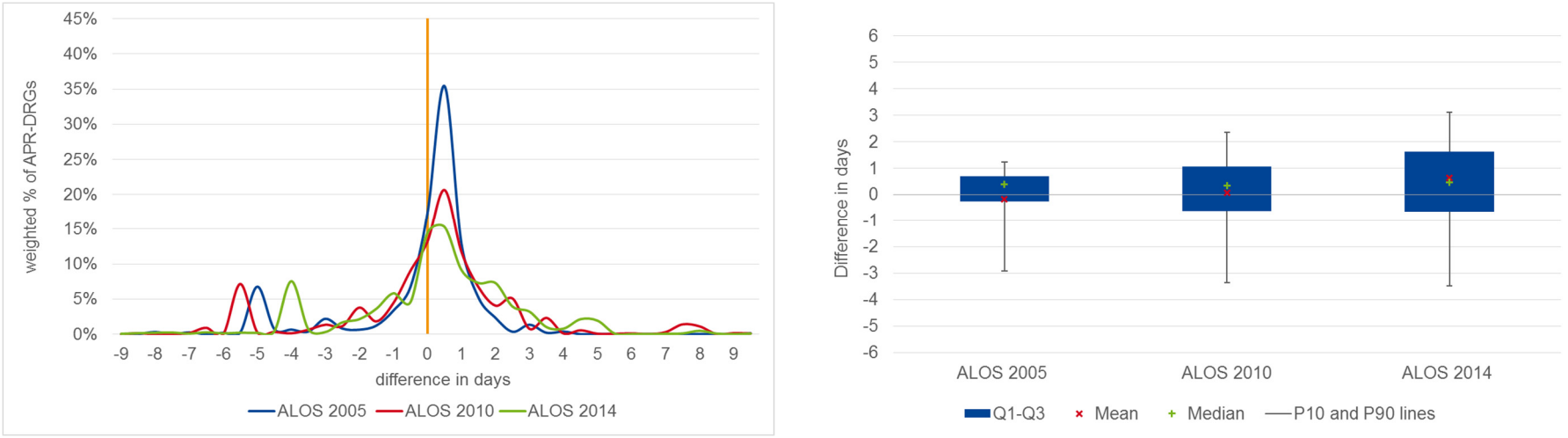
1.4.3.5 Evaluation lessons

The main conclusion from the evaluation are summarized in Table 4. In column two, methodological adjustments for our projection methodology are suggested. In section 1.5, our projection model is further elaborated.

Table 4 – Lessons from evaluation forecasts Cannoodt and proposed adaptations for own projection methodology

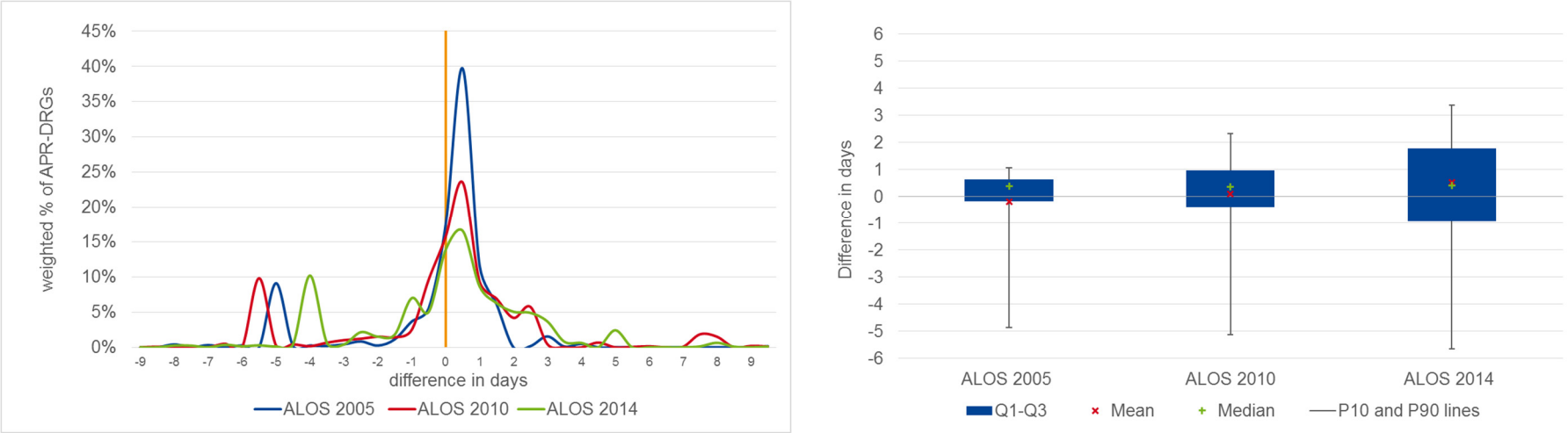
Lessons from evaluation	Proposed adaptations for own projection methodology (see section 1.5)
Population dynamics change over time	Regular updates of forecast results are necessary, incorporating updated and complementary data
Inaccurate assessment of the case mix	- Allow for a trend analysis of the admission rate (see section 1.5.1.4). - Reduce statistical noise in the estimation groups (see section 1.5.1.3) - Regular updates of forecast results are necessary - Break down results by bed type (see section 1.7.1.3)
Overestimation of ALOS	- Trend estimation for all pathology groups - Use time series models that better deal with volatility and recent changes (see section 1.5.3) - Regular updates of forecast results are necessary
Unrealistic projections	- Use upper and lower bounds (see section 1.5.3) - Use a combination of forecasts rather than one specific model (see section 1.5.3) - Compare results with current medical practices in the US (see section 1.7.1.2)

Figure 6 – Absolute difference in ALOS (projections – observations) in days, calculated by APR-DRG



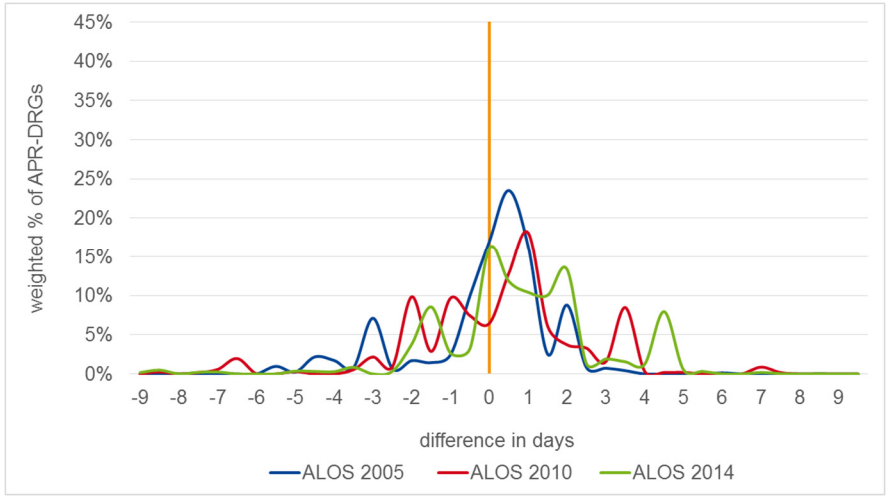
Note: APR-DRGs are weighted by number of nursing days in the year of the observation

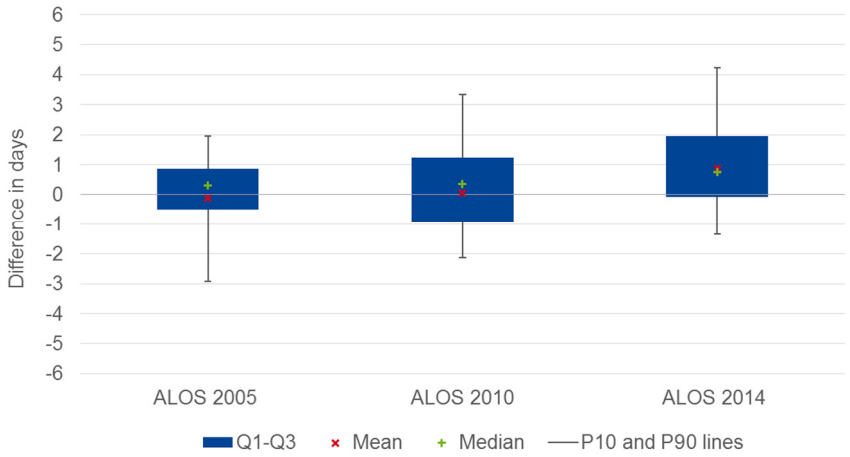
Figure 7 – Absolute difference in ALOS (projections – observations) in days, calculated by APR-DRG, for APR-DRGs with trend analysis



Note: APR-DRGs are weighted by number of nursing days in the year of the observation

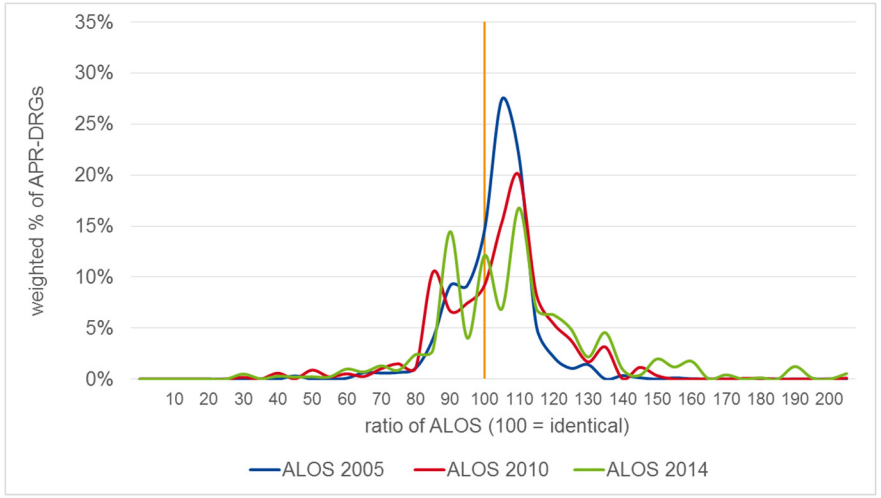
Figure 8 – Absolute difference in ALOS (projections – observations) in days, calculated by APR-DRG, for APR-DRGs without trend analysis

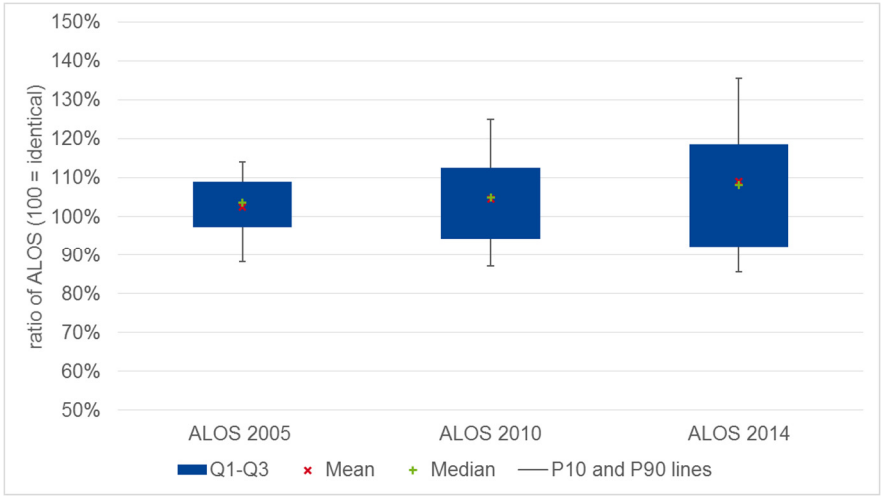




Note: APR-DRGs are weighted by number of nursing days in the year of the observation

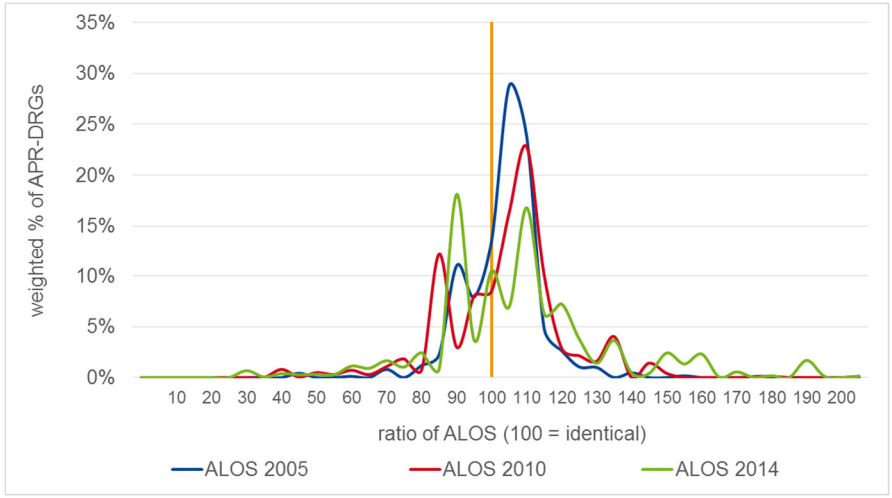
Figure 9 – Relative difference in ALOS (ratio: projections/observations) in %, calculated by APR-DRG

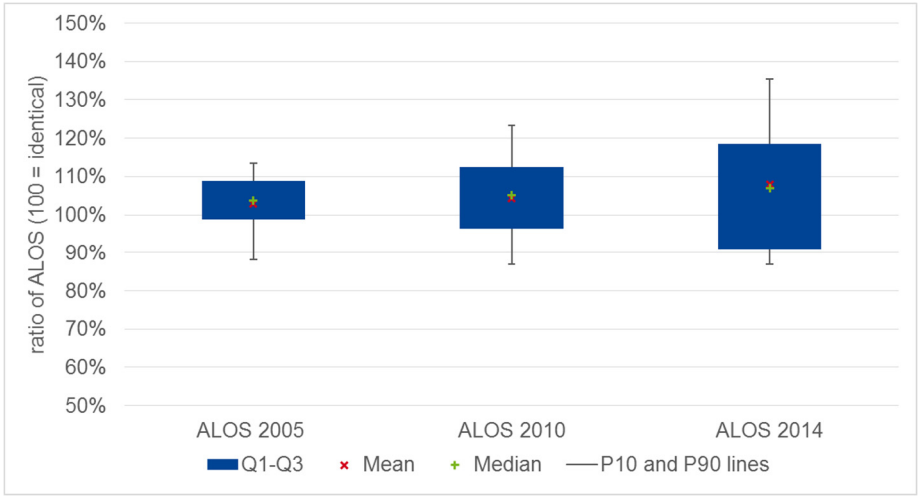




Note: APR-DRGs are weighted by number of nursing days in the year of the observation

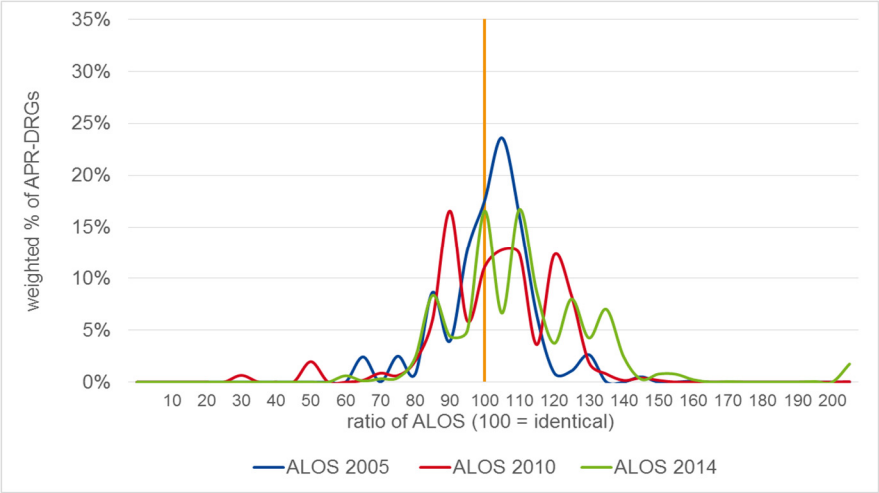
Figure 10 – Relative difference in ALOS (ratio: projections/observations) in %, calculated by APR-DRG, for APR-DRGs with trend analysis

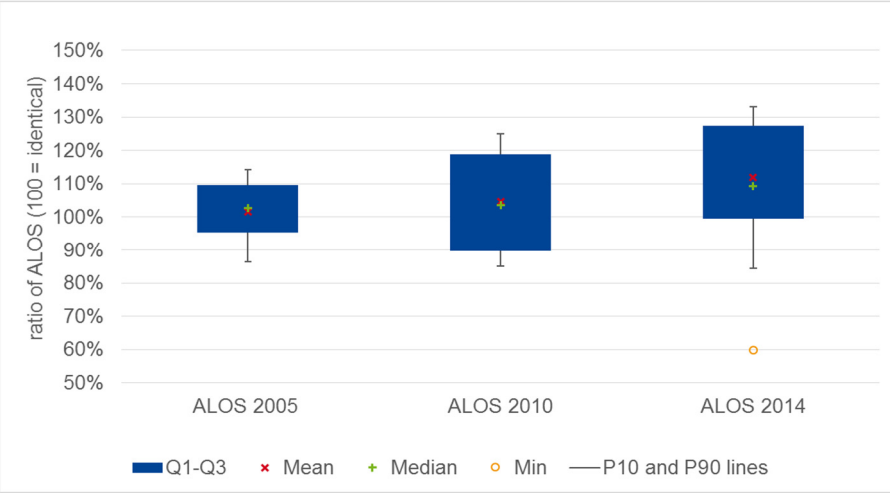




Note: APR-DRGs are weighted by number of nursing days in the year of the observation

Figure 11 – Relative difference in ALOS (ratio: projections/observations) in %, calculated by APR-DRG, for APR-DRGs without trend analysis





Note: APR-DRGs are weighted by number of nursing days in the year of the observation

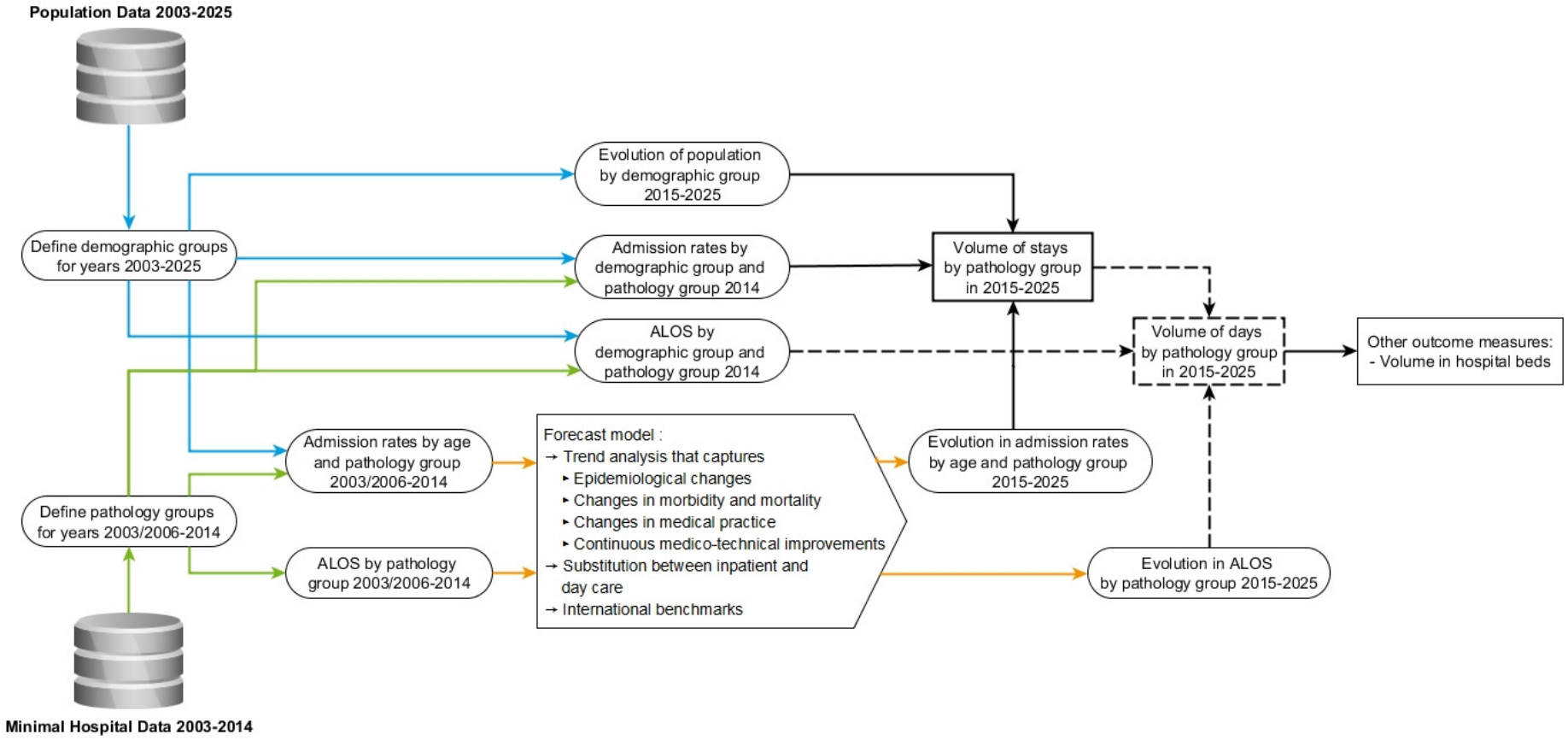
1.5 Projection model developed for the current study

In this section, the construction of the projection model is explained in detail. The aim of the model is to produce forecasts of non-psychiatric hospital services with a time horizon of 2025. The same projection methodology is used to project day-care and inpatient activity. The forecast outcomes are expressed in number of stays, number of nursing days and number of beds. They are presented in sections 1.6 to 1.9.

An overview of the projection model is given in Figure 12. First, we create derived variables using the population and Minimal Hospital Data (MZG – RHM), in particular we generate time series for the average length of stay (ALOS) by pathology group, and the admission rates by age and pathology group (see section 1.5.1).

Manipulations on the population data are indicated by the blue arrows in Figure 12, whereas manipulations on the MZG – RHM are designated by the green arrows. Next, we produce forecasts for the evolution in the ALOS and the admission rates up to the end of the planning horizon, i.e. 2025 (see sections 1.5.2 and 1.5.3.). The input and output flows of the statistical trend model are indicated by the orange arrows. Third, the change in population size and composition is taken into account to compute the volume of hospital stays (see sections 1.5.1.2 and 1.5.4). Finally, the forecasts for ALOS are added to get future projections of nursing days and bed usage (see section 1.5.4.2).

Figure 12 – Overview of projection model



***Note**: green line = Minimal hospital data, blue line = population data, orange line = flow statistical trend model (see Figure 14 for more detail), black lines = outcomes.*

1.5.1 Defining scope and concepts

1.5.1.1 Hospital services

Within the scope of this research project, only stays in acute and categorical hospitals are considered. Our baseline results provide a capacity assessment of inpatient care and day care for hospitals which fall under the competence of the federal government (see sections 1.7.1 and 1.7.2). The capacity requirements for isolated categorical hospitals which fall under the competence of the communities are discussed separately in section 1.7.3. A summary of the total capacity requirements is given in section 1.7.4. Hospital stays in psychiatric hospitals as well as full psychiatric stays recorded in non-psychiatric hospitals are out of scope.

Inpatient hospital services are defined as all classic stays from category «H»[c] as well as long-term stays from categories «F», «M» and «L». Contrary to the report Cannoodt, we include long-term stays in the definition of inpatient hospital services, since they take up hospital capacity and are forecastable.[2] In section 1.5.1.3, the classic stays will be further subdivided in forecast groups specified by pathology. In contrast, the category of the long-term stays is considered as a separate forecast group, irrespective of the underlying pathology.

Day-care activity is defined as all stays from categories «C» and «D» (see also section 1.3.2). All ambulatory visits to the emergency department (category «U») are excluded.

Finally, stays of newborns aged 29 days or less who are only registered in bed type M are omitted to avoid double counting with the stay of the mother. When other bed types are registered, e.g. bed type NIC for neonatal intensive care, the newborn's record is retained.

A more elaborate discussion of the data choices and exclusion criteria can be found in the Data Manual.

1.5.1.2 Socio-demographic groups

Special treatment of certain groups

The relevant population for the baseline projection model is delimited to all individuals residing in Belgium. In 2014, there were 11 209 044 individuals living in Belgium. By 2025, the population in Belgium is projected to grow by 596 134 individuals (or 5.3%) and rise to a total of 11 805 178 individuals.

The group of foreign patients, i.e. individuals who do not reside in Belgium, is treated separately. The future hospital capacity requirements for this group – accounting for about 34 000 day-care stays, 28 000 inpatient stays and 154 000 inpatient days in 2014 – are discussed separately in section 1.7.3. There are two main reasons to single out foreign patients. First, health service usage of individuals living abroad responds to other incentives than healthcare usage of individuals residing in Belgium. This would require an in-depth exploration of the evolution of the drivers of healthcare usage by foreigners, which is out of scope for this study. Second, population projections are not readily available for all foreign patient groups. A more elaborate discussion of the treatment as well as estimation strategy for foreign patients can be found in the Data Manual.

As is discussed in the Data Manual, individuals with unknown or changed sex are attributed either the male or female sex. This is a relatively small group with 262 inpatient stays and 78 day-care stays in 2014. They represent less than 0.01% of all stays. In addition, individuals living in Belgium but without a legal address are attributed the zip code of the hospital of treatment. Both adjustments are necessary, since population projections are specified by age, sex and residence.

[c] Category «H» indicates classic stays, to be contrasted with categories «F», «M» for temporary registration of long-term stays and «L» for the final registration of long-term stays, categories «C» and «D» for surgical and medical day care activity, category «P» for complete psychiatric stays and category «U» for ambulatory emergency contacts.

Definition of socio-economic groups

The remaining population is further subdivided in socio-demographic groups. The idea is that individuals pertaining to different socio-demographic groups differ with respect to the type of hospital services they use, the severity of their disorders, their admission rates, their health status, the length of their hospital stay etc. As the demographic composition of the population changes over time, it is important to translate demographic evolutions into future hospital usage.

The following example may clarify the intention. In 2013, there were about 14 000 inpatient stays for diabetes type 2, representing about 150 000 nursing days. Individuals aged 60 or more account for more than 80% of all nursing days.[24] The MZG – RHM data show that the number of inpatient admissions as well as nursing days for the treatment of diabetes type 2 differs across regions, based on the residence of the patient.[21-24] There are relatively more admissions and nursing days for patients residing in Wallonia and Brussels compared to Flanders. This can be explained by e.g. differences in the prevalence of the disease, environmental and lifestyle factors or differences in medical practice. In addition, population data show that there is a 20.2% increase between 2014 and 2025 in the number of individuals over 60 years of age (see Figure 1). The ageing of the population is, however, not evenly spread across the Belgian territory.[7] In particular, the population of over-60 year olds increases by 21.6% in Flanders, 19.7% in Wallonia, and only 11.2% in Brussels. Remark that in this example a more [less] important increase in the group of over-60 year olds is expected in regions with lower [higher] usage. Neglecting the prevailing differences in usage at the start of the projection period could in this case lead to an overestimation of future usage.

Socio-demographic groups are defined by sex, age, and region of residence. Hence, not only differential service usage patterns in age and sex are captured, but also geographic variations in healthcare are accounted for. Age is subdivided in 7 age groups: 0, 1-19, 20-39, 40-59, 60-74, 75-84, 85+. There are three main reasons for this particular choice:

1. All age groups should have a sufficiently important share of the population, of hospital care and in addition experience roughly the same evolution in population growth. Table 5 shows that this is the case for the applied subdivision.
2. There is a separate age group for newborns, given their different healthcare usage profile in comparison with children and teenagers in the age group 1-19.
3. There is a separate group for individuals aged 85 or more. Although this is a relatively small group in population size (2.5% of the population in 2014), they have an important patient share of hospital care (8.8% of all inpatient stays in 2014).

Role in the model

We incorporate the effect of socio-demographic groups mainly by computing the hospital admission rates and length of hospital stays at the intersection of socio-demographic and pathology groups for the year 2014. This is the point of departure for all future projections. This allows to capture differences in usage of hospital care between socio-demographic groups. We implicitly assume that the variability within a socio-demographic group over time has little impact on hospital care usage. On the 2014 values defined by socio-demographic group and pathology group, we apply change rates for the admission rate and the ALOS generated by the projection model (see also section 1.5.4).

Age plays an additional role as the future evolution of admission rates are projected by pathology group and age group (see below).

Table 5 – Relative evolution of the population by five-year age groups (2014 = 100)

Age group	Population size 2025 (2014 = 100)	Share of the population in 2014	Share in inpatient stays in 2014	Share in inpatient days in 2014	Share in day-care stays in 2014
0	108.1	1.1%	4.3%	3.6%	0.5%
1-4	105.8	4.6%	1.2%	0.6%	2.4%
5-9	102.8	5.8%	1.9%	0.9%	2.2%
10-14	108	5.5%	2.7%	1.2%	1.4%
15-19	109.6	5.6%	2.9%	1.5%	2.8%
20-24	96.5	6.2%	4.9%	2.7%	3.2%
25-29	99.6	6.4%	5.5%	3.1%	3.9%
30-34	103.4	6.5%	4.5%	2.5%	4.7%
35-39	105.1	6.5%	4.4%	2.5%	4.9%
40-44	97.2	6.8%	5.1%	3.3%	5.7%
45-49	93.0	7.1%	6.2%	4.4%	6.8%
50-54	90.3	7.3%	6.9%	5.8%	8.4%
55-59	100.7	6.7%	1.5%	0.6%	8.9%
60-64	115.6	5.9%	7.3%	7.0%	9.1%
65-69	116.8	5.3%	8.1%	8.5%	9.8%
70-74	138.5	3.8%	7.3%	8.6%	8.3%
75-79	127.7	3.5%	8.3%	11.8%	7.9%
80-84	100.5	2.9%	8.2%	13.9%	5.6%
85-89	112.9	1.7%	5.8%	11.2%	2.6%
90-94	127.9	0.7%	2.6%	5.4%	0.7%
95+	218.2	0.1%	0.4%	0.9%	0.1%

1.5.1.3 Pathology groups

The statistical trend in the admission rates and in the ALOS is projected at the level of the pathology group. Hospital stays can be grouped in various ways and the choice of pathology groups should be well-considered. A good choice should satisfy at least three conditions. First, it should be clinically meaningful within the Belgian healthcare context, and preferably compatible with the way hospitals are organised. Second, it should be observable in the data during the estimation period. Third, it should from a statistical point of view contribute to the accuracy of the projections. Let us elaborate on the different points.

There are different potential pathology classifications that are meaningful within the Belgian healthcare context and that can be observed in the Minimal Hospital Data. Several have been used for long-term planning purposes of hospital services in Belgium as well as other countries.

Disease-based and service-based pathology groups

Hospital capacity planning studies in high-income countries define either disease-based or service-based pathology groups:

- A classification based on body systems and/or disease types, e.g. diagnosis related groups (DRGs) or the international classification of diseases (ICD)
  - Pathology groups can be based on the classification used in pathology-based payment systems, e.g. a variant of the DRG classification. DRGs are designed to categorise stays in economically homogeneous and clinically meaningful groups of cases. Hospital stays allocated to one group should be distinguishable from other groups based on main diagnosis, severity, co-morbidity and/or treatment performed.[14] One can aggregate the DRGs at the level of major diagnostic categories (MDC) or any other self-chosen clustering. DRG classification was used in the report Cannoodt (Belgium, 2005), in New Jersey (2008, 2015), and in Ireland (2007, 2009).[2, 27-31] In Ireland 95 DRG cluster groups were defined (out of 665 DRGs) in which low-volume DRGs were grouped together. This disease-based classification is complemented with a service-based definition (see below).
  - Pathology groups can be defined using the ICD-9 or ICD-10 coding, which is frequently used to classify diagnoses in hospital registration data. In France, experts have defined their own classification system of 41 pathology groups using ICD-10 coding (e.g. diabetes, tumours, ischemic heart disease, etc.). They classify stays based solely on the principal diagnosis and patient co-morbidities are not directly accounted for. Given that useful information from secondary diagnoses is ignored, the researchers identify this as a limitation.[32, 33]
  - In the Netherlands (2009), the International Shortlist for Hospital Morbidity Tabulation (ISHMT) is used to cluster hospital activity in about 130 pathology groups. This classification is used by Eurostat, the OECD and the WHO and can be linked to ICD-9 as well as ICD-10 coding, which makes it particularly suitable when data are recorded in different ICD versions.[34, 35]
- A classification based on services and/or specialities
  - The most basic classification distinguishes between medical, surgical inpatient and surgical outpatient interventions.[36-39]
  - Most service-based definitions of pathology groups distinguish between 20 to 30 clinical speciality groups, providing few details on the construction of the categories. Most planning reports apply their own, slightly different division into clinical specialities.[40-44] There can be differences between pathology groups defined for hospital inpatient and hospital day care, as is the case e.g. in Austria.[42, 45]
  - In Australia, Ireland and the Swiss canton Zurich, researchers and experts have developed an extensive mapping between diagnostic or DRG information and clinical specialties. In Australia, one uses a mapping between DRGs and service related groups (SRGs). The classification consists of 138 extended SRGs (ESRGs) and about 40 SRGs.[45-47] In Ireland, a four-tier system is used. DRGs are the first tier. Low volume DRGs are clustered into 95 DRG groups. In a third and fourth step, DRG groups are mapped to 42 specialities

to be further aggregated into 8 speciality groups.[29, 31] The 2012 Zurich health services plan defined 125 speciality services using a combination of ICD and DRG codes. They can be further aggregated in 27 speciality groups. The current update is composed of 140 speciality services and 24 speciality groups.[48, 49]

Definition of pathology groups

We have opted for the Belgian APR-DRG classification system to define pathology groups. Every hospital stay is assigned to an APR-DRG which is further subdivided in 4 levels of severity of illness (SOI) (see Box 1). The APR-DRG-SOI group serves as point of departure. Several arguments substantiate this choice.

- First, APR-DRG-SOI information is readily available in the Minimal Hospital Data, the main registration system for hospital care. As it is used in the hospital payment system, it is definitely relevant in the Belgian hospital setting.
- Second, we prefer DRG-based classifications over classifications which only account for the principal diagnosis (based on ISHMT, ICD-9 or ICD-10 coding) since supplementary information on secondary diagnoses and co-morbidities is incorporated in the assignment of the APR-DRG-SOI. Not only the APR-DRG is important, but also the additional subdivision by SOI is of added value, all the more since population ageing might be associated with an increase in the SOI of hospital stays.
- Third, service-based classification systems are generally derived from DRG or ICD coding of the diagnoses associated with the hospital stay. Hence, the APR-DRG system appears a natural point of departure.
- Finally, there is a trade-off between heterogeneity and accuracy. Heterogeneity in hospital stays can be reduced by grouping together stays that are very similar. The usage of additional information leads to further refinements and a tendency to create more and more groups. The creation of small pathology groups, however, reduces the accuracy of the projections. From a statistical point of view, the aim is to detect a time pattern in the data as clearly as possible. The identification of the pattern can be improved by reducing unexplainable random noise. Therefore, we want to aggregate stays that have evolved similarly in the past and that are expected to continue doing so in the future. By grouping together stays, relevant clinical information might be lost. Service-based classification work with a limited number of pathology groups, most often between 20 and 40. Our preference goes to a system with a higher level of detail, as is the case in the APR-DRG-SOI system.

Adjustments to the APR-DRG-SOI classification

In 2014, 75 APR-DRG-SOI combinations have fewer than 10 inpatient stays and 438 APR-DRG-SOI combinations have fewer than 10 day-care stays. In order to improve the quality of the forecasts in terms of reliability and accuracy, certain APR-DRG-SOI are grouped together. APR-DRG-SOI with fewer than 400 stays per year on average over the estimation period are combined into a pathology group with other APR-DRG-SOI. The choice of 400 stays as target value is based on the volatility of the data and is discussed into detail in the Data Manual.

We prefer to group similar APR-DRG-SOI, either different SOI-levels of the same APR-DRG, or the same SOI-level of related APR-DRGs or a combination of both. Moreover, as much as possible, APR-DRG-SOIs are combined which have experienced a similar evolution over time, i.e. a constant, increasing or decreasing trend. A list of APR-DRG-SOI combinations is provided in the Data Manual. Remark that the pathology groups for inpatient care and day care are different, given the different number of hospital stays by APR-DRG-SOI and the potentially different historic time patterns.

Long-term care and chronic care

We have created pathology groups unrelated to the APR-DRG-SOI system for two specific groups of inpatient care: long-term care and chronic care. We discuss the main intuition for this choice here below, more information can be found in the Data Manual.

- Long-term stays are defined as hospital stays that last more than 6 months. The idea is to single out inpatient stays that can be considered as outliers with respect to their length of stay. This reduces heterogeneity and improves the trend analysis.
- Chronic care is defined as all care provided in S-beds, comprising S1, S2, S3, S4, S5 and S6-beds. There is an important discrepancy in the way chronic care is registered, hence an alternative classification is used. In 2014, nearly 30 000 stays register an acute procedure alongside chronic follow-up care. These stays are classified under the APR-DRG of the acute procedure. This mixed registration occurs when both acute treatment and chronic care are supplied in the same hospital. About 23 000 stays only register chronic care and the majority is classified in APR-DRG 860. This leads to two major issues. First, there is important heterogeneity in the APR-DRG of the acute procedure, since (shorter) inpatient stays with only an acute procedure are mixed with (longer) inpatient stays combining acute and chronic care. Second, APR-DRG 860 which groups together the majority of inpatients stays consisting exclusively of chronic care is of little informative value. It comprises a very heterogeneous group of hospital care. We deal with both problems by splitting up inpatient stays that take place partly in an S-bed and partly in a different bed type. The first part is classified under chronic care, the latter part is categorized according to the APR-DRG system. Chronic care is further subdivided according to bed index (S1 to S6) to reduce the heterogeneity within the group of chronic care. A separate group is created for chronic care that makes use of several types of S-beds.

1.5.1.4 Admission rates

Admission rates that are used for the trend analysis are defined at the level of the pathology group and age group. Age is used as defining factor as it is strongly correlated with the number of hospital admissions even after controlling for SOI. The idea is that for example a projected increase in admission rate by 4% on average for a certain pathology group might mask an increase in admission rate by 10% for individuals aged 60 or less and a decrease in admission rate by 2% for individuals over 60 years old. Given that the latter group experiences a more important increase in population size in the future, the number of future admissions over the entire population will be overestimated in the case of uniform admission rates.

The age groups used for forecasting the admission rates build on the age definition of socio-demographic groups. However, in most cases, the trend analysis can be performed with fewer age groups. This is the case if the evolution of the admission rate is similar in adjacent age groups. Fewer subdivisions make the forecasts statistically more robust. Hence, within a pathology group, age groups are combined which experienced a similar evolution of the admission rate in the past.

Admission rates are expressed in stays per 100 000 individuals. For each pathology group and (combination of) age group(s), we sum the number of stays, multiply it by 100 000 and divide it by the total population size of the relevant age group(s). The trend analysis is performed on the evolution over the period 2003/2006 to 2014. Forecasts of the admission rate are an intermediary result. To calculate the future number of hospital stays in a particular year *YR*, we start from the observed admission rates in 2014 computed separately for each socio-demographic group and pathology group. They capture existing differences in usage between socio-demographic groups. The pathology and age group specific forecast of the admission is converted into a change rate between 2014 and the particular year *YR*. In order to get the admission rate for year *YR*, the 2014 starting values are adjusted with this change rate. Next, the admission rate for year *YR* is multiplied by the expected population in year *YR* to get the number of stays. A more elaborate formula is provided in section 1.5.4.2.

1.5.1.5 Average length of stays

There are two potential variables that capture length of stay: the number of billed days or the number of days between admission and discharge. There can be a divergence between both concepts, because of the specific regulations that determine whether a day can or cannot be billed. Given that we want to project actual usage irrespective of the implications on days that can or cannot be billed, we have chosen for the second option. The projection model generates forecasts for the evolution of ALOS by pathology group. Given that pathology groups incorporate the SOI-level, which is strongly associated with ALOS, we choose not to further detail ALOS by age group for the trend analysis. Hence the implicit assumption is that the future growth path of ALOS is the same for each age group after correcting for the pathology group.

As for the admission rates, the point of departure are the 2014 values of ALOS defined by socio-demographic group and pathology group. Similar to the calculations for the admission rate, we compute future estimates of ALOS by applying the change rate produced by the projection model to the 2014 starting values. Estimates for ALOS serve as input to calculate the expected number of nursing days in the future. A more elaborate formula is provided in section 1.5.4.2.

1.5.1.6 Time

We use data from 2003 to 2014 for inpatient care. For day care the data period is shorter and ranges from 2006 to 2014. More recent periods are not yet available. A longer data period generally improves the fit of the model and the accuracy of the parameter estimates. On the other hand, important changes in the driving forces of hospital service usage might mean that past data are not representative for current conditions. Therefore we choose to start our data observation period in 2003, after the important hospital payment reform of 1 July 2002.

A time period can be defined in different units. We aggregate hospital usage in quarters. A hospital stay, and all of its features such as LOS, patient characteristics, pathology characteristics, diagnosis etc., is entirely attributed to the quarter in which the patient was discharged. The choice for quarters is motivated by the data requirements of the auto-regressive integrated moving average (ARIMA) models (see section 1.5.3.2). An acceptable ARIMA estimation requires at least 30 data points as a rule of thumb, preferably more.[50] Since the data period covers 12 years, this suggests time aggregation in quarters or smaller units. We prefer not to aggregate at a lower level to avoid additional volatility that may blur the statistical pattern.

The time periods are numbered consecutively, beginning with the value 1 for the first period, 2 for the second period, and so on. This numbering represents the 'value' of time and is particularly relevant for the deterministic trend regression models (see section 1.5.3.1.)

The forecast horizon is 2025. Hence we produce forecast outcomes for the period 2015 to 2025, i.e. a forecast period of 11 years. The choice of planning period for hospital care represents a trade-off between, on the one hand, the importance to have long-term forecasts reflecting the significant lead time to invest or disinvest in bed based services, and on the other hand, the increasing uncertainty and risk of inaccurate forecasts as the planning horizon is extended. A healthcare system equipped to satisfy the needs of the future population requires long-term planning to provide appropriate services and develop a complementary infrastructure. There is little evidence of an optimal planning period.[51] Based on the forecast horizon in 27 medium-term to long-term hospital capacity studies in high-income countries, we conclude that most planning studies have a planning horizon between 8 and 17 years. A planning horizon of 10 years is most frequently applied. A justification thereof is that a time period shorter than 10 years may be inadequate to support strategic capacity planning. Planning studies that provide projection results over longer time periods require long-term historic time series, good quality data and benefit from regular updates.[43, 51] Without regular updates, any capacity plan loses policy relevance or hinders the ability of the health system to self-adapt.[52] The importance of regular updates is subscribed in many planning studies.[2, 40, 42, 43]

1.5.2 Rationale for statistical trend analysis

The future evolution is modelled for two variables of interest, which we consider essential in determining hospital service usage: the ALOS and the admission rate. Of course, only the latter is estimated for day care activities. For the baseline forecast results, a statistical trend analysis is preferred above a scenario analysis using predetermined values or growth paths. The main advantage of statistical trend analysis over scenario analysis for the baseline forecasts is that trend analysis is data driven and able to capture past evolutions. Hence it incorporates indirectly many influential factors (see below). Moreover, since the evolution of ALOS and admission rates are examined by pathology group, the effect of influential factors is also pathology specific. The trend for both variables is estimated using the same statistical techniques that are described in detail in section 1.5.3.

However, the baseline forecast results are complemented with projection results that keep the future evolution in ALOS and/or in admission rates fixed at the 2014 level (demographic changes are always accounted for) (section 1.7). This makes it possible to discern the impact of each variable on the future need for hospital capacity.

In addition, scenario analysis is used to evaluate the effects of more disruptive policy and demographic changes (see section 1.8 on enhanced substitution from inpatient to day care, section 1.9 on accelerated population ageing and Chapter 8). Scenario analysis is well suited to capture the potential effect of policy, technological and organisational reforms or demographic shocks, having the ability to disrupt the ongoing evolution. In this way, scenario forecasts give a range of potential projection outcomes and serve as sensitivity analysis for the baseline forecast results.

Historic evolution in ALOS

It is well established that the ALOS of inpatient stays tends to change over time. For the greater part of pathology groups (80% of all APR-DRGs), a decline in ALOS is observed over the period 2003 to 2014. Some pathologies, however, are characterized by a prolonged duration. Figure 13, left panel, shows that in general ALOS has shortened by 15% over the period 2003 to 2014. Neglecting the evolution in ALOS would unmistakably lead to untrustworthy estimates.

Nearly all planning exercises that have come to our attention take into account changes in ALOS, either through a statistical trend analysis or through a scenario analysis in which the growth rate for ALOS is predetermined.

With regard to the evolution of ALOS, statistical trend analysis captures effects of, amongst others, continuous changes in medical practices and improvements in medical technologies, financial and other incentives stemming from healthcare policy, changes in health status of the population, and the development of other care settings.

Historic evolution in admission rates

Most planning studies that have come to our attention only use static reweighting to account for changes in the number of admissions, keeping admission rates constant over time. Only a few studies account for changes in admission rates. In Switzerland, information on expected future evolutions in epidemiology and medico-technical progress, obtained from academic articles are used to adjust admission rates for specific DRGs.[48] In France a statistical trend analysis was used to capture changes in admission rates.[32] This strategy was followed in this report.

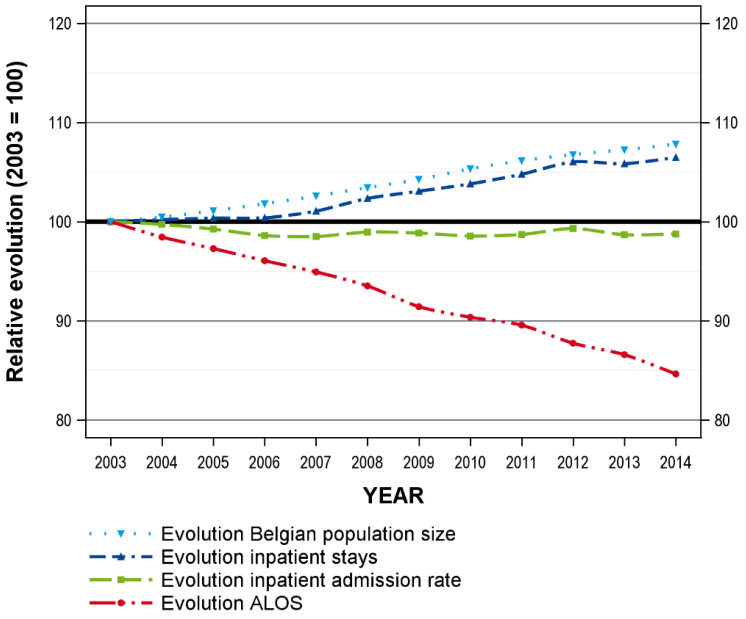
Figure 13 shows that the evolution of the volume of inpatient stays closely follows the evolution of the population size, but that this is not at all the case for the evolution in day-care activity. As can be seen in Figure 13, left panel, the change in inpatient admission rates is much more modest than the change in ALOS. A decrease of about 2% is observed over the period 2003 to 2014. This is the result of a slightly faster increase of the population size in comparison with the volume of inpatient admissions.

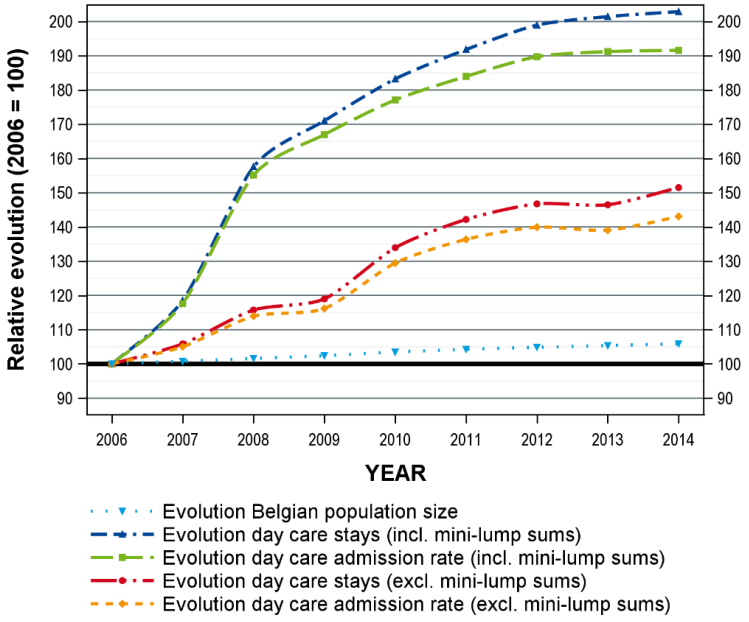
Behind this rather small change in inpatient admission rates, multiple forces are at work that affect the volume of admissions in opposite directions. First, there is substitution between inpatient stays and day care, reinforced by policy incentives and medical progress. This results in a downward pressure on inpatient stays. Second, there can be an upward or downward effect of

income or health status on the level of admission rates. Third, there can be changes in epidemiological trends (e.g. the prevalence of cancer, obesity, cataract, etc.) or fertility rate that increase or decrease admission rates for certain pathologies. As all these various factors have shaped the historic evolution in admission rates, statistical trend analysis is able to capture their consolidated effect on admission rates and assumes that the effect will persevere in the future.

Day-care activity has increased sharply over the period 2006 to 2014. When including mini lump sums in the analysis day-care activity volume has doubled; when mini lump sums are excluded, the growth amounts to 50% (see section 1.3.2 on data issues regarding mini lump sum stays). After correcting for the increase in population size, the growth of admission rates still amounts to 90% or 40% respectively. Clearly other factors than demographic changes played an important role. In KCE report 192, the increase in day-care activity was studied.[26] It was attributed to, amongst others, substitution from inpatient hospital care (e.g. meniscectomy of the knee joint) and ambulatory care (e.g. dental surgery) to day care and a growth in medical practice on top of the substitution of cases (e.g. eye lens surgery). In addition, the expansion of day-care activity has been facilitated by innovations in surgical and anaesthetic techniques, changes in the regulatory framework and financial incentives. Substitution and other effects are taken up by the statistical trend.

Figure 13 – Relative evolution of Belgian population size, ALOS, total inpatient stays, total day care activity and admission rates





Source: Minimal Hospital Data, own calculations

1.5.3 Statistical trend model

This section draws on Diebold (2007), Greene (2003), Hyndman and Athanasopoulos (2013), Makridakis, Wheelwright and Hyndman (2003), and Nau (2014).[3-6, 53]

Two broad families of statistical models

We estimate the time trend in ALOS and admission rates using specifications from two broad families of statistical models using a different estimation strategy: deterministic trend regression models and auto-regressive integrated moving average (ARIMA) time series models. These two model classes are widely used for planning purposes and satisfy the parsimony principle *'simple models are usually preferable to complex models'* (Diebold, 2007, p. 46).[3] Second, both classes of models have a solid theoretical foundation. Third, they are suitable for generating a large number of forecasts in a semi-automatic fashion within a reasonable computing time. Fourth, the ARIMA models are a general class of time series models which comprehends several popular forecast models as special cases, such as the random walk models or certain exponential smoothing models. A random walk model assumes that every period the forecast value goes randomly up or down by a fixed (estimated) amount. An exponential smoothing model estimates a forecast as a weighted average of past values. The weights are not the same for each time period, but decay over time from the most recent to the most distant time period in an exponential manner. In this way, more recent observations are more important in the computation of the forecast outcome. Exponential smoothing can account for a trend line and seasonality.

Outline of statistical trend analysis

A detailed description of the projection model is given below. An outline is presented in Figure 14. In short, we estimate deterministic trend regression models and ARIMA models on the entire data period. A first selection of models is based on how well a model fits the historical data and its level of complexity. We preserve the best models from both classes. For the final selection, we evaluate the forecast accuracy of all remaining forecast specifications. To this end, we split our data in two periods: an estimation period and a validation period. The former ranges from 2003 to 2011 for inpatient care and from 2006 to 2012 for day care. The validation period goes from 2012 to 2014 for inpatient care and from 2013 to 2014 for day care (see Figure 15).

There are two arguments in favour of this particular split of the data period. First, it is recommended that a validation sample covers at least 20% of the data or about 3 years for inpatient care and 2 years for day care.[6, 54] Second, the estimation period should comprise enough time periods to facilitate an acceptable ARIMA estimation, i.e. at least 30 data points or about 8 years (see section 1.5.1.6).[50] We re-estimate the models using only data from the estimation period and generate forecast outcomes for the evaluation period. Now it is possible to compare the accuracy of the predictions with actual observations. The models that perform best on this criterion are ultimately chosen. Finally, a combination forecast is computed as an average of the forecasts outcomes from the chosen models, obtained by the estimation on the entire data period.

Objective

The objective of our projection model is to produce the most trustworthy projections of the future. Therefore it has to produce a single forecast model for each dependent variable and forecast group. Moreover, the data used for estimation span a long time period during which health policy, and hospital and healthcare have changed. Hence it is important to account for trend changes in ALOS and admission rates that have set in recent years. Through the use of ARIMA models and a validation period, our methodology gives more weight to recent observations and enduring trend modification in the computation of the forecast outcomes. A good forecast needs to find a balance between the ability of the forecast model to fit the historic data, the accuracy of the forecast outcomes produced by the model and the model's complexity.

The dual selection procedure is specifically set up for this purpose. In the end, it is the accuracy of future forecast that is most important. This is the rationale of the final selection criterion, where forecast accuracy is evaluated using genuine forecasts. Hence the forecast accuracy is determined by assessing how well a model performs on new data that are not used when estimating the model. The caveat is that the validation period is rather short compared to the estimation period as well as the forecast horizon (see Figure 15). It is possible that a specific model performs particularly good or bad in the validation period merely by chance. To this end, we do not select a single best forecast, but rather a group of best forecasts which are averaged out.

Finally, we want to ensure a reasonable level of fit to the historical data, i.e. the ability of the model to reproduce the statistical signal it aims to detect. This is a prerequisite and hence the rationale of the first selection step.

Figure 14 – Outline of the statistical trend model

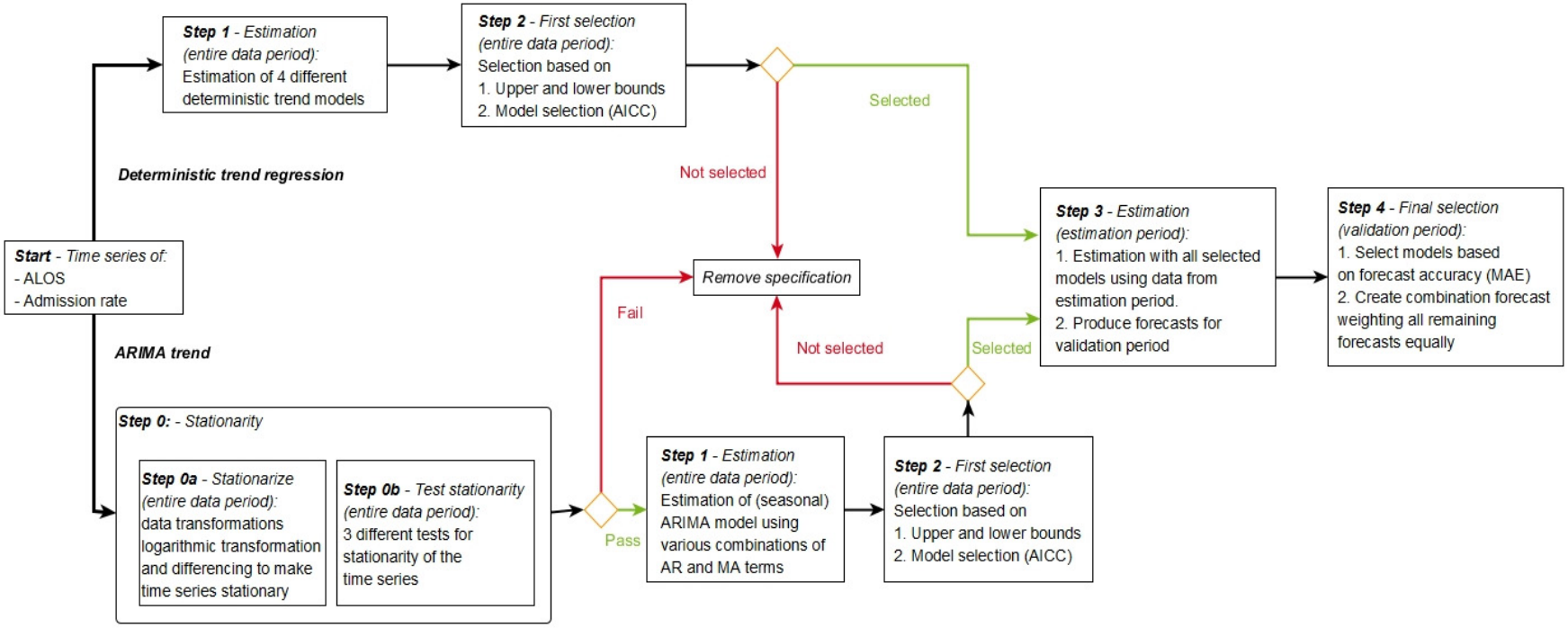
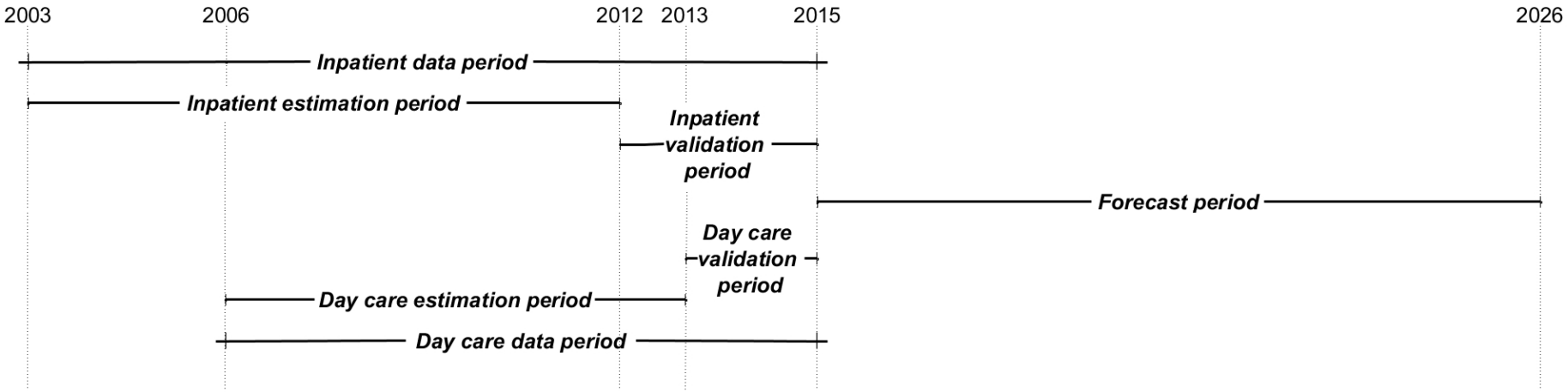


Figure 15 – Overview of time periods



1.5.3.1 Deterministic trend regressions models

Deterministic trend regressions models assume that there is a time signal to be found in the data. Alterations in ALOS or admission rates are described as a function of time. The time pattern of the forecasted variable has a specific, predetermined functional form, e.g. linear or exponential. The actual fit of the regression line to the data is determined by estimating a finite number of parameters. The main advantage of deterministic trend regression models is that they are clear-cut, easy to estimate and understand. On the other hand, deterministic trend regression models give equal weight to all observations, there is no priority given to the information provided by more recent observations. The latter in combination with the imposed functional form of the time patterns is a stringent assumption that limits the ability of the model to adjust to more complex and dynamic evolutions over time.

Step 1 – Estimation of the time trend

We test four different models, each characterized by two parameters and a specific trend line shape. The first model is a linear trend line. This shape assumes that the absolute change over time remains constant (expressed in days for ALOS or in stays per 100 000 individuals for admission rates).

- A **linear model** of the form: $\boldsymbol{forecast\ variable\ at\ time\ t = A + B \times t}$ where t represents time in quarters, A is a parameter related to the intercept and B is the slope of the linear trend line.

The remaining three models have curved trend lines. They assume that the ALOS or admission rate changes at an increasing or decreasing rate.

- A **logarithmic model**: $\boldsymbol{forecast\ variable\ at\ time\ t} = \boldsymbol{A} + \boldsymbol{B} \times \mathbf{ln}(\boldsymbol{t})$, where t represents time in quarters, A is a parameter related to the intercept and B is a parameter related to the slope of the natural logarithmic trend line.
- A log-linear model or **exponential model**: $\boldsymbol{ln(forecast\ variable\ at\ time\ t)} = \boldsymbol{A} + \boldsymbol{A} + \boldsymbol{B} \times \boldsymbol{t}$, where the dependent variable is the natural logarithm of the forecast variable, t represents time in quarters, A is a parameter related to the intercept, B is a parameter related to the slope of the trend line.
- A log-logarithmic model or **power model**: $\boldsymbol{ln(forecast\ variable\ at\ time\ t)} = \boldsymbol{A} + \boldsymbol{B} \times \mathbf{ln}(\boldsymbol{t})$, where the dependent variable is the natural logarithm of the forecast variable, t represents time in quarters, A is a parameter related to the intercept and B is a parameter related to the slope of the natural logarithmic trend line.

We want to adjust for seasonal patterns if hospital service usage is characterized by seasonality. Hence, for each parametric model, a second version is specified that captures seasonal variation by means of four season dummies, one for each quarter. If, for any reason, a systematic positive or negative deviation from the general long-run evolution occurs in a specific quarter, the season dummy will turn positive or negative, respectively.

The proc reg procedure in SAS is used to estimate the deterministic trend regression models on the time series covering the entire data period. This procedure uses ordinary least squares (OLS) to compute the parameter values. For the exponential and power model, we perform a back transformation after the estimation in order to express the forecast in the original units.

Step 2 – First selection: goodness of fit and acceptable value range

A first selection is made on the estimated models and their forecasts, based on two criteria.

The first criterion imposes an upper and lower bound on the acceptable range of forecast outcomes. Deterministic trend regression models generating forecasts that do not respect the upper and lower bounds are excluded from further consideration. We apply an absolute lower bound of 1 day on the ALOS of inpatient stays (this serves as demarcation between inpatient stays and day care) and of 0 on the admission rates. In addition, we compute a maximum permissible change over time. The upper bound equals the observed maximum value of the time series augmented with the maximum change, whereas the minimum value of the time series minus the maximum permissible change serves as a (second) lower bound. The maximum change is calculated as follows. First, we determine the maximum range of the time series (maximum – minimum). We divide the maximum range by the number of time periods over the entire data period (i.e. 48 quarters for inpatient care, 36 quarters for day care), to get a maximum equivalent per time period. Next, the maximum equivalent per time period is multiplied with the total number of forecasted time periods (i.e. 44 quarters), resulting in the maximum permissible change during the forecast period. Planning studies in other countries have equally relied on (ad hoc) upper and lower bounds. For example, a hospital capacity planning study in Ontario, Canada, sets projected service volume to zero when the trend projection turns negative.[43] A French planning study employs an upper bound for the number of cataract surgical procedures equal to 80% of the relevant patient population multiplied by two (eyes).[32]

The second criterion carries out a selection based on the fit of the regression model to the historical data. A variety of measures exists to evaluate a model's in-sample goodness of fit. We opt for the Akaike Information Criterion (AIC), corrected for usage in small sample sizes (AICc) (more details in Box 2). The AIC presents a trade-off between the goodness fit of the model and the complexity of the model evaluated by the number of estimated parameters. The AICc adds an additional bias correction in case the number of time periods is rather small compared to the number of estimated parameters. A penalization for the model's complexity is

necessary, since a perfect fit can always be obtained by using a model with enough parameters. Such an over-fitted model is not able to distinguish the statistical signal from the random variation and does not produce trustworthy forecasts.

The (corrected) AIC as well as the Bayesian information criterion (BIC) are widely used for assessing ARIMA specifications and regression models with a large number of potential parameters. In the examined deterministic trend regression models, the number of parameters is rather limited, so that the penalization for model complexity might appear unnecessary. However, the AICc can provide guidance whether to proceed with the seasonal version of the deterministic trend regression model or not. As we will use AICc for ARIMA selection, its usage here can be additionally defended for reasons of consistency.

The model with the lowest AICc value offers the best trade-off between goodness of fit and complexity. However, it occurs that the AICc value of an alternative model differs only to a limited extent, suggesting that there is supporting evidence in the data for either model. Benchmarks have been proposed in the literature for assessing whether the difference in AIC between two models is significant. A difference in AICc values of 2 or lower can be considered negligible, whereas a difference of 5 or higher suggests a clear preference for the model with the lower AICc value.[55-57]

Our selection criterion is based on the suggested benchmark value of 5. We compute the AICc value of all seasonal and non-seasonal deterministic trend regression models and identify the minimum value. Regression models whose AICc value differs no more than 5 units with the minimum are considered to fit the data sufficiently well. These models are retained for further analysis.

Box 2 – The Akaike Information Criterion

Some of the most common model selection procedures are founded on information theory. Two important examples are the Akaike's information criterion AIC and the Bayesian information criterion BIC.[58, 59] Both criteria are well suited for forecasting purposes.[60] Information criteria compute a value that reflects the goodness of fit of the model, penalized for the complexity of the model (evaluated by the number of estimated parameters). The model with the lowest value for the information criterion represents the best trade-off between goodness of fit and complexity according to the used criterion.

For BIC and AIC, the goodness of fit is calculated in the same way, whereas the magnitude of the penalty differs. The BIC penalizes additional model parameters more heavily. Hence, the model chosen by BIC is either the same as that chosen by AIC, or one with fewer terms. Claeskens (2016, pp. 236-237) notes that '*A criterion such as the AIC […] does not necessarily pick the simplest model. For prediction purposes, this might be advantageous, whereas the opposite behavior of underfitting might cause more harm to predictions*.'[61] This is the main argument to prefer AIC to BIC.

We do not use the AIC as such, but rather a corrected AIC adjusted for small sample sizes, the AICc, proposed by Hurvich and Tsai (1989).[62] The small-sample correction increases the complexity penalty to counter overfitting when the number of data observations is limited.

We use the following formula for AICc:

$$AICc = AIC + \frac{2 \times m \times (m+1)}{T - m - 1}$$

with $AIC = -2 \times \ln(L) + 2 \times m$ for ARIMA models

with $AIC = T \times \ln\left(\frac{\sum_{t=1}^{T} e_t^2}{T}\right) + 2 \times m$ for deterministic trend regression models

where m is the number of estimated parameters, T is the number of time periods used in the estimation, ln(.) is the natural logarithm function, L is the likelihood and e_t is the error term in period t, i.e. the difference between the actual observation and the model's fitted estimate.

Step 3 – Estimation on data from estimation period

All deterministic trend regression models that have passed the first selection round are re-estimated on the subset of the data belonging to the estimation period (see Figure 15). Next, forecasts for the validation period are produced by each model. The accuracy of the forecast of each individual model is evaluated in the next step.

Step 4 – Final selection: forecast accuracy

The final selection is made by assessing the forecast performance. We evaluate the accuracy of the forecasts by comparing predictions with the actual observations during the validation period. Predictions from deterministic trend regression models as well as from ARIMA models are assessed in the same procedure. Various accuracy measures exist and may lead to different rankings. We opt for the mean absolute error (MAE), which is a frequently used, scale-dependent measure for forecasting accuracy. Scale dependent means that its value is expressed in the same units as the time series, i.e. days for ALOS and admissions per 100 000 individuals for admission rates. Since we evaluate the accuracy for each time series separately, scale dependence is not a problem. Scale-dependent measures are preferred to scale-independent measures when observations can take values close to zero, which is the case for the admission rates of specific pathology groups. Furthermore, we prefer the MAE to the root mean squared error (RMSE), since it is less sensitive to an occasional large error that might result from random variation. The MAE is computed as the average of the sum of all errors for a given time series without regard to sign (see Eq. (4)).

$$\textbf{Mean absolute error} = \frac{1}{n}\sum_{t=1}^{n}|Y_t - F_t| \qquad (4)$$

where t is a subscript representing the n time periods in the validation period, Y_t are the real observations, F_t are the forecasts.

Next, we calculate the mean and standard deviation of the MAE over all remaining models. All models that have a MAE below the mean value augmented with 1 standard deviation are selected as 'accurate' models. We create one combination forecast as the average of the predictions of all remaining ARIMA and deterministic trend regression model. The final forecast is of course based on the estimates using the entire data period.

It has been shown that forecasting accuracy can be improved by combining various forecasts. [5, 61, 63] The idea is that several models can perform reasonably well and that each of them has its own strengths and limitations. The resulting combination forecast softens the more pronounced predictions from any one individual model. Similarities can be drawn with the way opinions of different experts/stakeholders are taken into account. In general, one does not favour one particular expert/stakeholder opinion, but attempts to incorporate all provided relevant information. In addition, combining forecasts can be seen as an approach to account for specification uncertainty (see section 1.2).

From the combination forecasts, we derive change rates over time which are used to adjust the starting values observed in 2014 to the projected trends.

1.5.3.2 ARIMA models

The ARIMA class of models assumes that current values of ALOS or admission rates are a function of past events. Two events are considered important here, former values of the forecasted variable and shocks, i.e. deviations from what the ARIMA model considers a 'normal' value, which occurred in the past. In this way ARIMA models can adapt in a more flexible way to the data, and can give e.g. more weight to recent observations.

ARIMA is short for auto-regressive integrated moving average. ARIMA models do not structure the data to fit a pre-determined functional form, they combine three techniques to approximate in a parsimonious and accurate way the complexity of the time patterns in the data. We briefly introduce the three techniques and discuss them more in detail below. The first technique, differencing, is intended to make the data approximately stationary. A time series is stationary if its statistical properties (e.g. mean, variance, autocovariances, etc.) are time-independent. It exhibits no trend, no systematic growth or decline, nor seasonal patterns. Non-stationary data can be stationarized through differencing, i.e. looking at changes over time rather than the actual levels. A time series that requires differencing is an integrated series (the 'I' in ARIMA). The second and third technique are essential in the ARIMA estimation. The value of the (potentially differenced) forecast variable is considered a function of its own lagged values, called the auto-regressive terms (the AR in ARIMA), and lagged values of forecast error terms, called the moving average terms (the MA in ARIMA). The forecast errors are the difference between the prediction of the model and the actual observed value. Each ARIMA specification is adapted to the forecasted variable and can be summarized by three numbers as an *ARIMA(p,d,q)* model. It consists of *p* auto-regressive terms, *d* levels of differencing and *q* moving average terms. A (non-technical) ARIMA equation has the following form:

Differenced forecast variable at time =

constant

and/or the weighted sum of the p most recent values of the forecast variable

and/or the weighted sum of the q most recent forecast errors.

ARIMA models also have a seasonal version, sometimes called SARIMA, short for seasonal ARIMA. They follow the same main principles as ARIMA models. First, the time series is purged from seasonal patterns to make it stationary. In our setting a season is defined as a quarter. Seasonal differencing does not occur between adjacent periods, but between the same time periods in adjacent years, e.g. the difference is taken between quarter 1 in year 2004 and quarter 1 in year 2003. In the same vein, auto-regressive and moving average terms are included from lagged seasons. SARIMA models are summarized by 6 numbers in the form *(p,d,q)x(P,D,Q)*, with *(p,d,q)* the normal ARIMA terms and *(P,D,Q)* the seasonal counterpart.

The advantage of the ARIMA model class is its ability to produce forecasts in a very flexible and data-driven way that account for time-varying trends and seasonal patterns requiring a limited number of parameters. Many different specifications can be tested and even combined. The disadvantage is that the model parameters are more difficult to interpret compared to parametric regressions.

Figure 14 provides an overview of the followed procedure.

Step 0 – Stationarity of the data

Non-stationary data should be transformed and made stationary. In principle, any nonlinear transformation might be suitable to stationarize a time series. Given the large number of potential transformations, we chose to focus on the two most frequently used techniques, i.e. taking the natural logarithm of the series and differencing. We apply the commonly used rule of thumb of transforming no more than two times in total.[6] Hence, for each time series, we specify eight transformation options:

1. No differencing (d=0; D=0). The time series is not transformed.
2. First-difference transformation (d=1; D=0). A new time series is constructed that consists of the period-to-period changes in the forecast variable. The equation looks like this: ***first-differenced forecast variable at time t = forecast variable at time t – forecast variable at time t-1.***

3. Second-difference transformation (d=2; D=0). A second transformation may be necessary when the first-differenced time series is still non-stationary, e.g. for smoothly-varying time series. In this case the newly defined series takes the first-difference of the first-difference. We only use a second-difference transformation if the first-difference transformation is not stationary. Remark that this is not the same as the change relative to the two period lagged value. The equation looks like this: *second-differenced forecast variable at time t = first-differenced forecast variable at time t – first-differenced forecast variable at time t-1.*
4. Seasonal first-difference transformation (d=0; D=1). First-differences are taken between two successive seasons aiming to filter out the seasonal pattern. As we work with quarterly data, the new series consists of the change relative to the four period lagged value. The equation looks like this: *seasonal first-differenced forecast variable at time t = forecast variable at time t – forecast variable at time t-4.*
5. First-difference combined with seasonal first-difference transformation (d=1; D=1). The normal first-difference transformation is combined with a seasonal first-difference transformation. The equation looks like this: *seasonal and normal first-differenced forecast variable at time t = first-differenced forecast variable at time t – first-differenced forecast variable at time t-4.*
6. Logarithmic transformation of the dependant variable, no differencing (d=0; D=0). This is identical to option 1 but with a log-transformed forecast variable.
7. Logarithmic transformation of the dependant variable, in combination with first-difference transformation (d=1; D=0). This is identical to option 2 but with a log-transformed forecast variable.
8. Logarithmic transformation of the dependant variable in combination with seasonal first-difference transformation (d=0; D=1). This is identical to option 4 but with a log-transformed forecast variable.

Seasonal differencing, i.e. options 4, 5 and 8, consumes at least one entire year of data simply to calculate the differences. These observations are no longer available for the estimation. Given the shorter data period for day care (see Figure 15), we do not allow for seasonal differencing when estimating the trend for admission rates for day care.

The stationarity of the resulting data over the entire data period is controlled for each of the eight specifications. We apply three different tests for stationarity: the augmented Dickey-Fuller test (ADF), the Phillips-Perron test (PP) and the Kwiatkowski-Phillips-Schmidt-Shin test (KPSS).[64, 65] The main reason for using several tests is the low statistical power of each of the tests separately in small samples. Statistical power is the ability of a test to reject a false null hypothesis. The first two tests have the null hypothesis of a non-stationary series, whereas the latter test has the null hypothesis of a stationary series. The opposite null hypotheses are of added value given the possible power issues. The tests are executed in SAS using proc autoreg. For the ADF test, we include the number of lags as proposed by Ng and Perron (2001).[66] The specification for the PP and the KPSS tests are automatically computed in SAS. We assume that the time series is stationary if at least two of the three tests indicate that the series is stationary at the 5% significance level.

All (differenced) time series that are considered stationary are retained for the ARIMA estimation. No forecasts are calculated for non-stationary series.

Step 1 – ARIMA estimation

In the estimation phase, the evolution of the ALOS and admission rates is fitted on the entire data period using combinations of auto-regressive and moving average terms.

A time series is characterized by autoregressive behaviour if it has the tendency to return to its mean. The sum of the coefficients of the auto-regressive terms indicates the speed of mean reversion. The closer the sum is to zero, the faster the series moves back towards its mean; if the sum is close to one, the mean reversion is slow. In the latter case, one should worry about the stationarity of the time series.

A time series exhibits moving-average behaviour if it is influenced by apparent random variability which effects last two or more successive periods. The coefficient of a moving average term related to a lagged period,

expresses to what extent the forecast error of that lagged period affects the current period's value. If the sum of moving average terms approaches one, the time series might be overdifferenced.

We comply with two rules of thumb in (business) economics to limit the sum of auto-regressive and moving average terms to three, i.e. $p+q \leq 3$, and to limit the number of seasonal auto-regressive and moving average terms to 1, i.e. $P+Q \leq 1$.[6] In addition, we limit p and q to 2. More specifically, we estimate the following non-seasonal models where * denotes the degree of differencing in one of the eight transformation options specified above: (0,*,0); (1,*,0); (0,*,1); (1,*,1); (2,*,0); (0,*,2); (2,*,1); (1,*,2). All models are estimated with constant. The SARIMA models that we consider are all non-seasonal models complemented with either x(0,1,0) or x(0,*,1) or x(1,*,0) as seasonal component.

The estimation is executed in SAS using proc ARIMA.[50] The parameters are identified using the maximum likelihood method with a maximum of 200 iterations.

Step 2 – First selection: goodness of fit and acceptable value range

The selection criteria are similar to those used for deterministic trend regression models, and are described in detail in step 2 in section 1.5.3.1. The first criterion imposes an upper and lower bound on the prediction results. The second criterion assesses the goodness of fit, corrected for the complexity of the model using the AICc value. The evaluation is performed separately for each of the eight differencing options. The reason is that differencing reduces the number of data observations in the time series. One major advantage of AICc is its ability to compare very different (non-nested) estimation models, however, with one important premise, being that the underlying data are the same.

Step 3 – Estimation on data from estimation period

Step 3 is completely similar to step 3 for deterministic trend regression models. First, the selected models are re-estimated using only data from the estimation period. For each model, forecasts are produced for the validation period.

Step 4 – Final selection: forecast accuracy

The final selection is made by assessing the forecast performance of all remaining deterministic trend regression models, and ARIMA models. The evaluation of forecast accuracy and final selection is described in detail in step 4 for deterministic trend regression models.

1.5.4 Projection outcomes

1.5.4.1 Starting values

Individuals who belong to different socio-demographic subgroups differ with respect to the type of hospital services they use. We account for this by computing the ALOS and the hospital admissions in 2014 – the most recent available year – at the intersection of socio-demographic and pathology groups. This cross-section is the point of departure. The effects of three evolutions – i.e. the demographic evolution, the trend in admission rates, and the trend in ALOS – are applied to the starting values to generate the projection results. For all three variables, the projected future evolution is converted into growth rates over time to easily modify the starting values in 2014. The baseline forecast results combine the effects of all three evolutions. However, the projection model can equally generate results using only one or two factors and keeping the other factor(s) fixed at the 2014 level.

1.5.4.2 Projected hospital stays, days and beds

Demographic evolution

The projections for hospital usage are adjusted for the evolution in population size of a socio-demographic group. This is called static reweighting. More specifically, the future number of stays for a certain pathology P and demographic group D in a specific year Y and quarter Q corresponds to the number of hospital stays observed in 2014 multiplied by the growth in population size for group D between 2014 and that year Y in the future. This procedure is similar to the methodology of Cannoodt to account for demographic evolution (see section 1.4.1).

Equation (5) indicates this further in mathematical terms. It can be shown that static reweighting can be equally expressed in terms of the admission rate of 2014. This is important when the effects of static reweighting are combined with the results of the statistical trend analysis in the following section.

$$\begin{aligned}&\textbf{total number of stays}_{year\ Y,\ quarter\ Q,\ group\ D,\ pathology\ P} \\ &= \frac{\text{size}_{year\ Y,\ group\ D}}{\text{size}_{year\ 2014,\ group\ D}} \\ &\times \text{total number of stays}_{year\ 2014,\ quarter\ Q,\ group\ D,\ pathology\ P} \\ &= \frac{\text{size}_{year\ Y,\ group\ D}}{100\ 000} \times 100\ 000 \\ &\times \frac{\text{total number of stays}_{year\ 2014,\ quarter\ Q,\ group\ D,\ pathology\ P}}{\text{size}_{year\ 2014,\ group\ D}} \\ &= \frac{\text{size}_{year\ Y,\ group\ D}}{100\ 000} \\ &\times \text{admission rate per } 100\ 000_{year\ 2014,\ quarter\ Q,\ group\ D,\ pathology\ P}\end{aligned} \tag{5}$$

Evolution in admission rates

The projected volume in hospital stays is not only affected by demographic evolutions, but also the change in admission rates over time. To incorporate the latter effect, we further adjust the (demographically) reweighted number of stays for year Y, quarter Q, socio-demographic group D and pathology group P by the change rate in admissions as projected by the projection model. The change rate is pathology- and age-specific and is computed as the ratio of the forecasts of the admission rate in year Y, quarter Q to the forecast of the admission rate in 2014, quarter Q. The age groups used for the trend estimation of admission rates are linked to the age definition applied for socio-demographic groups and are denoted D' (see section 1.5.1.4). The projected total volume in hospital stays for a specific year Y corresponds to the sum over all quarters Q, socio-demographic groups D and pathology groups P. We calculate this separately for inpatient hospital stays and day care. Equation (6) summarizes the calculations.

$$\begin{aligned}&\textbf{baseline total stays}_{year\ Y} \\ &= \sum_{Q}\sum_{P}\sum_{D} \frac{\text{size}_{year\ Y,\ group\ D}}{100\ 000} \\ &\times \text{admission rate per } 100\ 000_{year\ 2014,\ quarter\ Q,\ group\ D,\ pathology\ P} \\ &\times \frac{\text{forecast admission rate per } 100\ 000_{year\ Y,\ quarter\ Q,\ pathology\ P,\ group\ D'}}{\text{forecast admission rate per } 100\ 000_{year\ 2014,\ quarter\ Q,\ pathology\ P,\ group\ D'}}\end{aligned} \tag{6}$$

Evolution in ALOS

The second outcome of interest is the number of nursing days for each future year Y up to 2025. Evidently, this is only computed for inpatient stays. The number of nursing days is equal to the product of the baseline total stays in year Y, broken down by quarter Q and pathology group P, and the ALOS observed in 2014 adjusted by the change rate between year Y and 2014. The methodology to include the trend in ALOS is similar to the way the trend in admission rates is incorporated in the model. In order to obtain the yearly number of projected nursing days, a sum is taken over all pathology groups and quarters. This is shown in Equation (7).

$$\begin{aligned}&\textbf{baseline total nursing days}_{year\ Y} \\ &= \sum_{Q}\sum_{P} \text{baseline total stays}_{year\ Y,\ quarter\ Q,\ pathology\ P} \\ &\times ALOS_{year\ 2014,\ quarter\ Q,\ pathology\ P} \\ &\times \frac{\text{forecast ALOS}_{year\ Y,\ quarter\ Q,\ pathology\ P}}{\text{forecast ALOS}_{year\ 2014,\ quarter\ Q,\ pathology\ P}}\end{aligned} \tag{7}$$

The future number of beds for inpatient stays is the third main outcome variable. They are calculated by bed type (B). Therefore, the admission rate and the ALOS of an inpatient stay is further broken down by bed type. We compute the projected number of nursing days per bed type (Eq. (8)) and apply a bed type specific normative occupancy rate to infer the normative bed need (Eq. (9)). The occupancy rates are detailed in section 1.7.1.3.

The number of day-care places is calculated in a similar way, but without accounting for changes in ALOS. Each day-care stay is attributed a duration of 1 day. In addition, the number of workdays in a day care centre is about 250 and not 365 as in an inpatient facility. Further details on the computation are given in section 1.7.2.1.

$$\begin{aligned}&\textbf{baseline total nursing days}_{year\ Y,\ bed\ type\ B}\\&=\sum_{Q}\sum_{P}\sum_{D}\frac{\text{size}_{year\ Y,\ group\ D}}{100\ 000}\\&\times \text{admission rate per } 100\ 000\ _{year\ 2014,\ quarter\ Q,\ group\ D,\ pathology\ P,\ bed\ type\ B}\\&\times\frac{\text{forecast admission rate per } 100\ 000_{year\ Y,\ quarter\ Q,\ pathology\ P,\ group\ D\prime}}{\text{forecast admission rate per } 100\ 000\ _{year\ 2014,\ quarter\ Q,\ pathology\ P,\ group\ D\prime}}\\&\times ALOS_{year\ 2014,\ quarter\ Q,\ pathology\ P,\ bed\ type\ B}\\&\times\frac{\text{forecast ALOS}_{year\ Y,\ quarter\ Q,\ pathology\ P}}{\text{forecast ALOS}\ _{year\ 2014,\ quarter\ Q,\ pathology\ P}}\end{aligned} \tag{8}$$

$$\begin{aligned}&\textbf{baseline total required beds}_{year\ Y,\ bed\ type\ B}\\&=\frac{\text{baseline total nursing days}_{year\ Y,\ bed\ type\ B}}{365\times\text{occupancy rate}_{bed\ type\ B}}\end{aligned} \tag{9}$$

1.6 Introduction results

In section 1.7, the baseline forecast results generated by the projection model are presented. The results include the future evolution of hospital inpatient stays, nursing days and beds as well as the volume of day-care stays and places up to 2025 at the national level. We decompose the results to discern the impact on future care usage of population change, and of the expected evolutions in ALOS and in admission rates. Regional breakdowns of the forecast results are provided as well. Furthermore, we examine the evolution in case-mix and discuss age-specific effects.

In the subsequent sections, two scenarios are elaborated. The scenarios build upon the baseline results from the projection model. In a first scenario, the trend in admission rates is adjusted. In a second scenario, the demographic evolution is altered. The scenario results serve as sensitivity analysis to the baseline results, and, might additionally provide insights for future policy direction.

In section 1.8, a first scenario evaluates the effects of an acceleration in the substitution from inpatient care to day care. Such an acceleration can be the result of e.g. policy measures stimulating the expansion of day care activity, the introduction of new medical techniques that allow procedures to be performed in a day care setting rather than an inpatient setting or an increase in the availability, expertise and coordination of community services to support patients at home rather than in a hospital after a procedure.

As is shown in Figure 1 (right panel), the effects of population ageing become more pronounced from 2030 onwards, with a steep increase in individuals aged 75 or more. When making decisions on hospital capacity, it is of utmost importance to consider a long-term perspective, including the potential evolution beyond the planning horizon of 2025. On that account, we speed up the demographic evolution and assess in section 1.9 the effects of accelerated population ageing on the requirements for hospital capacity.

1.7 Baseline forecast results of the projection model

1.7.1 Future need for hospital inpatient care

The projection model combines three evolutions to generate forecasts for future hospital capacity. First, it accounts for the future evolution in population size and composition. Second, the future evolution of ALOS is estimated by pathology group, and third, the evolution of the admission rate (AR) is computed by age group and pathology group. In order to separately identify the effect of all three evolutions, we produce forecasts for four different cases that either include a statistical trend analysis for ALOS and/or AR or keep their future evolution fixed at the 2014 level. The four cases are the following:

1. Demographic reweighting only: the forecasts only take into account the demographic changes, ALOS and admission rates are fixed at the level of 2014.
2. Demographic reweighting + trend ALOS: in addition to demographic changes, the projection results also account for the future evolution of ALOS, admission rates are fixed at the level of 2014.
3. Demographic reweighting + trend AR: in addition to demographic changes, the projection results also account for the future evolution of the admission rates, ALOS is fixed at the level of 2014.
4. Demographic reweighting + trend ALOS + trend AR (baseline): the forecasts combine the effects of all three evolutions.

We consider the fourth option as the baseline case. Remark that forecasts for the number of hospital stays are not influenced by the evolution of ALOS. Consequently, they are equal for case one and two, on the one hand, and case three and four, on the other hand. When detailed forecast results are presented – e.g. at the level of the bed indices, the MDCs or the APR-DRGs –, these are drawn from the baseline case, unless stated otherwise.

The provided capacity estimates do not incorporate capacity requirements for patients living abroad nor for isolated categorical hospitals which fall under the competence of the communities. The capacity requirements for both groups are discussed briefly in section 1.7.3. A summary of the total capacity requirement, including all hospitals and foreign patients is made in section 1.7.4.

For a good understanding of the results, remember that long-term stays – i.e. hospital stays that last more than 6 months – as well as chronic care – i.e. all care provided in S-beds – are separately classified (see section 1.5.1.3).In what follows, long-term care and chronic care are used alongside MDCs. When descending to the level of APR-DRGs, the specific S-bed type is used to indicate the pathology group.

1.7.1.1 Forecasts for hospital inpatient stays

Forecast results for total hospital inpatient stays at the national level are summarized in Figure 16 and Table 6. Table 6 additionally provides a breakdown of the forecasts by MDC. The MDCs are ordered in descending number of inpatient stays as observed in 2014.

Inpatient stays grow at faster pace than the population

Several conclusions can be drawn from these results. First, in both instances, an important increase in hospital inpatient stays is projected: a growth of 215 000 stays (11.8%) and 176 000 stays (9.6%) in a projection with and without trend analysis for admission rates, respectively. Demographic changes are always incorporated. The relative change in inpatient stays is well above the population growth over the same period which amounts to 5.3% (or about 45% or the total increase of 11.8%). Hence, about 4.3 percentage points of the increase (or 36% of the total growth) can be attributed to changes in the composition of the population, i.e. the ageing of the population (see Figure 1). The effect of population ageing on the growth in inpatient stays is only slightly inferior to impact of the population growth.

Increase is driven by increases in older age categories

Second, the forecasts with trend analysis are above those without trend analysis. This implies an expected increase in admission rates for inpatient care over the total population. The difference between both forecasts amounts to 40 000 stays or about 2.2% of the observed volume in 2014 (or 19% of the total growth). This is at first sight surprising given the small decrease in admission rates over the period 2003-2014 (see Figure 13, left panel). The expected increase in the admission rate for the population masks a decrease in admission rates for individuals aged 40 years or less and an increase for individuals aged 40 years or more (see section 1.7.1.4 and Figure 24).

Table 6 indicates that the increase in inpatient stays is driven by important expansions (over 20 000 stays) of some types of inpatient care, such as diseases of the ear, nose, mouth or throat, of the respiratory system, of the musculoskeletal system, of the circulatory system and care related to health status and aftercare. Those five groups by themselves represent 43% of all inpatient stays and 38% of all inpatient days (see Table 7 and Figure 23). In relative terms, an important growth (over 25%) in hospital stays is expected for diseases of the ear, nose, mouth or throat, of the metabolic system, for infectious and parasitic diseases, for chronic care and for care related to health status and aftercare. We further elaborate on the admission rate and on age specific effects in section 1.7.1.4.

The number of stays will increase in most major diagnostic categories

Third, a subdivision of the results by MDC indicates that the majority of the MDCs are characterized by a projected increase in the number of stays. Only eight – predominantly smaller – groups show a decreasing evolution. From the top fifteen MDCs in terms of hospital inpatient stays, fourteen show a positive trend and one has a negative evolution. Remind that our results do not incorporate hospital stays in psychiatric hospitals and full psychiatric stays in general hospitals (see section 1.5.1.1). This is particularly important when interpreting the results for MDC 19 covering mental diseases and disorders.

Figure 16 – Observed evolution and forecasts for hospital inpatient stays

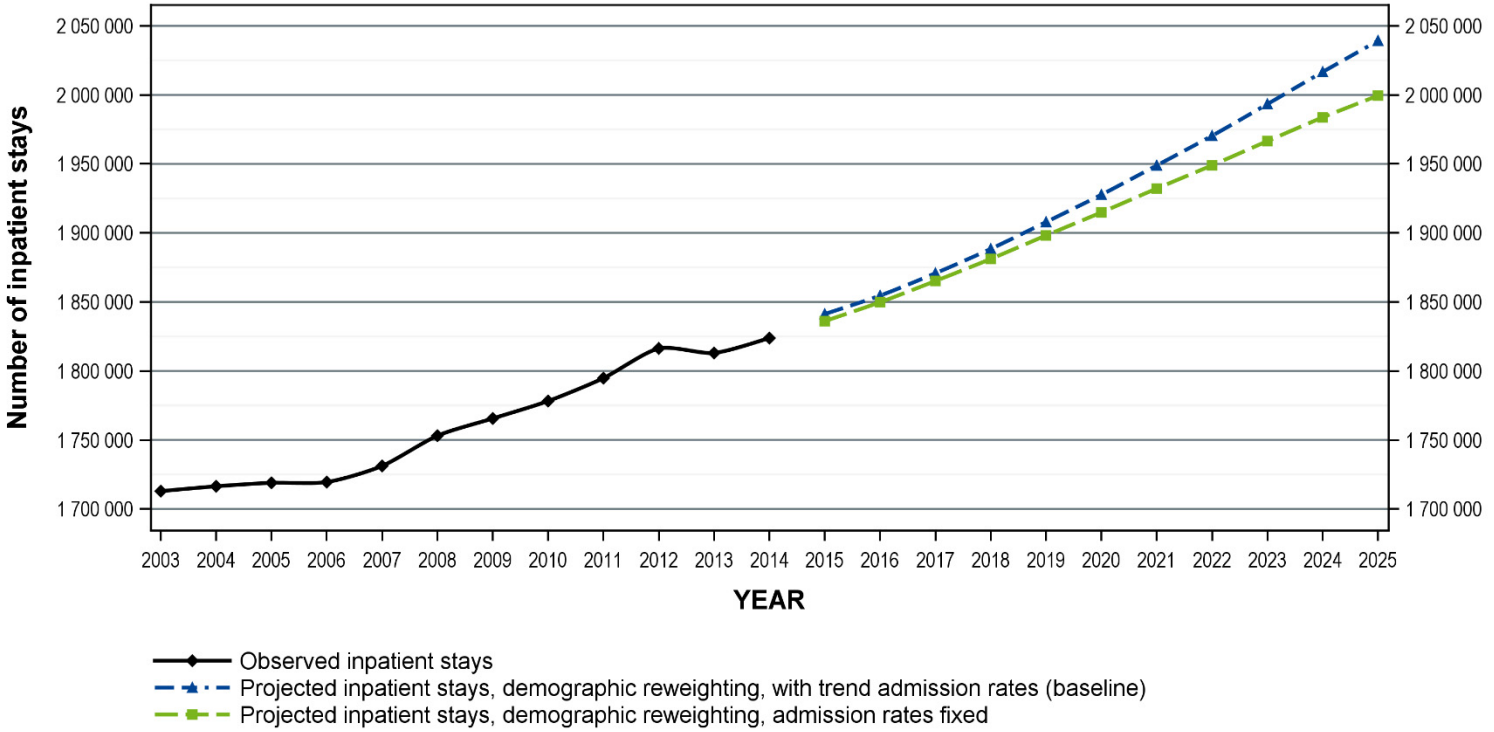


Table 6 – Overview of observed and forecasted hospital inpatient stays, total and broken down by MDC, for years 2005, 2010, 2014, 2020, 2025

MDC		2005	2010	2014	2020	2025	Abs. difference 2014-2025	Rel. difference 2014-2025
All MDC, demographic reweighting without trend admission rate		1 718 938	1 778 194	1 823 820	1 914 903	1 999 480	175 660	9.6%
All MDC, demographic reweighting with trend admission rate (baseline)					1 927 677	2 039 226	215 406	11.8%
Baseline forecast results subdivided by MDC								
08	Musculoskeletal system	237 383	258 220	260 843	274 554	288 792	27 949	10.7%
05	Circulatory system	206 530	205 101	203 607	211 560	224 976	21 369	10.5%
06	Digestive system	188 237	188 298	191 289	193 389	197 306	6 017	3.1%
14	Pregnancy/childbirth	141 278	152 236	147 394	150 857	153 523	6 129	4.2%
04	Respiratory system	142 269	140 078	143 968	158 099	172 405	28 437	19.8%
01	Nervous system	112 918	119 906	123 469	131 264	139 675	16 206	13.1%
03	Ear, nose, mouth and throat	87 990	98 930	112 281	129 465	143 586	31 305	27.9%
11	Kidney/urinary tract	70 856	77 423	82 372	90 661	98 952	16 580	20.1%
23	Health status/aftercare	49 772	56 227	69 329	79 386	89 808	20 479	29.5%
09	Skin/tissue	63 684	62 409	63 942	64 737	66 075	2 133	3.3%
07	Hepatobiliary system	49 165	51 602	55 976	60 844	65 214	9 238	16.5%
10	Metabolic system	41 199	47 731	51 617	59 071	64 905	13 288	25.7%
	Chronic care (S-beds)	34 825	41 443	45 730	53 045	61 514	15 784	34.5%
17	Neoplasms	40 880	41 234	38 588	38 942	39 271	683	1.8%
13	Female reproductive system	46 950	41 816	38 282	32 997	29 032	-9 250	-24.2%
18	Infections/parasites	20 635	27 468	32 209	40 395	47 915	15 706	48.8%
21	Intoxication	22 853	25 474	26 551	28 467	30 465	3 914	14.7%
19	Mental illness	32 529	24 983	24 999	22 457	20 686	-4 313	-17.3%
15	Newborns	31 280	26 699	24 683	22 798	20 455	-4 228	-17.1%
12	Male reproductive system	27 287	24 148	22 429	21 222	20 481	-1 948	-8.7%

16	**Blood/related organs**	15 488	16 502	16 744	18 056	19 591	2 847	17.0%
02	**Eye**	18 589	16 150	14 857	13 008	12 027	-2 830	-19.0%
20	**Alcohol/drugs**	14 432	13 387	13 304	12 814	12 500	-804	-6.0%
00	**Residual group**	13 739	12 330	11 401	11 535	11 891	490	4.3%
PP	**Transplants**	3 005	3 252	2 933	3 203	3 436	503	17.1%
25	**Trauma**	2 244	2 274	2 283	2 296	2 359	76	3.3%
22	**Burns**	1 437	1 184	1 189	1 007	863	-326	-27.4%
24	**HIV**	830	1 006	956	985	989	33	3.5%
	Long-term stays	654	683	595	563	534	-61	-10.3%

1.7.1.2 Forecasts for hospital inpatient nursing days

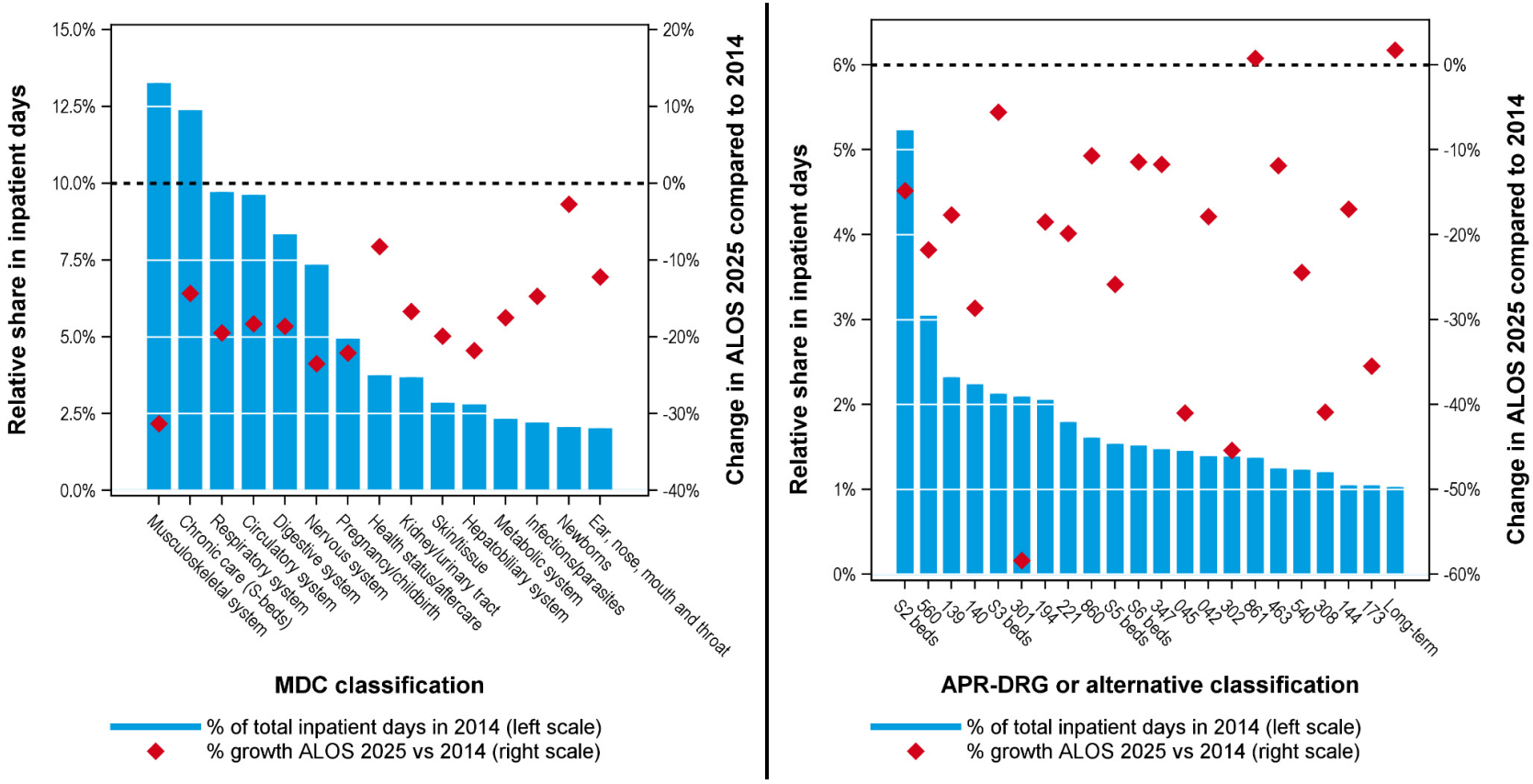
An increase in hospital inpatient stays does not necessarily require a capacity expansion in terms of hospital beds. All depends on the evolution of the length of stay. Shorter stays can free up capacity to absorb an increasing number of stays. Over the period 2003-2014, the tendency to shorten inpatient stays has led to a decrease in nursing days and bed requirements, in spite of an upward evolution in inpatient stays (see Figure 16 and Figure 19).

The inpatient ALOS is reduced at an annual rate of 1.5%

Multiple factors have contributed to the decrease of ALOS over time, amongst others financial incentives to increase efficiency and shorten stays, medico-technical progress, the development of home care services, the expansion of day care etc. Between 2003 and 2014, the average length of hospital inpatient stays has gone down from 8.26 days to 6.99 days or a reduction of 1.27 days on average. In relative terms the decrease amounts to 15.38% or a yearly reduction of 1.51%, on average.

Our projections suggest that the decline in ALOS will endure over the considered planning horizon. The average duration of an inpatient stay is projected to be 6.38 days in 2020 and 5.94 days in 2025. Between 2014 and 2025 the ALOS is predicted to shorten by 1.05 days or 15%. The yearly reduction factor is very similar to what we have observed in the past, i.e. 1.47%.

Figure 17 – Expected change in ALOS between 2014 and 2025 for important MDCs (left panel) and important APR-DRGs (right panel)



Note APR-DRGs (right panel): S2-beds: all care provided in bed type S2 (rehabilitation of the locomotor system); 560: Vaginal delivery; 139: Other pneumonia; 140: Chronic obstructive pulmonary disease; S3-beds: all care provided in bed type S3 (neurologic rehabilitation); 301: Hip joint replacement; 194: Heart failure; 221: Major small and large bowel procedures; 860: Rehabilitation; S5-beds: all care provided in bed type S5 (chronic poly-pathologies); S6-beds: all care provided in bed type S6 (psycho-geriatrics); 347: Other back and neck disorders, fractures and injuries; 045: Cerebral vascular accident and precerebral occlusion with infarct; 042: Degenerative nervous system disorders except multiple sclerosis; 302: Knee joint replacement; 861: Signs, symptoms and other factors influencing health status; 463: Kidney and urinary tract infections; 540: Caesarean delivery; 308: Hip and femur procedures for trauma, except joint replacement; 144: Respiratory signs, symptoms and minor diagnoses; 173: Other vascular procedures; Long-term: Hospital stays with LOS ≥ 6 months.

ALOS of inpatient stays with SOI-level 1 or 2 shortens faster

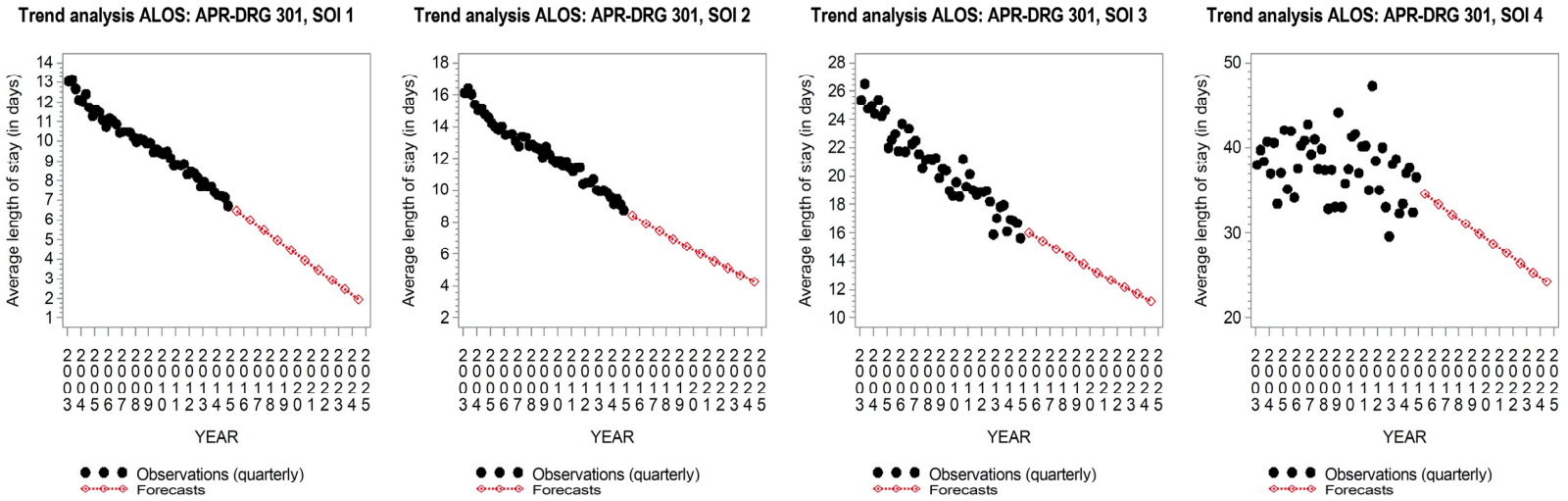
Inpatient stays which are attributed a severity of illness 1 or 2 have experienced a decline in ALOS of about 25% between 2003 and 2014. The reduction for SOI 3 is somewhat lower and amounts to 19%, whereas the decline in ALOS of inpatient stays with patients having the highest level of co-morbidities, i.e. SOI-level 4 was limited to 5.8%. The projection results predict similar reductions in ALOS between 2014 and 2025, of about 23% for SOI 1 and 2, 19% for SOI 3 and a slightly stronger reduction for SOI 4 of 9.5%.

ALOS decreases for nearly all pathologies

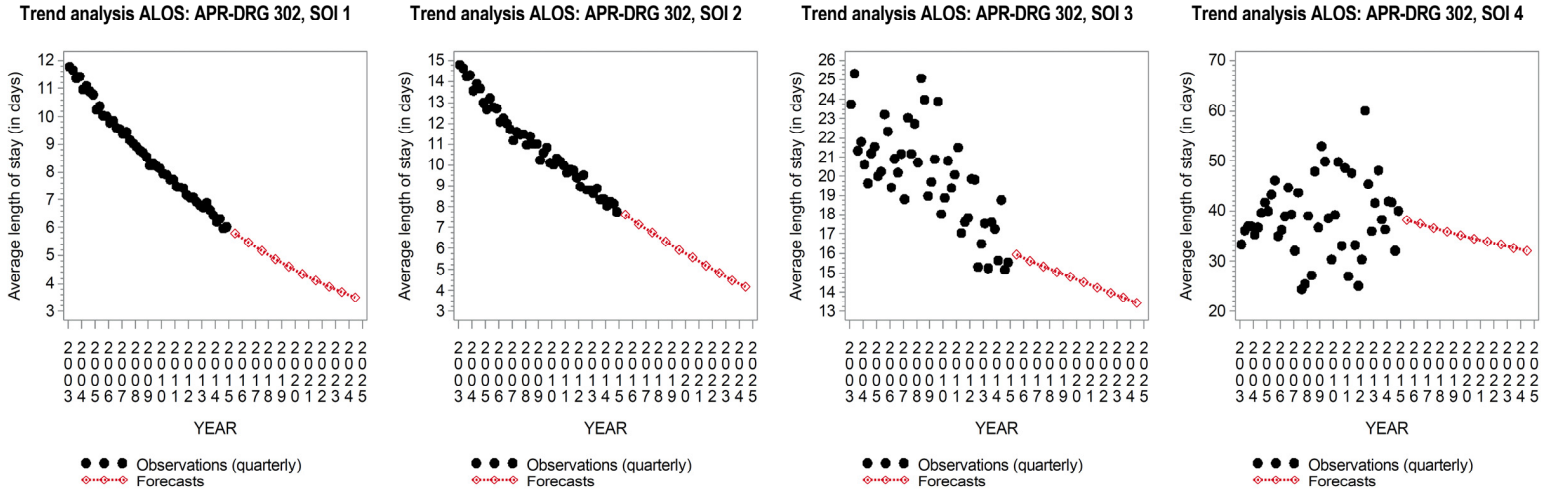
Figure 17 shows the relative change in ALOS between 2014 and 2025 for a selection of MDCs (left panel) and APR-DRGs (right panel). We select MDCs which cover at least 2% of all inpatient days in 2014. For the selection of APR-DRGs a threshold of 1% is used. The vertical bars show the importance of the MDC/APR-DRG in percentage of inpatient days (left scale). The change in ALOS is indicated by the red markers and valued on the right scale. The dotted horizontal line marks the zero-change line where ALOS remains constant between 2014 and 2025.

Figure 18 – Projected change in ALOS by APR-DRG-SOI for APR-DRGs 301 'Hip joint replacement', 302 'Knee joint replacement' and 347 'Other back and neck disorders, fractures and injuries'

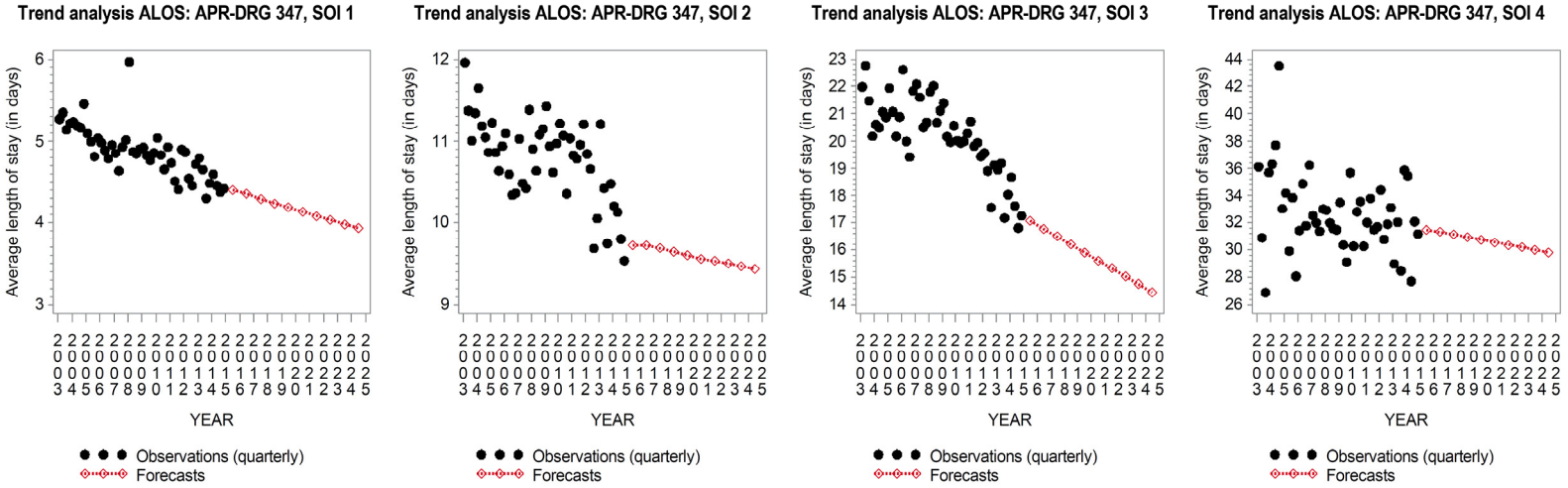
APR-DRG 301 'Hip joint replacement' – overall reduction in ALOS of 58%



APR-DRG 302 'Knee joint replacement' – overall reduction in ALOS of 45%



APR-DRG 347 'Other back and neck disorders, fractures and injuries' – overall reduction in ALOS of 12%



The results per MDC generally show a decrease in ALOS by 10% to 20%. MDC 8, diseases and disorders of the musculoskeletal system and connective tissue, representing the largest share of inpatient care in terms of stays as well as days has an even more important fall in ALOS of about 30%. Care for newborns and neonates (MDC 15) is situated at the other extreme with almost no decrease in ALOS. Remark that stays of newborns aged 29 days or less who are only registered in bed type M are removed to avoid double counting with the stay of the mother. Given that the combined share in inpatient days of the MDCs taken up in Figure 17 (left panel), but excluding care for newborns and neonates, amounts to 85%, we can conclude that the projected decrease will exert a profound downward pressure on the number of hospital days.

When looking at the predicted future evolution of ALOS for the selected APR-DRGs, the overall picture shows a reduction in ALOS. There is somewhat more variability at the level of the APR-DRG. For example, three APR-DRGs classified in MDC 8 have quite divergent reductions in ALOS: APR-DRG 347 'Other back and neck disorders, fractures and injuries', APR-DRG 302 'Knee joint replacement', and APR-DRG 301 'Hip joint replacement' are expected to shorten by 12%, 45% and 58%, respectively. An illustration of the trend projections for the three APR-DRGs at the APR-DRG-SOI level is given in Figure 18.

Detailed graphs and forecast results for the evolution of ALOS of all APR-DRGs at the APR-DRG-SOI level are available in the online appendix.

Evaluation of projected ALOS

To assess to what extent the trend results for ALOS by APR-DRG-SOI are realistic to achieve, the projected ALOS in 2025 is compared to current medical practices in the US (known forerunners in reduced ALOS). Two data sources are used for the comparison. First, the observed ALOS in 2016 in the US state Texas.[67] The figures are very recent and use the same classification system as in Belgium, which are important advantages. Only 12 APR-DRG-SOIs could not be matched. The second point of comparison are data on ALOS from the Healthcare cost and utilization project (HCUP) of the US Agency for Healthcare Research and Quality (AHRQ).[68] The information relates to the year 2014 and is arranged using a different classification system, which is also based on diagnosis related groups. For the majority of pathologies, a mapping with the Belgian APR-DRG-SOI classification is possible for severities 1, 2 and 3. However, 466 APR-DRG-SOI groups out of 1 238 could not be matched.

In general, the projected ALOS in 2025 do not diverge inexplicably from the current situation in the US. For about 55% of the matched APR-DRG-SOIs, the projected ALOS in 2025 deviates less than 40% from the current length of stay in the US. This fraction rises to 70% when considering a deviation of 50%. This is true for both data sources.

Certain patterns emerge when examining the APR-DRG-SOI for which the projections diverge

The APR-DRG-SOIs for which the projected ALOS in 2025 is substantially shorter than is currently the case in the US, are predominantly surgical DRGs (about 66%) and have a low severity of illness (80% has SOI 1 or 2). Our interpretation thereof is that in the US a larger part of medical and surgical procedures with low SOI are performed in day care, implicitly resulting in a longer ALOS for the remaining inpatient stays. For example the projected ALOS for APR-DRGs 227 and 228 related to hernia procedures is about 40% to 60% shorter than the current ALOS in the US for SOI 1 and 2. For APR-DRG 228 'Inguinal, femoral and umbilical hernia procedures', the projected ALOS in 2025 amounts to 1 and 1.6 days for SOI 1 and 2, respectively. The ALOS in 2016 in Texas indicates an ALOS of about 2.1 and 3.4 days for SOI 1 and 2. Moreover, the ALOS observed in Belgium in 2014 – i.e. 1.5 and 2.5 days for SOI 1 and 2 – is also below the US figures, further underpinning our hypothesis. Similar results are found for other APR-DRGs, such as 'Laparoscopic cholecystectomy' (APR-DRG 263), 'Breast procedures except mastectomy' (APR-DRG 363) and 'Urinary stones and acquired upper urinary tract obstruction' (APR-DRG 465).

The APR-DRG-SOIs for which the projected ALOS in 2025 is substantially longer than is currently the case in the US are predominantly medical DRGs (about 75%) and have a high severity of illness (75% has SOI 3 or 4). At least part of the difference in duration can be explained by the different population structure in Texas/the US compared to Belgium. The Belgian population has a larger portion of older persons, who – given their increased

risk for co-morbidities – are on average characterized by longer hospital inpatient stays and a higher severity of illness. Hence, it is not surprising that ALOS is longer for certain pathologies having higher shares of older patients and higher SOI-levels. For example APR-DRG 194 'Heart failure', has a projected ALOS in 2025 of 11.5 days for SOI 3 and 18.8 days for SOI 4. In the US, the ALOS equals 5.9 days and 11 days for SOI 3 and 4, respectively. Similarly, APR-DRG 463 'Kidney and urinary tract infections' has a projected ALOS of 10.3 and 19.9 days for SOI 3 and 4, respectively, compared to 4.9 and 7.2 days in the US. A complementary explanation is a difference in medical practice between Belgium and other countries. A good example thereof is the ALOS for vaginal deliveries (APR-DRG 560). The projection for ALOS in 2025 amounts to 3 days for SOI 1 and 3.3 days for SOI 2, coming from 3.8 and 4.2 days in 2014 This is well-above ALOS in other countries, e.g. 1.9 and 2.4 days currently in Texas, 2.2 and 2.7 days in the HCUP data in 2014, and 2.3 days in 2014 in Sweden.[69] The effects on projected hospital capacity of a reduction in ALOS for caesarean and vaginal deliveries in line with international benchmarks are further detailed in the chapter on maternity services (see Chapter 8).

Inpatient days are predicted to decline as a result of a further decline in ALOS

Forecast results for total hospital inpatient days at the national level are summarized in Figure 19 and Table 7. The forecast results reveal that the four cases produce quite different forecast results.

A first and most important inference that can be made is that whether or not the trend in ALOS is taken up in the projection model is of vital importance to the forecast results. The two cases that keep ALOS fixed at the 2014 level (the blue and green lines in Figure 19) forecast an increase in inpatient days. This is not surprising, given the increase in the future number of inpatient stays (see section 1.7.1.1). The two cases that account for the change in ALOS show a lower future need for inpatient days in continuation of the observed evolution in the past. Compared to forecasts which do not factor in the trend in ALOS, those that do incorporate the trend in ALOS show a projected decrease of about 3 000 000 inpatient days or 23% of the inpatient days in 2014. This is the projected efficiency effect of a continued decline in the length of inpatient hospital stays.

Given that the evolution in ALOS over time has been a crucial factor in the evolution of inpatient days (see Figure 13, left panel), we choose to include its estimated trend in the baseline forecasts. For the baseline results (the red line in Figure 19), the decrease in inpatient days between 2014 and 2025 is estimated at 633 000 days or 5.0% of the inpatient days in 2014. This corresponds to about 2 170 beds at an occupancy rate of 80% or 4.2% of all licensed beds (excluding (neuro-)psychiatric bed-types) in 2014 (see Table 12). The decrease in nursing days for inpatient stays between 2003 and 2014 amounted to about 1.4 million days.

Second, the growth in inpatient days in a scenario only accounting for demographic changes amounts to 13.0%, whereas the growth in inpatient stays is 9.6%. The more important response in terms of days implies that older patients, whose population growth is the most notable demographic change, have on average longer hospital stays. In 2014, patients between 60 and 74 years old and patients aged 75 or more, have a hospital duration which is, respectively, about 10% and 20% above the overall average after correcting for APR-DRG and SOI-level. This discrepancy in ALOS by age is taken up in the projection model (see section 1.5 for more details on the projection model).

In addition, also the discrepancy in the forecasts accounting for demographic changes with and without the trend in admission rates (the blue and green lines in Figure 19) has widened. The difference measures 800 000 days or 6.3% of the inpatient days in 2014, whereas the same comparison for inpatient stays shows a gap of 2.2%. This is the result of three related effects. As discussed in sections 1.7.1.1 and 1.7.1.4, the admission rates will increase over the forecast period for patients aged 40 or more. These patients have typically longer ALOS. Second, the rise in admission rates is particularly important for chronic care, care related to health status and aftercare, and diseases of the respiratory system. These stays represent an important share of hospital usage by older patients and have an above-average ALOS. Third, within certain APR-DRGs the evolution in admission rates brings about a shift from inpatient stays with low SOI-levels (decreasing admission rates) to high SOI-levels (increasing admission rates). Higher SOI-levels are associated with longer ALOS.

Figure 19 – Observed evolution and forecasts for hospital inpatient days

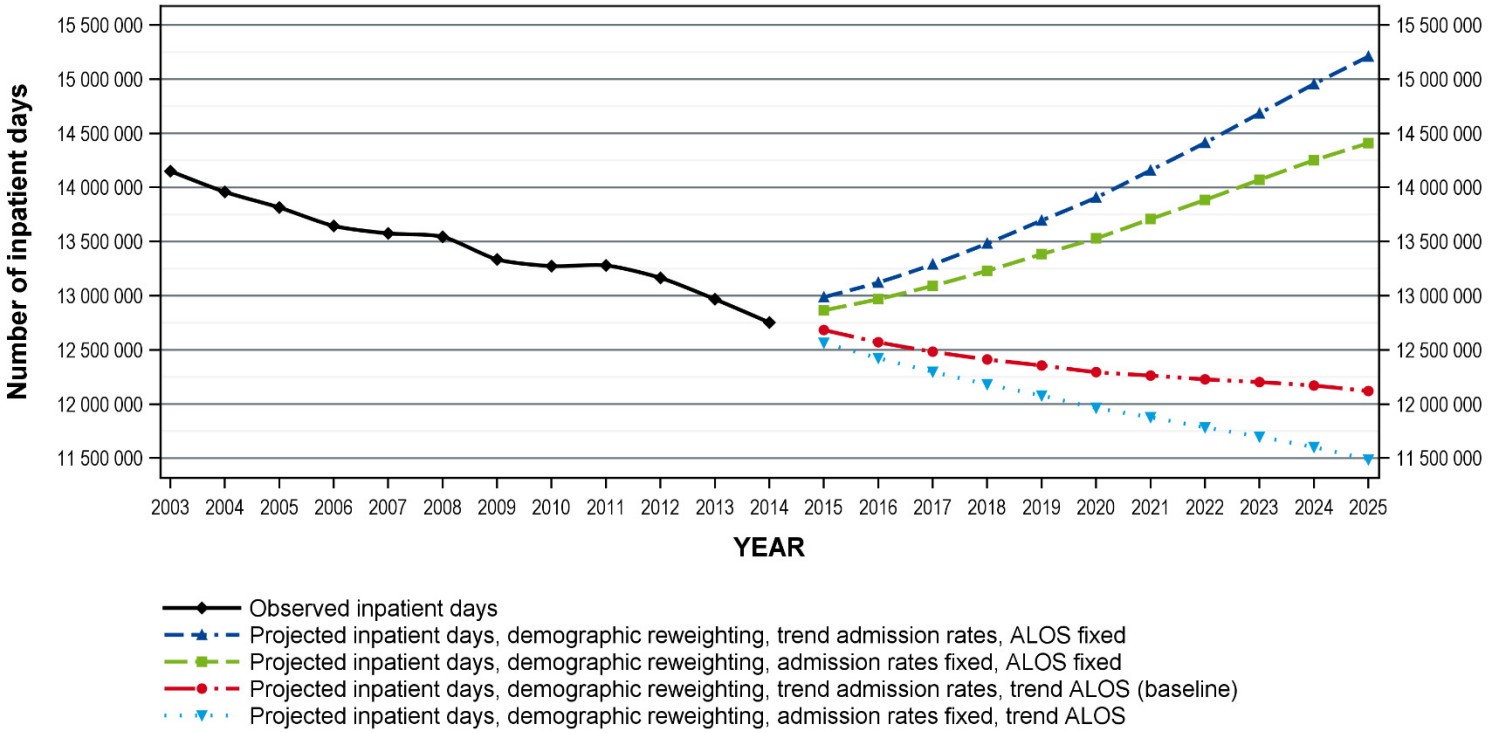


Table 7 – Overview of observed and forecasted hospital inpatient days, total and broken down by MDC, for years 2005, 2010, 2014, 2020, 2025

MDC		2005	2010	2014	2020	2025	Abs. difference 2014-2025	Rel. difference 2014-2025
All MDC, demographic reweighting		13 814 727	13 273 482	12 752 551	13 530 134	14 409 111	1 656 560	13.0%
All MDC, demographic reweighting, trend ALOS					11 964 472	11 487 227	-1 265 324	-9.9%
All MDC, demographic reweighting, trend admission rate					13 906 799	15 208 921	2 456 370	19.3%
All MDC, baseline					12 294 423	12 119 611	-632 940	-5.0%
Baseline forecast results subdivided by MDC								
08	**Musculoskeletal system**	1 922 266	1 835 192	1 691 198	1 485 341	1 324 978	-366 220	-21.7%
	Chronic care (S-beds)	1 334 842	1 474 369	1 577 816	1 701 081	1 852 695	274 879	17.4%
04	**Respiratory system**	1 409 310	1 275 251	1 238 730	1 214 974	1 209 270	-29 460	-2.4%
05	**Circulatory system**	1 453 211	1 298 387	1 227 820	1 140 987	1 098 329	-129 491	-10.5%
06	**Digestive system**	1 195 780	1 107 468	1 063 123	982 238	935 030	-128 093	-12.0%
01	**Nervous system**	1 106 738	1 025 842	936 445	866 550	816 639	-119 806	-12.8%
14	**Pregnancy/childbirth**	712 427	699 695	630 286	573 169	524 255	-106 031	-16.8%
23	**Health status/aftercare**	439 790	472 885	478 167	488 230	527 863	49 696	10.4%
11	**Kidney/urinary tract**	445 744	466 258	469 188	483 941	502 955	33 767	7.2%
09	**Skin/tissue**	395 582	380 345	364 042	347 526	340 080	-23 962	-6.6%
07	**Hepatobiliary system**	388 747	364 483	357 449	341 333	329 777	-27 672	-7.7%
10	**Metabolic system**	286 901	304 592	297 872	302 262	305 756	7 884	2.6%
18	**Infections/parasites**	194 507	255 857	281 287	330 406	372 058	90 771	32.3%
15	**Newborns**	307 320	280 964	263 141	257 490	241 293	-21 848	-8.3%
03	**Ear, nose, mouth and throat**	251 149	241 486	257 609	270 765	281 525	23 916	9.3%
19	**Mental illness**	377 149	277 144	251 047	200 066	169 722	-81 325	-32.4%
17	**Neoplasms**	217 343	210 300	205 237	201 998	199 948	-5 289	-2.6%
00	**Residual group**	256 041	226 794	189 609	173 977	165 795	-23 814	-12.6%

21	**Intoxication**	124 086	141 923	151 652	169 997	190 591	38 939	25.7%
13	**Female reproductive system**	210 869	163 445	133 861	97 067	73 736	-60 125	-44.9%
PP	**Transplants**	146 925	156 109	131 416	143 005	150 813	19 397	14.8%
	Long-term	131 600	152 184	131 284	125 521	120 243	-11 041	-8.4%
16	**Blood/related organs**	113 637	119 273	116 657	122 459	131 554	14 897	12.8%
12	**Male reproductive system**	154 918	128 174	108 301	92 053	82 153	-26 148	-24.1%
20	**Alcohol/drugs**	105 788	101 679	94 763	88 352	85 805	-8 958	-9.5%
25	**Trauma**	49 467	45 197	45 182	42 326	40 947	-4 235	-9.4%
02	**Eye**	56 391	42 680	36 734	30 706	27 162	-9 572	-26.1%
24	**HIV**	12 048	12 581	11 666	11 045	10 166	-1 500	-12.9%
22	**Burns**	14 151	12 925	10 969	9 558	8 473	-2 496	-22.8%

Two out of three MDCs will experience a decrease in inpatient days

A detailed overview of the forecast results by MDC is provided in Figure 20 and Table 7. The MDCs are sorted in descending number of inpatient days as observed in 2014.

The change in ranking between Table 6 (based on number of stays) and Table 7 (based on number of days) provides information on the ALOS of hospital stays. An increase [decrease] in ranking implies an ALOS in 2014 which is substantially higher [lower] than the overall average. Most notable increases in position are chronic care, diseases of the respiratory system, infectious and parasitic diseases, and care for newborns. These pathology groups have on average longer inpatient stays in 2014. Most notable decreases in position are pregnancy and childbirth, diseases and disorders or the ear, nose, mouth and throat, of the digestive system and neoplasms. These pathology groups have on average shorter inpatient stays in 2014.

The forecasts of inpatient stays discussed in section 1.7.1.1 suggest that the majority of the MDCs will face an increase in the number of stays over time. Table 7 draws a more differentiated picture. On an aggregate level, the baseline forecasts show a decrease in total inpatient nursing days between 2014 and 2025. However, a breakdown by MDC reveals that the expected days will in fact increase for one in three MDCs. From the top fifteen MDCs in terms of hospital inpatient days, six show a positive trend and nine have a negative evolution.

There is a shift from acute care towards chronic care

Figure 20 further illustrates the effects of demography, admission rates and ALOS on hospital capacity requirements in 2025 by MDC. We focus on the MDCs representing at least 1% of all inpatient days in 2014. The number of hospital inpatient days in 2014 is represented by the black filled diamonds. The baseline forecasts for 2025 are indicated by the red circles.

A major finding is that chronic care – i.e. all care provided in S-beds – will replace diseases and disorders of the musculoskeletal system as most important MDC in terms of inpatient days. This is the result of an important increase in hospital stays and a relatively modest reduction in ALOS of about 13%. Overall, Table 7 shows that the increase in inpatient days related to chronic care amounts to 17.4% by 2025. In comparison, inpatient days

related to medical and surgical procedures are projected to decline by 2.2% and 19.3%, respectively. Moreover, the figures in Table 7 indicate that this shift had already started in the past. From the top five MDCs in terms of hospital inpatient days, chronic care is the only one which has experienced an increase in inpatient days between 2005 and 2014. Remark that the results in this section exclude care in isolated categorical hospitals, which is discussed separately in section 1.7.3, hence effectively underestimating the need for chronic care.

The shift towards chronic care manifests itself equally in the required bed capacity (see section 1.7.1.3). The emphasis is on a cutback in acute beds and a capacity extension of chronic (and geriatric) beds. We come back to the shift from acute care towards chronic care in section 1.7.4.1, where the forecast results in terms of number of stays, days and beds are detailed by S-bed type.

The effects of demography, admission rates and ALOS on inpatient days

The effect of demographic changes is visualized by the green square in Figure 20. For all care types, the demographic evolution on its own leads to an upward pressure on the number of inpatient days. However, differences are clearly visible. The effect on inpatient care for newborns and neonates and pregnancy and childbirth is almost non-existent, whereas the upward effect is most pronounced for the top six MDCs: diseases and disorders of the musculoskeletal system, chronic care, diseases and disorders of the respiratory system, of the circulatory system, of the digestive system and of the nervous system.

The admission rate has an upward trend for MDCs where the upward pointing blue triangle is to the right of the green square. This effect is especially important for chronic care, infectious and parasitic diseases, and diseases and disorders of the musculoskeletal system, of the respiratory system, of the kidney and urinary tract. A decrease in the admission rate is revealed for diseases and disorders of the circulatory system, of the digestive system and care for newborns and neonates.

The evolution of ALOS is captured by the position of downward pointing azure blue triangle and the green square. If the triangle is to the left of the square, the estimates indicate that the ALOS will shorten. This is the case for all MDCs, but to a varying extent as is also shown in Figure 17.

For the majority of MDCs in Figure 20, the trend in ALOS and the trend in admission rates exert an influence on inpatient days in opposite directions. For chronic care, after accounting for demographic changes, the effect of the admission rate and the ALOS on inpatient days is more or less equally important. This implies that after accommodating the increased need for chronic care, related to the growth and ageing of the population, any capacity gain related to shorter stays is directly taken up by an increase in the number of stays due to a higher admission rate. Visually, both triangles are equally distant from the green square at opposite sides. As a result the overall baseline forecast (the red circle) is very close to the forecast produced by demographic reweighting (the green square). A similar effect is found for diseases and disorders of the ear, nose, mouth and throat.

In most cases, however, the effect of ALOS outweighs the effect of the admission rates. This is clearly visible for diseases and disorders of the musculoskeletal system, which has undoubtedly the largest decrease in ALOS. For infectious and parasitic diseases, the opposite is true. The increase in the admission rate dominates the decrease in ALOS.

In a limited number of cases, both the trend in admission rates and trend in ALOS have a decreasing effect on inpatient days. We observe this for diseases and disorders of the circulatory system, of the digestive system, for care for newborns and neonates and for the other MDCs combined.

Figure 20 – Observed situation hospital inpatient days in 2014 and forecasts for 2025 by MDC

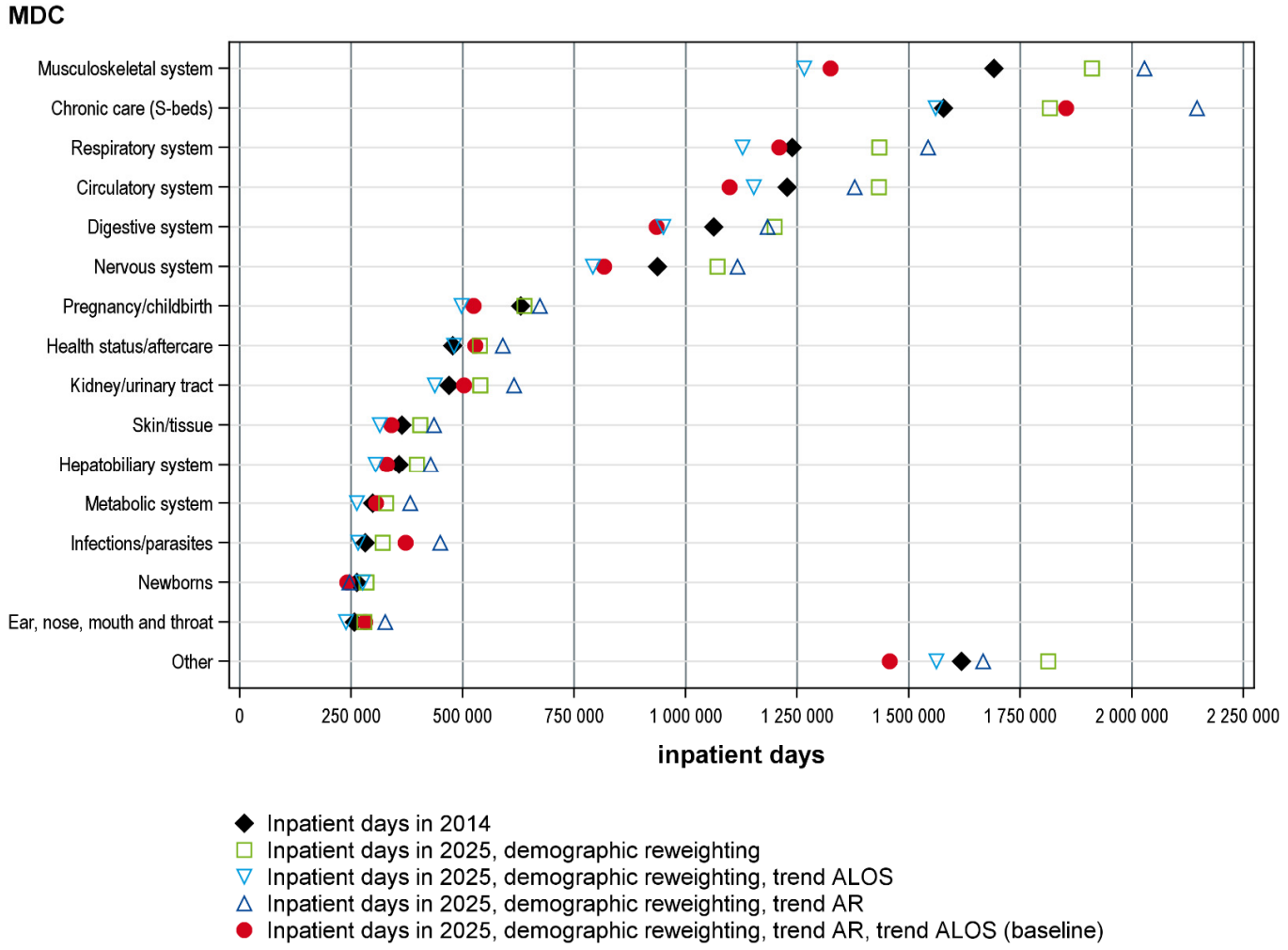


Table 8 – Overview of observed and forecasted hospital inpatient beds, total and broken down by bed index, for years 2005, 2010, 2014, 2020, 2025

Bed index	2005	2010	2014	Licensed beds 2014*	2020	2025	Abs. difference 2014-2025	Abs. difference Licensed-2025	Rel. difference 2014-2025	Rel. difference Licensed-2025
Total	46 028	44 079	42 174	50 973	40 588	39 901	-2 273	-11 072	-5.4%	-21.7%
D	15 274	13 837	12 879	14 638	12 514	12 387	-492	-2 251	-3.8%	-15.4%
C	12 532	11 149	9 897	14 310	8 649	7 703	-2 194	-6 607	-22.2%	-46.2%
G	6 330	6 937	7 228	7 340	7 226	7 498	270	158	3.7%	2.2%
S (=S1, S2, S3, S4, S5, S6)	4 321	4 795	5 060	5 439	5 420	5 869	809	430	16.0%	7.9%
M	2 799	2 768	2 511	3 176	2 280	2 080	-431	-1 096	-17.2%	-34.5%
E	2 250	1 997	1 920	2 651	1 828	1 731	-189	- 920	-9.8%	-34.7%
I	1 535	1 592	1 737	2 026	1 727	1 731	-6	- 295	-0.3%	-14.6%
N (=NIC, N*)	954	941	883	1 311	888	850	-33	- 461	-3.7%	-35.2%
L	33	36	32	38	31	29	-3	- 9	-9.4%	-23.7%
BR	-	27	27	44	25	23	-4	- 21	-14.8%	-47.7%

** The number of licensed beds is based on information from December 2014 provided by FPS Health. The official number is complemented with information from the file unitindex of the Minimal Hospital Data to account for N*-beds and to create a division between BR-, C-, D-, E- and I-beds. Moreover, licensed CD-beds are attributed for 50% to C-beds and for 50% to D-beds. The number of licensed beds does not account for beds of categorical hospitals which fall under the competence of the communities.*

1.7.1.3 Forecasts for hospital inpatient beds

The baseline forecast results in terms of inpatient days can equally be expressed in terms of required future beds per bed type. For inpatient care, a distinction is made between 8 bed indices: C, D, E, M (grouping M and MI), N (grouping N* and NIC), G, I (grouping EI, CI, DI and HI), S (grouping S1, S2, S3, S4, S5 and S6). The remaining bed types (=A, A1, K, K1, T, T1) are not further analysed.

In order to translate projected inpatient nursing days in bed numbers, we need to decide on a certain occupancy rate. We use the normative occupancy rates as applied in the calculation of the number of justified beds or staffing standards: an occupancy rate of 70% for M and E beds; 75% for N*; 80% for C, D, L, BR, and I beds; and 90% for G beds. For N* and S beds[d], no justified beds are calculated and hence no occupancy rate proposed.[70] We assume a rate of 75% for N* beds, in line with NIC beds, and a 90% rate for S beds, in line with G beds.

Applying normative occupancy rates allows us to calculate an estimate of the normative usage or normative need for bed types. The normative usage does not necessarily correspond to the number of licensed beds. To quantify the gap, we added a column licensed beds in Table 8 and computed the difference between licensed beds and the projected normative usage in 2025 in addition to the change in normative usage between 2014 and 2025.

The number of licensed beds does not include beds in isolated categorical hospitals. Moreover, the capacity requirements for foreign patients are not yet included in the forecast results. Both groups are discussed separately in section 1.7.3 and a summary of the main forecast results including isolated categorical hospitals and foreign patients is made in section 1.7.4. In addition to this, certain inpatient bed types, in particular C-, D- and to a lesser extent E-, M- and G-beds tend to be used for day-care activity as well. In 2014, 29 000 day care stays were performed using an inpatient bed type, of which 74% C-beds and 19% D-beds. Please note that because the hospital capacity which is used for the treatment of foreign patients and for day-care activity is not accounted for, the normative need in Table 8 is slightly underestimated.

Shift from acute to chronic beds

The results in Table 8 show a future increase in G- and S-beds. The normative need for G- and S-beds increases and the number of licensed beds in 2014 is not sufficient to absorb the growth. The increase in S-beds is entirely related to the evolution of chronic care, discussed in detail above. The usage of G-beds is associated with a wide range of pathology groups. The combined evolution of these different care types necessitates an expansion of G-beds.

For G-beds and – to a lesser extent – S-beds, the number of licensed beds in 2014 more or less matches usage in 2014. This might indicate supply restrictions for these bed types, especially given the high normative occupancy rate of 90% that is already applied. To that end, D-beds and C-beds are sometimes used as an alternative for G-beds when the latter would actually be more appropriate but is unavailable due to capacity restriction. Based on the age of the patient (over 70 years old), the LOS of the stay and the number of organ systems involved (at least two), inpatient stays in D-beds and C-beds can be labelled as G-potential stays by the FPS Health. This implies that in fact a G-bed would have been better suited to accommodate the patient. This downward bias in the current usage of G-beds implies that the baseline forecasts underestimate the future need for G-beds and the real future need is situated above the projected bed numbers. The other side of the picture is of course an upward bias in the projections of necessary C- and D-beds.

As for G-beds, D- , E- and I-beds accommodate a wide range of different pathologies. Their combined effect leads to the projected evolution. The projection results suggest a levelling out of I-beds, and a reduction in the future need for the remaining bed types. Remark that the future need for I-beds may be underestimated as a consequence of the followed projection

[d] For S1, S2, S3 and S5 an occupancy rate of 80% (per 30 beds) is used to determine staffing standards.

methodology. The majority of hospital inpatient stays (85%) occurs in one bed type. The opposite is true for hospital inpatient stays taking place (partly) in an I-bed. In this case, 90% of the inpatient stays register at least one additional bed type, predominantly C- or D-beds. As inpatient days are projected and attributed to bed types, the change in ALOS plays a key role (see section 1.7.1.2). Its projected evolution is pathology specific, but does not differ by bed type. As it is a likely hypothesis that reductions in ALOS are more difficult to attain in more intensive bed types, it is possible that the baseline forecast results underestimate the number of inpatient days spent in I-beds and hence the number of beds. Alternatively, if important reductions in ALOS are equally achieved in I-beds, the counterpart might be an intensification in care needs in C- and D-beds.

N-beds are concentrated in MDC 15 'newborns and neonates' and to a lesser extent in MDC 23 'health status and aftercare', which contains APR-DRG 863 'Neonatal aftercare'. The baseline forecasts for MDC 15 and MDC 23 contribute respectively to a lower and higher need for N-beds.

The forecasts demonstrate a particularly important drop for M-beds and C-beds. The former is related to a significant projected shortening of 20% to 25% of hospital time for pregnancies and childbirth in combination with a minor increase in hospital stays. The admission rate for pregnancies and childbirth is not expected to increase in an important way and demographic changes are small (see Figure 20). The phase-down of C-beds is the result of important reductions in ALOS for surgical treatments and the substitution to day care. The more pronounced reduction in C-beds compared to D-beds reflects the more important reduction in inpatient days related to surgical procedures. Figure 20 and Figure 17 substantiate the projected decline of ALOS for procedures related to the musculoskeletal system, the circulatory system and the digestive system, the three treatment groups that contribute most to the usage of C-beds.

The projected scaling down of M-beds and C-beds is even more pronounced when comparing to the number of licensed beds. In 2014, there is a mismatch between normative need for those bed types and the number of licensed beds. The gap is about 30% of the licensed number of C-beds and 20% for M-beds. Also for E-, N- and BR-beds, the number of licensed beds is about 30% above the normative usage in 2014. Hence the potential cutback in bed capacity of all five bed types is much more important than the reduction indicated by the change in normative need between 2014 and 2025.

Overall reduction in need for hospital inpatient beds

Despite the increased need for chronic beds, the baseline projections indicate a reduced need for hospital inpatient beds. Based on the normative bed need, the decrease amounts to about 2 300 beds by 2025 or 5.4%. If we use the number of licensed beds as point of comparison the downward potential rises to almost 11 000 beds or about 21.7% of the current capacity. As already mentioned these figures do not yet include the capacity requirements of foreign patients (see section 1.7.3 and section 1.7.4).

Relative evolution of different bed types

Figure 21 presents the relative evolution of the past and future number of normative beds per bed type using the normative usage in 2014 as a reference point. This confirms the tendencies set out in Table 8. For most bed types, the forecasts (between 2015 and 2025) are unambiguously upward or downward sloping. However, G-beds and N-beds have a slope discontinuity around 2020. This is related to the demographic changes of the relevant population. The number of newborns is projected to increase rapidly between 2015 and 2020, whereas the number of individuals aged between 75 and 84 is projected to slightly decrease over the same period. This is followed by a rapid expansion of the latter age group between 2021 and 2025.

Figure 22 also represents the relative evolution of the past and future number of normative beds per bed type, but uses the number of licensed beds in 2014 as reference. The difference between the 100-line and the actual figure in 2014 indicates the mismatch between needs and number of licensed beds. A larger gap is associated with a more important mismatch. The divergence in 2025 shows the total potential change in current bed capacity comprising both the change in underlying need and the adjustment of licensed beds. In general, the evolution line in Figure 22 is below the evolution in Figure 21 for the same bed type. The slopes, however, are similar.

Figure 21 – Relative evolution of the projected number of inpatient beds per bed type (Reference = normative need in 2014)

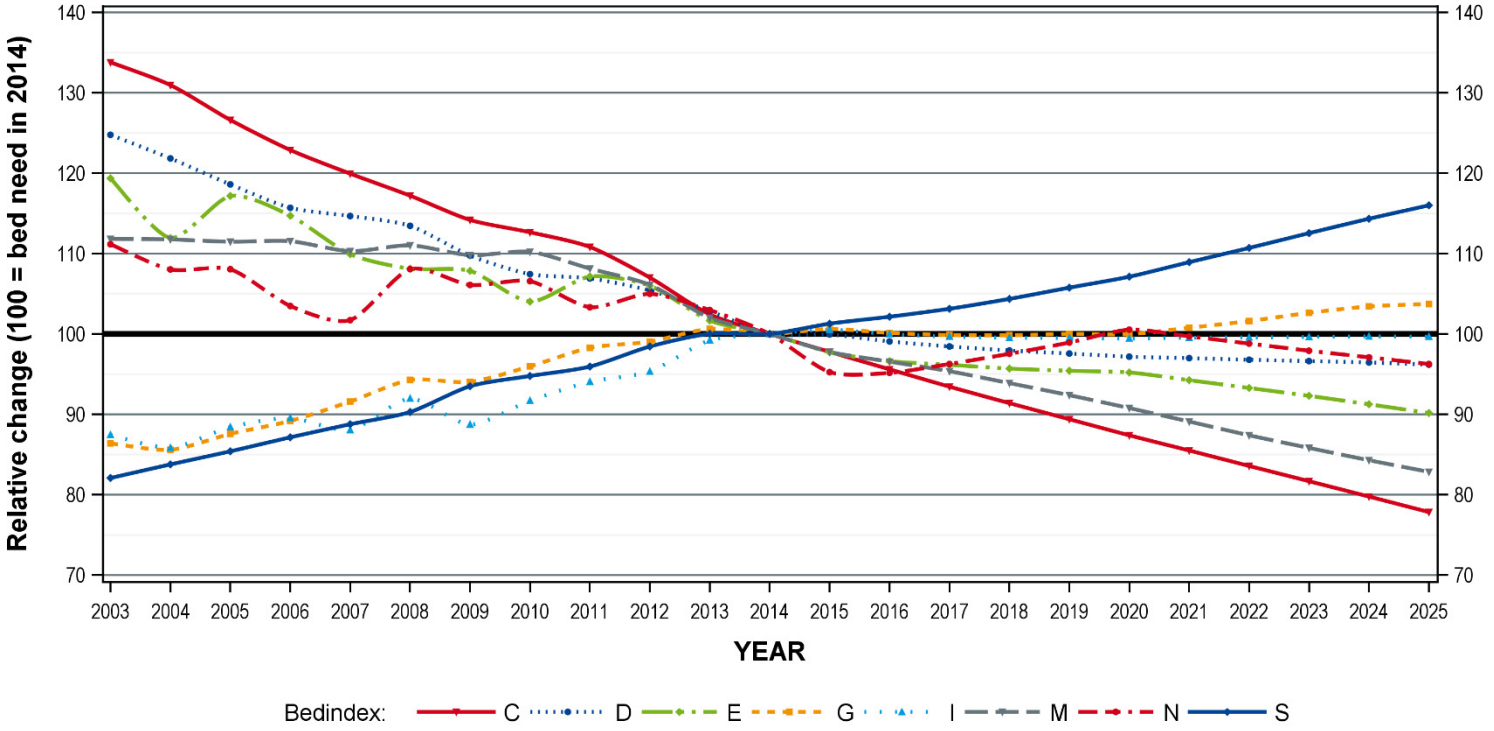
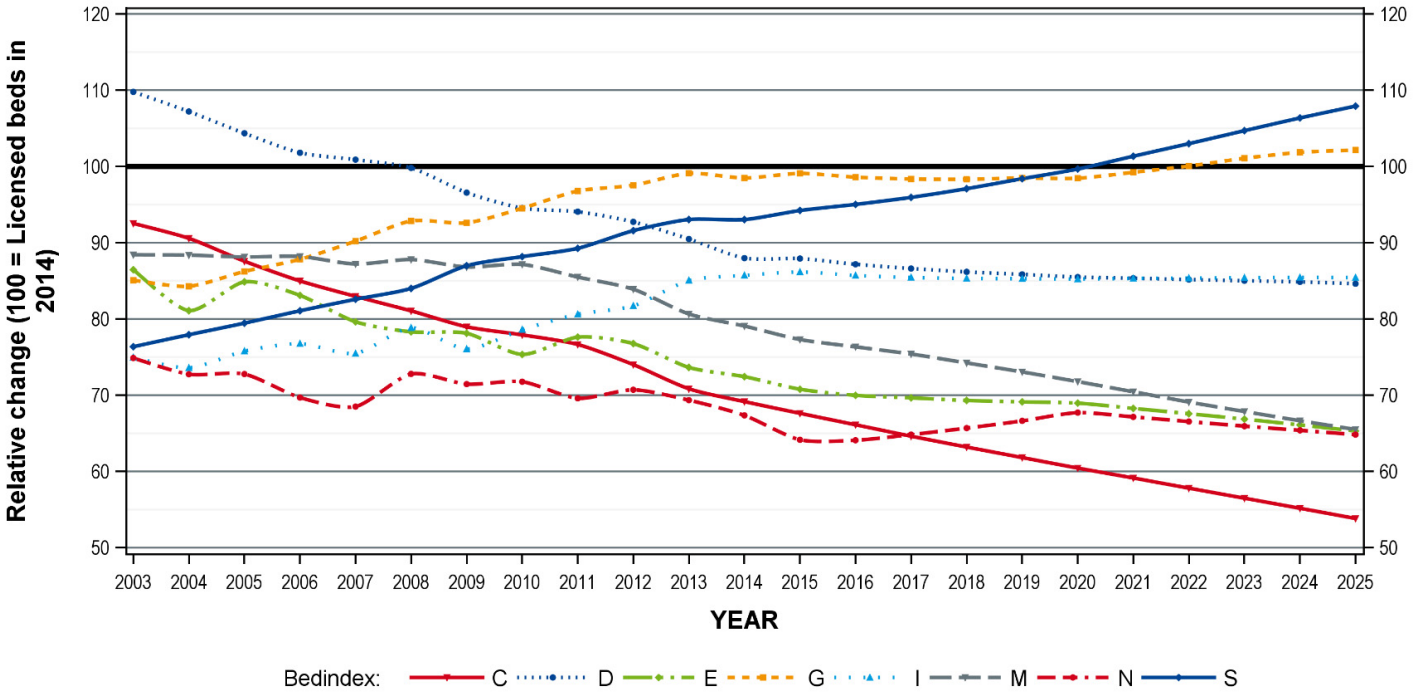


Figure 22 – Relative evolution of the projected number of inpatient beds per bed type (Reference = number of licensed beds in 2014)



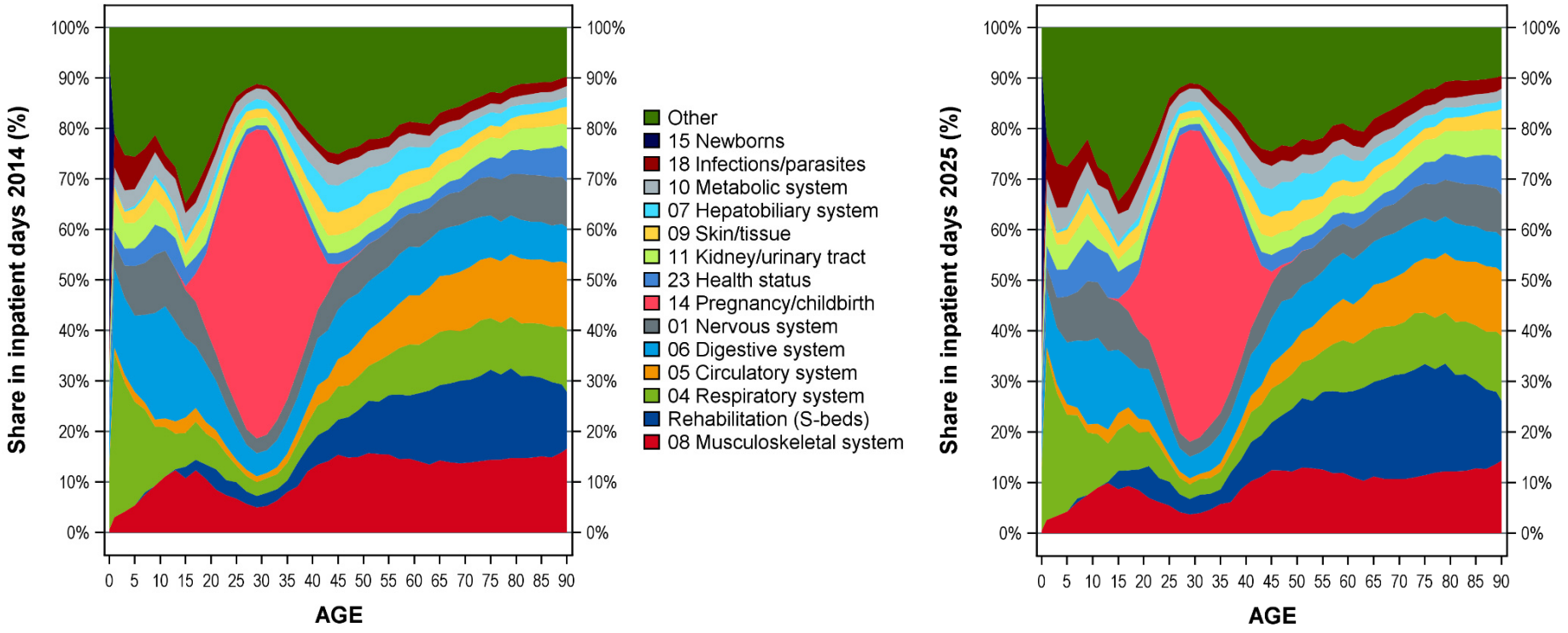
1.7.1.4 The effects of age and the evolution of the inpatient case mix

Figure 23 provides the distribution of inpatient care categorized in MDCs, by age. All patients aged 90 or more are grouped together as age 90. The left panel represents the situation in 2014, whereas the right panel shows the projected situation in 2025. Both cross-sections appear similar although one can notice certain changes over time, some of which have been brought up before.

For most age groups, about four MDCs account for half of all inpatient hospital days. However, these can be quite different. The share of chronic care, diseases and disorders of the musculoskeletal system, and of the circulatory system increases with age. Care for newborns and neonates is obviously the predominant care type for newborns. Diseases and disorders of the respiratory system, of the digestive system and infectious and parasitic diseases are more common among individuals less than 20 years old. Pregnancy and childbirth is the predominant care type for individuals between 20 and 40 years old.

Between 2014 and 2025, the forecasts predict an important growth of chronic care especially for individuals aged between 55 and 80. Treatments related to the digestive system, the circulatory system and the musculoskeletal system lose in importance, especially at younger ages. Infectious and parasitic diseases on the other hand gain in importance for all ages. Pregnancies and childbirth appear to shift somewhat to later ages, with an increase in share for individuals aged mid-30 to mid-40.

Figure 23 – Distribution of inpatient care type (MDC) by age in 2014 (left panel) and 2025 (right panel)



In Figure 24 and Figure 25, the analysis by MDC and age group continues. Figure 24 illustrates the relative growth in inpatient stays for five different age groups. Each circle specifies the growth rate for the MDC, the colour defines the age group. As benchmark, the population growth of each of the age groups is indicated by vertical dotted lines in the colour of the age groups. Hence, circles at the right [left] of the benchmark line indicate an increase [decrease] in the admission rate for that age group. The size of the circles indicates the importance of each MDC for the particular age group.

For example, stays related to diseases and disorders of the digestive system are projected to decrease by 20.0% between 2014 and 2025 for the age group between 0 and 19 years (indicated by the red circle). The decrease occurs despite an increase in size of that age group by 6.6% over the same period (indicated by the red line). The bubble size indicates that diseases and disorders of the digestive system represent an important share of all inpatient stays of individuals aged 19 or less.

Figure 24 substantiates the statement made in section 1.7.1.1 that the admission rate on average increases for individuals aged 40 or more and decreases otherwise. Indeed, for the majority of MDCs, the green, yellow and azure blue circles are on the right side of the same-coloured dotted line. The opposite is true for the dark blue and red circles. This is summarized for all MDCs combined on the top line.

The results in Figure 24 allow to make more balanced statements with respect to the admission rates. In section 1.7.1.2, we put forward that the admission rate for diseases and disorders of the circulatory system decreases. On average, this is true. However, Figure 24 provides more detailed information and shows that the admission rate in fact increases for children and young adults (0-39) and older individuals (75+) and decreases for the other groups.

The admission rate is unambiguously positive for all age groups for 7 MDCs: chronic care, infectious and parasitic diseases, diseases and disorders of the respiratory system, of the metabolic system, of the hepatobiliary system, of the blood and blood forming organs, and of the ear, nose, mouth and throat.

Figure 25 is similar in construction, but describes the evolution of inpatient days. The top line shows that the total number of inpatient days remains constant for individuals aged 60 or more. For these groups, the reduction in ALOS balances out with the upward pressure from demographic changes and the increase in admission rate. Individuals below 60 years of age experience an overall decrease in inpatient days.

Except for infectious and parasitic diseases, all MDCs have at least one age group with a growth in inpatient days below its demographic growth rate. Moreover, 3 MDCs have a projected increase in inpatient days for all age groups: chronic care, care related to health status and aftercare and infectious and parasitic diseases.

A comparison between Figure 24 and Figure 25 provides additional useful insights. For pregnancies and childbirth, the number of stays in the age group 20-39 more or less follows the demographic change. The fall in ALOS, however, leads to an important decrease in inpatient days. The number of pregnancies and births at the age of 40 or above will increase sharply both in stays and in days. However, the circle size shows that pregnancies and births in women aged above 40 occur less frequently than in women between 20 and 39.

Figure 24 – Relative growth in inpatient stays between 2014 and 2025 by MDC and age group

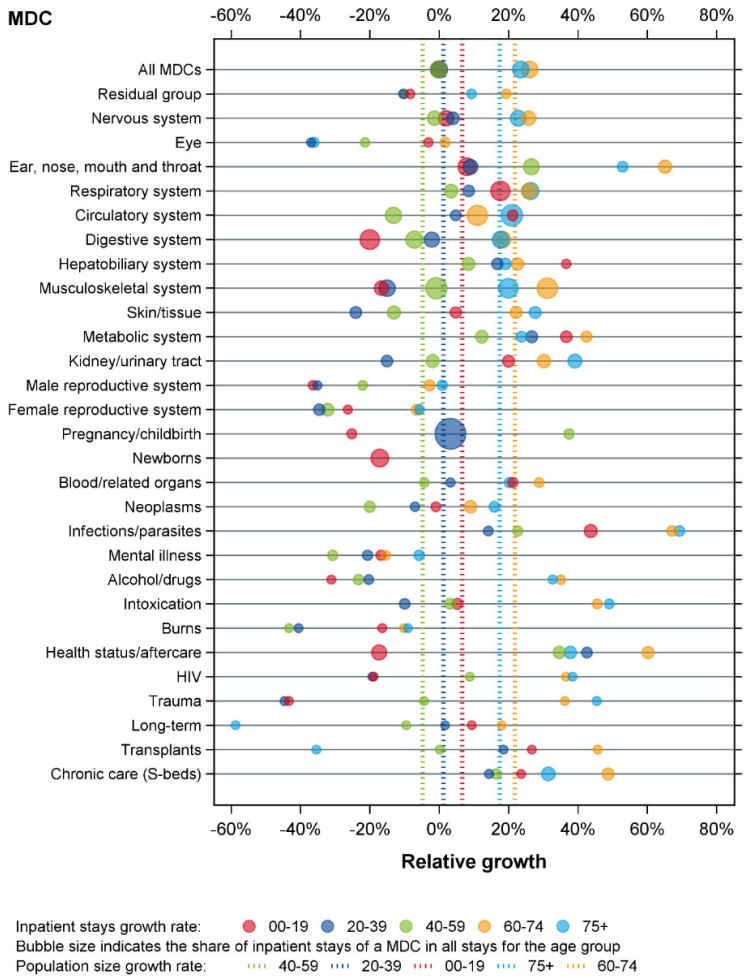
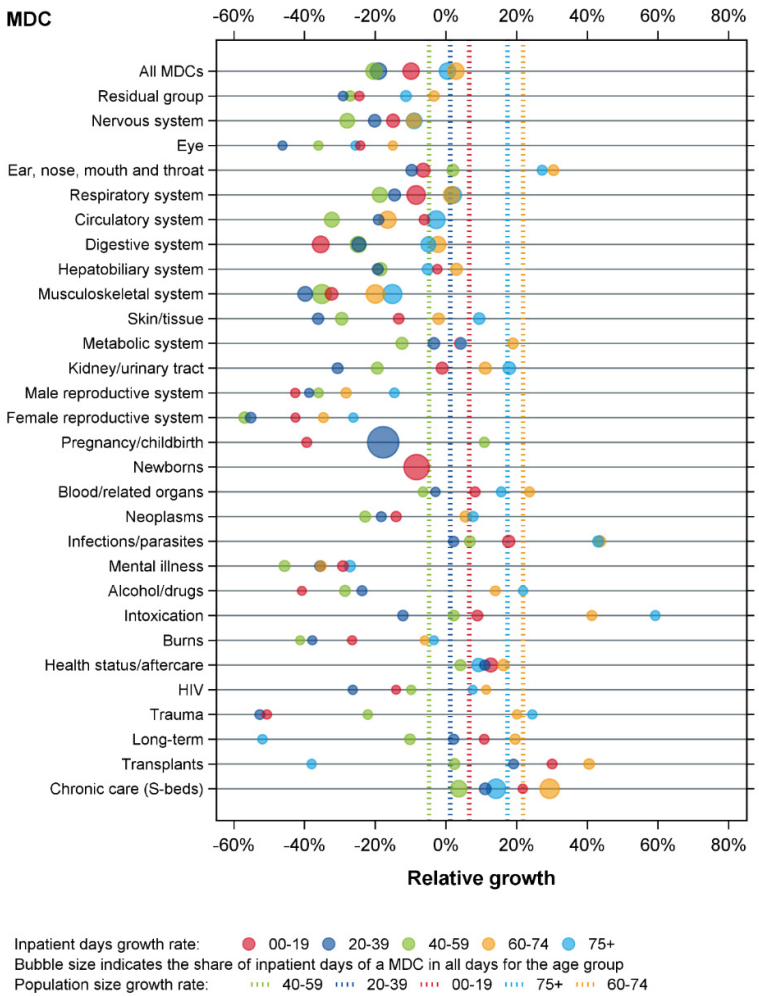


Figure 25 – Relative growth in inpatient days between 2014 and 2025 by MDC and age group



1.7.2 Future need for hospital day care

1.7.2.1 Forecasts for hospital day-care stays

Figure 26 and Table 9 provide information on the forecast results for total hospital day-care stays at the national level. Table 9 additionally gives an overview of the baseline forecasts by MDC. The MDCs are ordered in descending number of day-care stays as observed in 2014.

Registration issues mini lump sums

Remember that the registration of mini lump sums in 2006 and 2007 in the hospital data was incomplete (see also section 1.3.2). While the billing information of the mini lump sums was registered, it could not be coupled to patient characteristics and other complementary information. The incomplete stays were excluded from the data. The consequence is an unrealistic evolution of mini lump sums between 2006 and 2008. This affects the appraisal of the past evolution of the global day-care volume. Therefore, when discussing the evolution of day care, information is provided with and without including mini lump sums.

With respect to the forecasts, the effect should be limited. Only the projections for mini lump sums might be affected and upward biased. However, we believe that the upward bias is minimal given our estimation strategy including a validation period and the use of ARIMA models which both adjust estimated patterns to more recent observations (see section 1.5.3).

Figure 27 visualizes the forecast results, but excluding the mini lump sums from the analysis. The future tendencies are identical to those observed in Figure 26, however, the historic evolution follows a more linear growth pattern.

An important increase in day-care activity driven primarily by a growth in admission rates

From the forecast results, several conclusions can be drawn. First, in both instances – i.e. with and without accounting for the trend in admission rates –, an increase in day-care activity is projected. When the forecasts are based solely on demographic changes, an additional 230 000 stays (or 8.3% of the day-care stays in 2014) are expected in 2025 relative to 2014. As for inpatient stays, the relative change is well above the population growth over the same period which amounts to 5.3%. Hence, 3 percentage point of the increase, or about 35% of the demographic impact, can be attributed to changes in the composition of the population. The increase in day-care stays related to demographic evolutions is smaller than for inpatients stays, where a growth rate of 9.6% is found. This is related to the different socio-demographic profile of the patients in inpatient and day care setting. On average, the patient population in day care is younger than in inpatient care and day care activity is therefore less sensitive to population ageing. The elective procedural day care rate is also higher in Flanders than in Wallonia.[71]

When the forecasts account for the evolution in the admission rate, the projected number of stays is substantially higher. The forecasts suggest an additional 700 000 day care stays on top of the increase attributed to population changes. The total increase amounts to 934 000 stays or 33.5% of the day-care activity registered in 2014 or a growth of 2.66% on an annual basis. Hence, the forecast results crucially depend on the inclusion of the trend for the admission rate in the projection model. Figure 13 (right panel) makes clear that over the period 2006 – 2014 the growth in day-care activity was markedly higher than the population growth both with and without inclusion of mini lump sums, providing an argument in favour of the inclusion of the evolution of the admission rate in the baseline case.

The increase of day care by 33.5% over a period of 11 years, will require a significant expansion of the available capacity. The expansion appears challenging, but realistic given the large increase observed between 2006 and 2014 of 1 400000 stays with the inclusion of mini lump sums or 700 000 stays without including information on mini lump sums.

The overview in Table 9 shows that day-care activity is highly concentrated in a limited number of MDCs. The top 5 MDCs cover over 70% of all stays, the top 10 MDCs represent over 90%. Moreover, the top 10 MDCs account for over 90% of the growth in day-care activity. Absolute increases of more than 100 000 stays are projected for interventions previously covered by the mini lump sum (see also section 1.3.2), treatments related to the digestive system, to neoplasms, and to health status and aftercare. In addition to these groups, particularly large relative increases of 40% or more are predicted for eye treatments, treatments of the respiratory system, of the metabolic system, of the hepatobiliary system and of mental illness.

Next, the majority of the MDCs are characterized by a projected increase in the number of stays. Only four – predominantly small – groups show a decreasing evolution.

Increase is driven by medical procedures

Medical procedures are the locomotive in the expansion of day care. In 2014, medical day care (including the interventions previously covered by the mini lump sum) accounts for 78% of the volume in stays, while surgical day care has a share of 22%. This discrepancy is further enlarged in the forecasts. Medical day care is projected to increase between 2014 and 2025 by 35.6% when including the mini lump sum and even by 41.9% without incorporating the mini lump sum. Surgical day care grows by 26.1% over the same period.

As for inpatient care, the baseline forecasts for day care can be expressed in beds or places. In Table 9, we translate the forecasts in medical and surgical places. For this, we assume that a stay equals 1 day, and that the day-care centre is open for 250 days a year. For the computations, the occupancy rate is set at 100%. This high rate is justifiable given that the length of the day-care stay is defined rather generous. The current need for medical places equals 8 684 places and is projected to further expand with about 3000 places. For surgical day care, usage in 2014 equals slightly less than 2 500 places and is projected to grow with 650 places. The capacity projections exclude foreign patients whose needs are discussed in section 1.7.3.

Figure 26 – Observed evolution and forecasts for hospital day-care stays

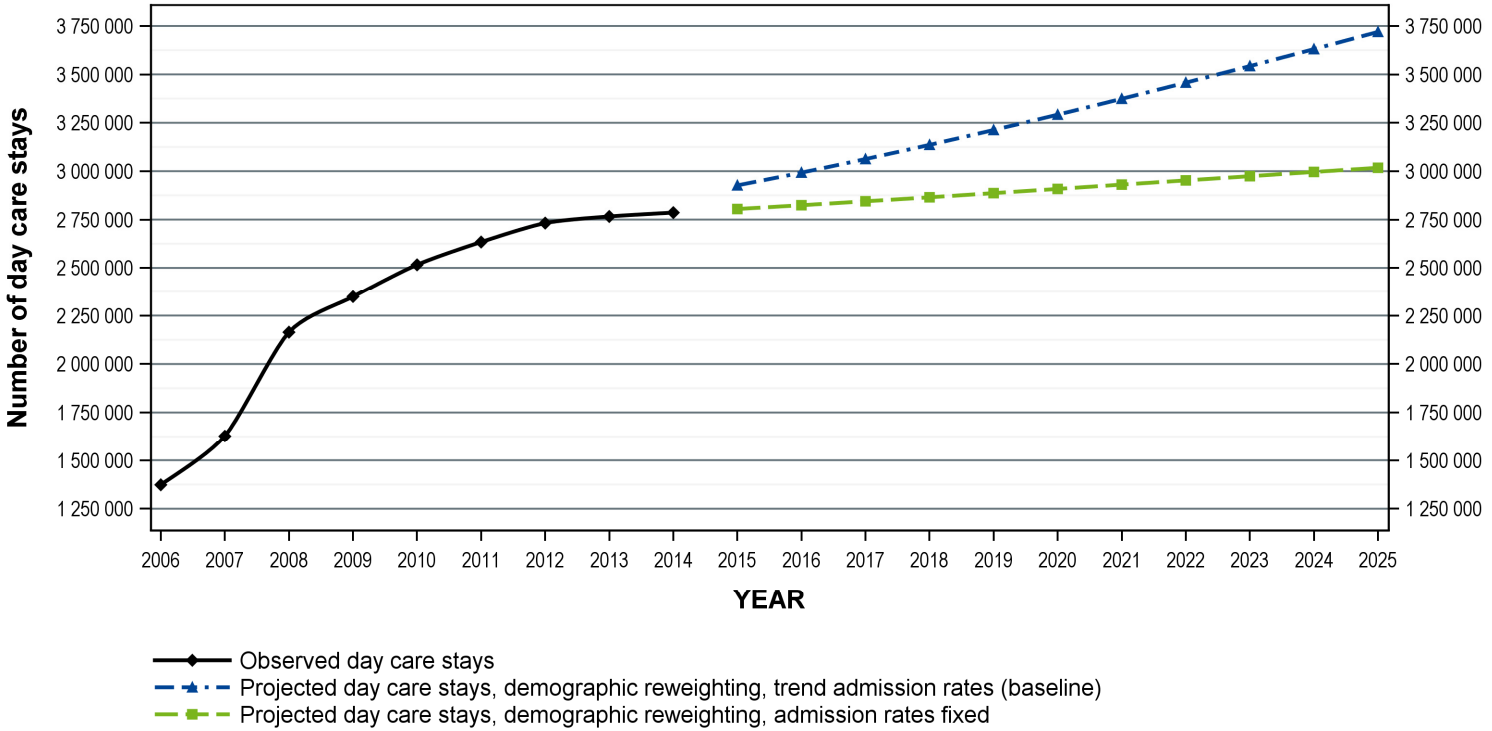


Figure 27 – Observed evolution and forecasts for hospital day-care stays, excluding mini lump sums

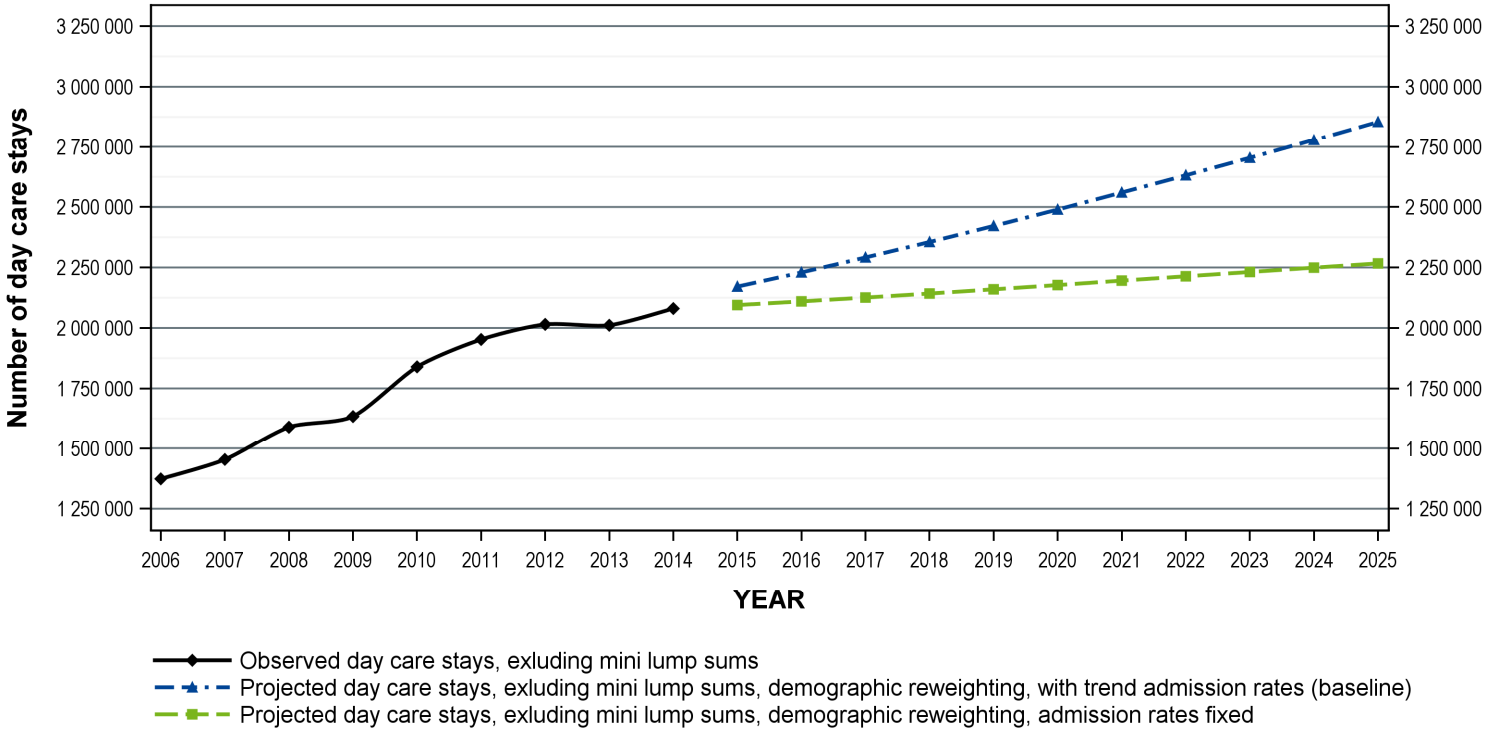


Table 9 – Overview of observed and forecasted hospital day-care stays, total and broken down by MDC, for years 2006, 2010, 2014, 2020, 2025

MDC		2006	2010	2014	2020	2025	Abs. difference 2014-2025	Rel. difference 2014-2025
All MDC, demographic reweighting without trend admission rate		1 373 071	2 516 057	2 785 988	2 908 346	3 017 521	231 533	8.3%
All MDC, demographic reweighting with trend admission rate (baseline)					3 291 897	3 719 531	933 543	33.5%
Baseline forecast results subdivided by MDC								
	Mini lump sum	-	676 873	705 669	802 343	865 170	159 501	22.6%
17	Neoplasms	315 189	365 850	412 537	506 168	579 595	167 058	40.5%
23	Health status/aftercare	70 726	177 658	329 420	418 980	489 464	160 044	48.6%
08	Musculoskeletal system	218 357	344 265	300 270	347 378	392 375	92 105	30.7%
03	Ear, nose, mouth and throat	174 430	216 856	234 490	265 261	292 710	58 220	24.8%
06	Digestive system	132 234	177 512	211 563	265 475	315 925	104 362	49.3%
02	Eye	106 490	129 377	143 913	174 304	210 292	66 379	46.1%
01	Nervous system	42 691	65 665	64 763	76 857	89 293	24 530	37.9%
09	Skin/tissue	48 883	56 221	63 120	73 193	82 414	19 294	30.6%
05	Circulatory system	47 387	49 893	55 605	63 176	69 192	13 587	24.4%
11	Kidney/urinary tract	39 301	45 758	50 588	58 905	67 455	16 867	33.3%
12	Male reproductive system	37 975	46 688	50 456	58 004	65 265	14 809	29.4%
16	Blood/related organs	39 853	45 583	42 504	46 358	50 489	7 985	18.8%
13	Female reproductive system	37 569	36 991	38 858	39 493	40 218	1 360	3.5%
14	Pregnancy/childbirth	19 319	25 028	19 663	19 268	19 199	-464	-2.4%
04	Respiratory system	8 143	16 482	17 191	22 021	26 661	9 470	55.1%
10	Metabolic system	11 727	11 093	14 257	18 045	21 169	6 912	48.5%
07	Hepatobiliary system	6 729	8 431	10 002	12 228	14 240	4 238	42.4%
19	Mental illness	2 054	4 666	6 409	9 143	12 214	5 805	90.6%
21	Intoxication	5 036	5 522	5 345	5 611	5 972	627	11.7%

00	Residual group	3 736	4 476	4 360	4 604	5 041	681	15.6%
18	Infections/parasites	2 869	2 866	3 028	3 117	3 239	211	7.0%
20	Alcohol/drugs	1 385	1 155	877	928	857	-20	-2.3%
15	Newborns	519	650	472	528	537	65	13.8%
24	HIV	244	198	386	256	261	-125	-32.4%
22	Burns	163	255	212	225	254	42	19.8%
25	Trauma	47	28	22	20	21	-1	-4.5%
PP	Transplants	15	17	8	8	9	1	12.5%
Baseline forecast results expressed in places								
Medical places		3 566	7 776	8 684	10 387	11 778	3 094	35.6%
Surgical places		1 926	2 288	2 460	2 780	3 101	641	26.1%

1.7.2.2 Evolution day-care case mix

Figure 28 provides the distribution of day-care stays categorized in MDCs, by age. All patients aged 90 or more are grouped together as age 90. The left panel represents the situation in 2014, whereas the right panel shows the projected situation in 2025. Even more so than for inpatient care, both cross-sections appear similar. Only small changes over time are observed, some of which have been brought up before.

For most age groups, about three MDCs account for half of all day-care stays. There is quite a lot of pathology heterogeneity by age. Individuals aged 30 or less are treated more frequently for diseases and disorders of the ear, nose, mouth and throat. The mini lump sums cover treatments especially important for individuals aged between 20 and 45. From the age of 30 years onwards, procedures related to the respiratory system and to health status and aftercare gain in importance. Patients aged above 45 are more likely to be treated for neoplasms, and eye treatments occur predominantly on patients aged over 65 years. Diseases and disorders of the digestive system, on the other hand, are important for all age groups.

Between 2014 and 2025, the forecasts predict a growth for all age groups of diseases and disorders of the digestive system. Care related to health status and aftercare increases especially for younger age groups. Eye treatments appear to gain in importance for individuals aged between 55 and 70. Procedures on the ear, nose, mouth and throat as well as mini lump sums lose in relative share.

Figure 28 – Distribution of day-care type (MDC) by age in 2014 (left panel) and 2025 (right panel)

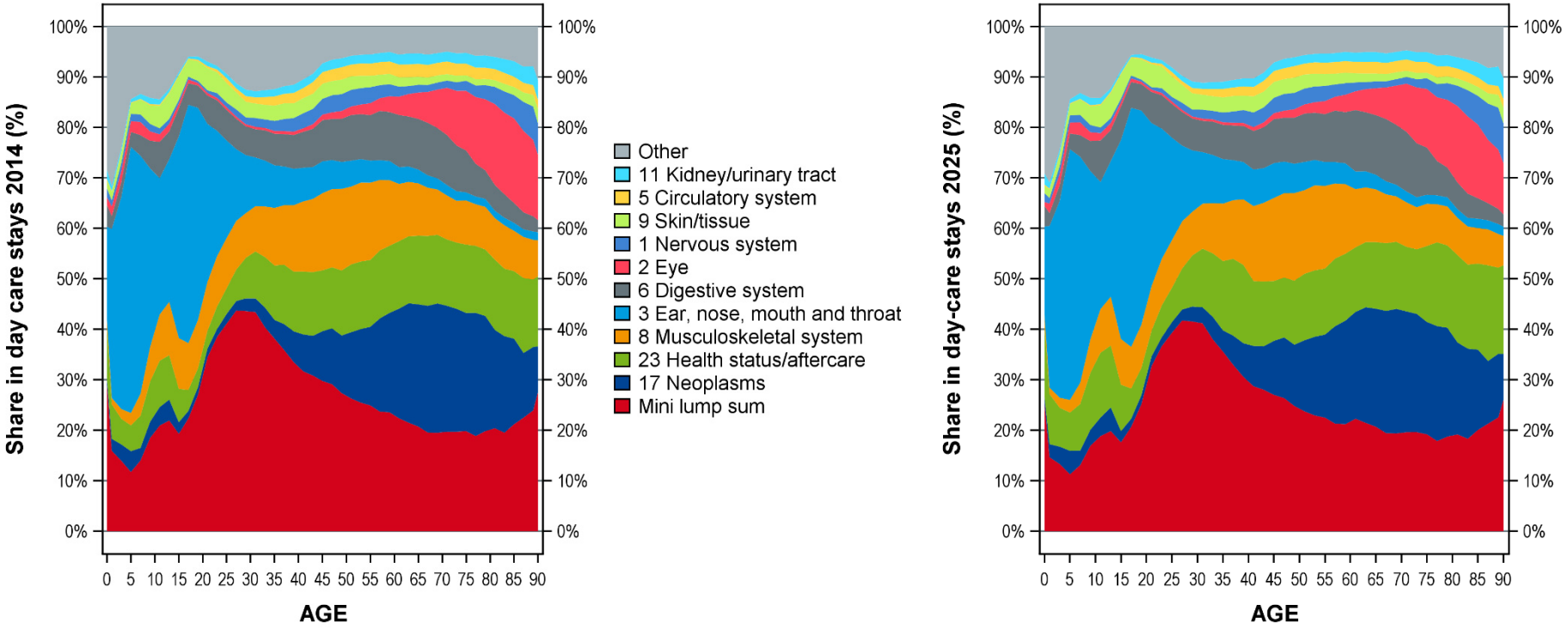


Figure 29 sheds a complementary light on the evolution of day care by MDC and age group. The growth rate in day-care stays between 2014 and 2025 is indicated for each MDC and for five different age groups by a coloured circle. The colour defines the age group. As point of comparison, the population growth of each of the age groups over the same time period is indicated by vertical dotted lines in the colour of the age groups. Hence, circles at the right [left] of the benchmark line indicate an increase [decrease] in the admission rate for that age group. Finally, the size of the circles indicates the importance of each MDC for the particular age group.

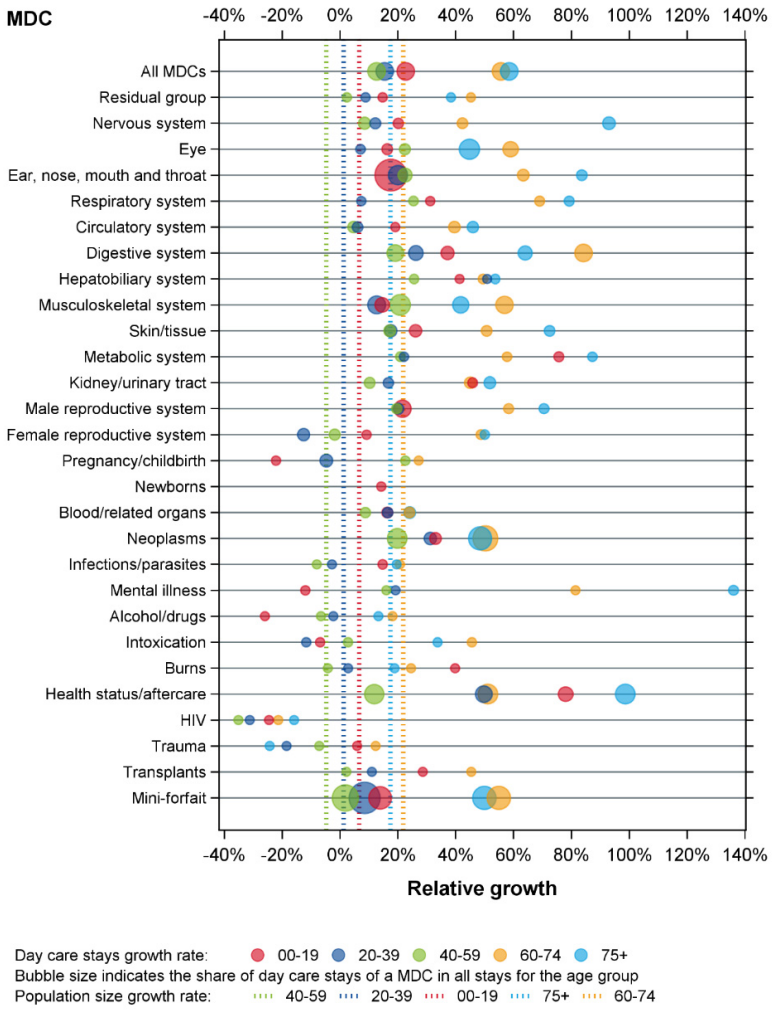
For example, stays related to diseases and disorders of the ear, nose, mouth and throat are particularly important for the age group of under 19 year olds (indicated by the red bubble). For all age groups, a growth in day care is projected between 2014 and 2025. The growth rate exceeds population growth for all age groups, i.e. all bubbles are to the right of the same coloured dotted line. There is a particularly strong growth of 60% for individuals aged between 60 and 75 (indicated by the orange bubble) and even about 85% for individuals aged over 75 (indicated by the azure blue bubble).

Figure 29 shows that, contrary to inpatient care, nearly all MDCs for most age groups increase in the absolute number of stays between 2014 and 2025. There is one notable exception, the number of day-care stays related to HIV treatment is projected to further decrease over time for all age groups. Most age-group-MDC combinations grow at a faster pace than the demographic evolution. Growth rates between 40% and 100% over the forecast period of 11 years are no exception especially in the age groups above 60 years old.

The top line summarizes the change in day-care volume for all MDCs combined. The large increase in day-care activity is clearly visible since all age-bubbles on the top line are situated to the right of the same coloured dotted line. The top ten MDCs in terms of day-care stays all have an increase in hospital activity above the demographic growth for all age groups. In other words, all these age-group-MDC combinations have a positive admission rate.

When comparing the bubbles of a particular MDC with the bubbles on the top line, one can make inferences about the change in relative share of that MDC. If the bubble of a specific MDC is to the right [left] of the same coloured bubble on the top line, there is a relative increase [decrease] in share of that MDC for the corresponding age group. When this is true for all age groups, there is an overall gain [decline] in relative importance for the pathology. Only two MDCs have an increase in relative importance for all age groups, i.e. diseases and disorders of the digestive system and of the metabolic system. Nine MDCs, generally smaller in terms of volume, have a declining relative share in overall activity between 2014 and 2025. Remark that it is perfectly possible to have an increase in absolute terms in day-care activity, in combination with a decrease in relative share. This is true for example for diseases and disorders of the circulatory system. The volume in day-care stays rises but at a slower pace than for other pathologies. This further emphasizes the important growth of 33.5% projected for day-care activity by 2025.

Figure 29 – Relative growth in day-care stays between 2014 and 2025 by MDC and age group



1.7.3 *Capacity requirements for isolated categorical hospitals and foreign patients*

Table 10 and Table 11 provide summary information on the baseline forecast results of, respectively, care provided in isolated categorical hospitals which fall under the competence of the communities, and hospital care consumed by foreign patients.

Isolated categorical hospitals

Isolated categorical hospitals only provide inpatient care. By definition, we only find care provided in S-beds and G-beds. Except for six licensed S-beds in Wallonia, the hospital capacity in isolated categorical hospitals is entirely situated in Flanders.

Isolated categorical hospital supply three categories of care (MDC): chronic care stays, which is the predominant category, long-term stays, and stays related to health status and aftercare. Chronic care is projected to increase both in stays and days, whereas the other two categories show a declining trend. Overall, the growth of chronic care implies an increased need for inpatient care in categorical hospitals of about 45 000 nursing days or 135 beds in 2025 at a normative occupancy rate of 90% for G- and S-beds. The capacity in isolated categorical hospitals is limited and has decreased over time due to hospital mergers and collaborations. Hence a response to the increased future need for chronic care should be formulated in combination with the capacity evolution in acute hospitals having chronic care beds. We provide an overall summary of the projection results including foreign patients and isolated categorical hospitals in section 1.7.4.

Table 10 – Summary of baseline forecast results for hospital care in isolated categorical hospitals, for years 2005, 2010, 2014, 2020, 2025

	2005	2010	2014	Licensed beds 2014*	2020	2025	Abs. difference 2014-2025	Abs. difference licensed-2025	Rel. difference 2014-2025	Rel. difference licensed-2025
Inpatient stays										
Total stays	6 020	6 452	7 474		8 713	9 983	2 509		33.6%	
Stays chronic care (S-beds)	5 527	5 936	6 915		8 193	9 490	2 575		37,2%	
Stays health status/aftercare (MDC 23)	311	361	418		387	367	-51		-12.2%	
Stays long-term	182	155	141		133	126	-15		-10.6%	
Inpatient days										
Total days	322 544	316 095	324 378		346 523	368 427	44 049		13.6%	
Stays chronic care (S-beds)	258 110	258 519	276 617		303 117	327 889	51 272		18,5%	

Stays health status/aftercare (MDC 23)	17 575	18 317	18 547		16 296	15 063	-3 484		-18.8%	
Stays long-term	46 859	39 259	29 214		27 110	25 475	-3 739		-12.8%	
Bed types inpatient care										
S (=S1, S2, S3, S4, S5, S6)	925	906	931	971	1 005	1 076	145	105	15.6%	10.8%
G	56	56	56	52	50	46	-10	-6	-17.9%	-11.5%

** The number of licensed beds is based on information from December 2014 provided by FPS Health.*

Foreign patients

The group of foreign patients, i.e. patients who do not reside in Belgium but make use of hospital care in a Belgian hospital, is expected to continue growing in number of hospital stays in the short and medium term. The forecast results show a modest increase in day-care activity, entirely attributable to an expansion in medical procedures. The projected rise in inpatient stays between 2014 and 2025 is more substantial and amounts to 5 800 stays or 21% of the inpatient stays of foreign patients in 2014. Since we do not adjust care usage by foreigners for demographic changes, the increase is entirely due to the increase in stays observed in the past (see also the Data Manual for more information on the adjusted estimation methodology for foreign patients).

The decline in ALOS of hospital inpatient stays leads to an overall decrease in the projected number of inpatient days and inpatient beds. The majority of hospital stays of foreign patients has SOI-level 1 or 2, which have the highest projected reduction of ALOS in the future. This is reflected in the forecast results for inpatient days. The contraction by 3% of the projected inpatient days between 2014 and 2025 differs substantially from the 21% growth in inpatient stays. The translation of inpatient days to bed capacity applies the same normative occupancy rates as put forward in section 1.7.1.3, i.e. an occupancy rate of 70% for M- and E-beds; 75% for N-beds; 80% for C-, D-, L-, BR-, and I-beds; and 90% for G- and S-beds. Mostly C- and D-beds are used. The decrease in normative need for C-beds is most pronounced. The projected need for other bed types matches closely the observed levels in 2014.

Table 11 – Summary of baseline forecast results for hospital care for foreign patients, for years 2005, 2010, 2014, 2020, 2025

	2005	2010	2014	2020	2025	Abs. difference 2014-2025	Rel. difference 2014-2025
Day-care stays	16 984♣	33 666	34 043	34 670	35 467	1 424	4.2%
Bed types day care							
Medical places	37	94	100	103	106	6	6.0%
Surgical places	31	41	36	36	36	0	0.0%
Inpatient stays	24 738	30 265	27 792	30 908	33 567	5 775	20.8%
Inpatient days	150 459	179 948	154 347	152 176	149 228	-5 119	-3.3%
Bed types inpatient care							
C	243	272	217	205	194	-23	-10.6%
D	132	164	147	147	146	-1	-0.7%
I	40	43	47	49	50	3	6.4%
M	23	36	34	34	33	-1	-2.9%
E	34	32	31	32	32	1	3.2%
S (=S1, S2, S3, S4, S5, S6)	20	28	20	21	21	1	5.0%
G	10	26	18	18	17	-1	-5.6%
N (=NIC, N*)	15	12	12	13	14	2	16.7%
BR	-	2	3	3	3	0	0.0%
L	1	0	1	1	1	0	0.0%

♣ *For day care the number of stays registered in 2006 is used.*

Table 12 – Summary of baseline forecast results at the national level: all hospitals and foreign patients, for years 2005, 2010, 2014, 2020, 2025

	2005	2010	2014	Licensed beds 2014*	2020	2025	Abs. difference 2014-2025	Abs. difference Licensed-2025	Rel. difference 2014-2025	Rel. difference Licensed-2025
Day-care stays	1 390 059♣	2 549 723	2 820 031		3 326 573	3 754 989	934 958		33.2%	
Bed types day care										
Medical places	3 603	7 871	8 784		10 490	11 883	3 099		35.3%	
Surgical places	1 957	2 328	2 496		2 816	3 137	641		25.7%	
Inpatient stays	1 749 696	1 814 911	1 859 086		1 967 289	2 082 753	223 667		12.0%	
Inpatient days	14 287 730	13 769 513	13 231 270		12 793 118	12 637 257	-594 013		-4.5%	
Bed types inpatient care										
Total beds	47 528	45 659	43 691	51 995	42 163	41 534	-2 157	-10 461	-4.9%	-20,1%
D	15 406	14 001	13 026	14 638	12 661	12 533	-493	-2 105	-3.8%	-14,4%
C	12 775	11 421	10 114	14 310	8 854	7 897	-2 217	-6 413	-21.9%	-44,8%
G	6 397	7 019	7 302	7 392	7 293	7 561	259	169	3.5%	2,3%
S (=S1, S2, S3, S4, S5, S6)	5 266	5 730	6 011	6 410	6 446	6 966	955	556	15.9%	8,7%
M	2 822	2 804	2 545	3 176	2 313	2 113	-432	-1 063	-17.0%	-33,5%
E	2 284	2 030	1 951	2 651	1 860	1 763	-188	-888	-9.6%	-33,5%
I	1 575	1 635	1 784	2 026	1 776	1 781	-3	-245	-0.2%	-12,1%
N (=NIC, N*)	969	953	895	1 311	900	864	-31	-447	-3.5%	-34,1%
L	34	37	33	38	32	30	-3	-8	-9.1%	-21,1%
BR	-	29	30	44	28	26	-4	-18	-13.3%	-40,9%

Note: including stays and days of foreign patients (i.e. patients living abroad) and stays and days in isolated categorical hospitals.
*♣ For day care the number of stays registered in 2006 is used; * The number of licensed beds is based on information from December 2014 provided by FPS Health. The official number is complemented with information from the file unitindex of the minimal hospital data to account for N*-beds and to create a division between BR-, C-, D-, E- and I-beds. Moreover, licensed CD-beds are attributed for 50% to C-beds and for 50% to D-beds.*

1.7.4 Summary of baseline forecast results

1.7.4.1 Summary at the national level and shift to chronic care

Table 12 provides a summary of the main projection results. We combine the forecasts for inpatient care, day care, foreign patients and care in isolated categorical hospitals in one summary forecast at the national level. Forecasts of bed capacity are provided using the following normative occupancy rates: an occupancy rate of 70% for M- and E-beds; 75% for N-beds; 80% for C-, D-, L-, BR-, and I-beds; and 90% for G- and S-beds (see section 1.7.1.3). The forecast estimates for bed capacity in 2025 are also compared to the number of licensed beds in 2014.

The forecast results in Table 12 confirm the main trends already discussed above. A strong expansion of 33.2% in day-care activity is projected between 2014 and 2025. Although important growth rates are projected for both surgical and medical day care, the core of the expansion will be in medical day care. The dominant force behind the increase is an important growth in admission rates, rather than the demographic evolution.

Over the same period, the number of hospital inpatient stays is expected to grow. In this case the change in demographics underlies the positive evolution, both the increase in total population size and the ageing of the population contribute significantly to the increase in stays. However, due to a decline in ALOS, the number of hospital inpatient days does not show the same upward trend, but rather a decreasing tendency. The need for inpatient days declines by 4.5% in 2025.

The decrease in inpatient days implies a decline in the normative need for inpatient beds of a similar magnitude. Compared to the number of licensed beds in 2014, the normative bed need in 2025 can be met with 10 000 fewer beds or a reduction of one fifth. The number of licensed beds is generally well above the normative bed need in 2014, especially for C-, M-, E-, and N-beds. For these bed types, the potential for capacity cutbacks or bed reconversions equals 30% or more of the licensed beds in 2014.

Note that the capacity for BR-beds – i.e. beds in burn care centres assigned to treat severe burn injuries –, both in terms of licensed beds and normative need does not account for the burn care centre of the military hospital in Neder-Over-Heembeek (Militair Hospitaal Koningin Astrid/ l'Hôpital Militaire Reine Astrid).

In terms of beds per 1 000 inhabitants, the projected decline is about 10%, from a normative need of 3.90 to 3.52 beds per 1 000 inhabitants. The number of licensed beds (excluding (neuro-)psychiatric bed types) amounts to 4.64 per 1 000 inhabitants in 2014. An evolution towards the normative need of 3.52 beds in 2025 implies a decrease by a quarter.

Shift from acute care to chronic care

Despite the projected downward evolution in hospital capacity, an increase, is projected for G-beds and chronic (S-)beds. This is due to two trends, first the population ageing that requires specific care types in a suitable setting and bed; second a shift from acute care towards chronic care, e.g. rehabilitation. The normative need for G-beds and – to a lesser extent – S-beds in 2014 closely matches the number of licensed beds. This might imply that due to capacity restrictions, geriatric care or chronic care is currently performed in other bed types and the actual need is even more important. In the current care model, a capacity extension of or reconversion towards G- and S-beds in the future is necessary to accommodate the increasing need.[e] However, depending on the type of chronic care that is required in

[e] In the Short Report the normative need in 2014 and 2025 are compared with the number of licensed beds in 2017 which qualifies the required capacity extension for G-beds.

the future, part of the increase might be shifted from hospital care to other care settings to alleviate the projected capacity extension for chronic care.

A more detailed analysis of capacity requirement for chronic care, subdivided by bed type, is provided in Table 13. It reveals that inpatient stays are projected to increase by 30% or more between 2014 and 2025 for chronic care in bed types S1 (cardiopulmonary rehabilitation), S3 (neurologic rehabilitation) and especially S2 (rehabilitation of the locomotor system) and S6 (psycho-geriatrics). In terms of days and beds, the projected increase is about 25% for chronic care in bed types S2 and S3 and equals about 30% for S6-beds. With an activity share of almost 40%, rehabilitation of the locomotor system (S2) is an important driver in the future need for chronic care. For chronic care in S1 beds, an important decrease in ALOS of -20% between 2014 and 2025 is predicted. This decline is more important than the overall downward evolution in ALOS of about -13%. Hence despite the important increase in inpatient stays, the projected future need expressed in (nursing days spent in) S1-beds is only about 4%. The increase in normative bed need can be met by the current number of licensed beds and does not impede a reduction in S1-beds.

Mixed stays are projected to grow at high pace. However, this group remains small both in terms of stays and days. The projections for palliative care in S4-beds show a small increase in normative bed need between 2014 and 2025 by 7%. However, the normative need in 2025 remains below the number of licensed beds in 2014. Chronic care in bed type S5 (chronic poly-pathologies) is the only chronic care type that is projected to decrease, by about 9% in number of stays and – given an important decline in ALOS – by about 30% in the number of inpatient days and beds.

Compared to the number of licensed beds in 2014, no bed type reached a level where the observed normative need in 2014 exceeds licensed bed capacity. However, by 2025, the normative bed need for the three types of chronic care that are projected to expand most (S2, S3 and S6) is projected to surpass the available capacity. For all three chronic care types alternative care settings are conceivable to alleviate the projected capacity extension. Psycho-geriatric care (S6) can be provided in specialised nursing homes instead of in a hospital setting. Where possible, rehabilitation of the locomotor system (S2) and neurologic rehabilitation can be provided through community care, e.g. home nursing, and occupational therapy, speech therapy and physiotherapy at home or with well-adapted patient transport.

Table 13 – Detailed overview of forecasts for chronic care at the national level

	2005	2010	2014	Licensed beds 2014*	2020	2025	Abs. difference 2014-2025	Abs. difference Licensed-2025	Rel. difference 2014-2025	Rel. difference Licensed-2025
Inpatient stays										
Chronic care	40 336	47 354	52 607		61 194	70 956	18 349		34.9%	
S1	2 929	3 421	3 683		4 203	4 816	1 133		30.8%	
S2	15 918	20 817	23 731		29 035	34 788	11 057		46.6%	
S3	6 380	7 096	7 871		9 190	10 678	2 807		35.7%	
S4	5 613	6 100	6 364		7 053	7 839	1 475		23.2%	
S5	6 192	6 649	6 253		5 876	5 703	-550		-8.8%	
S6	2 900	2 735	4 096		5 080	6 227	2 131		52.0%	
Mixed S	404	536	609		757	905	296		48.6%	
Inpatient days										
Chronic care	1 592 445	1 731 756	1 853 070		2 002 766	2 179 125	326 055		17.6%	
S1	106 409	108 910	116 904		117 850	121 564	4 660		4.0%	
S2	599 405	719 836	789 107		885 789	982 155	193 048		24.5%	
S3	323 272	348 860	369 185		418 901	471 464	102 279		27.7%	
S4	102 115	101 172	104 350		107 006	110 709	6 359		6.1%	
S5	276 536	261 332	222 849		180 502	154 333	-68 516		-30.7%	
S6	157 457	154 611	207 544		241 261	279 443	71 899		34.6%	
Mixed S	27 251	37 035	43 131		51 457	59 457	16 326		37.9%	
Long-term care (in S-beds)	130 554	140 146	113 590		106 593	100 848	-12 742		-11.2	
Foreign patients (in S-beds)	6 896	10 449	7 860		8 210	8 433	573		7.3%	
Average length of stay (days / stays)										
Chronic care	39.47	36.57	35.22		32.72	30.71	-4.51		-12.8%	

S1	36.32	31.83	31.74		28.03	25.24	-6.49		-20.5%	
S2	37.65	34.57	33.25		30.50	28.23	-5.01		-15.1%	
S3	50.66	49.16	46.90		45.58	44.15	-2.75		-5.9%	
S4	18.19	16.58	16.39		15.17	14.12	-2.27		-13.9%	
S5	44.66	39.30	35.63		30.71	27.06	-8.57		-24.1%	
S6	54.29	56.53	50.66		47.49	44.87	-5.79		-11.4%	
Mixed S	67.45	69.09	70.82		67.97	65.69	-5.12		-7.2%	
Bed types S (chronic care, long-term care and care for foreign patients)										
ALL	5 266	5 730	6 011	6 410	6 446	6 966	955	556	15.9%	8.7%
S1	364	382	396	457	401	415	19	-42	4.8%	-9.2%
S2	1 881	2 301	2 512	2 648	2 813	3 112	600	464	23.9%	17.5%
S3	1 185	1 285	1 331	1 441	1 483	1 643	312	202	23.4%	14.0%
S4	333	326	331	379	341	355	24	-24	7.3%	-6.3%
S5	922	851	720	725	590	510	-210	-215	-29.2%	-29.7%
S6	581	585	719	760	817	931	212	171	29.5%	22.5%

Note: S1 = cardiopulmonary rehabilitation; S2 = rehabilitation of the locomotor system; S3 = neurologic rehabilitation; S4 = palliative care; S5 = chronic poly-pathologies; S6 = psycho-geriatrics; Mixed S = combination of different S-bed types.
Note: including stays and days of foreign patients (i.e. patients living abroad) and stays and days in isolated categorical hospitals.
** The number of licensed beds is based on information from December 2014 provided by FPS Health.*

1.7.4.2 Summary at the regional level

Subdivision by region of residence

The regional subdivision of care use in Table 14, Table 15, and Table 16 is made by the region of residence of the patient, , i.e. Flanders, Wallonia or Brussels. The hospital usage of foreign patients is attributed to the region of the treatment hospital. Licensed beds are allocated to the region of the treatment hospital.

Population ageing more pronounced in Flanders

The three Belgian regions differ substantially with respect to their population size and composition. In 2014, about 57.5% of the population resides in Flanders, 32% in Wallonia, and 10.5% in Brussels. The population shares hardly change between 2014 and 2025, with 57.4% of the population living in Flanders, 31.7% in Wallonia, and 10.9% in Brussels.

The effects of population ageing are more pronounced in Flanders than in the other two regions, especially Brussels has a relatively younger population. In 2014, the share of over 75 [65] year olds equals 9.7% [19.3%], 8.5% [17.5%] and 6.8% [13.2%] in Flanders, Wallonia and Brussels, respectively. In 2025, these shares amount to 11% [22.5%], 9.6% [20.7%] and 6.4% [13.3%] in Flanders, Wallonia and Brussels, respectively. As can be seen in Table 5, ageing is generally associated with increased hospital usage. Hence, in comparison to the population share, we expect a more important share in hospital care use in Flanders and Wallonia compared to Brussels.

Regional differences in hospital usage pattern

Table 14, Table 15, and Table 16 indeed reveal important differences with respect to hospital usage. The results include summary forecasts for all hospitals (including isolated categorical hospitals) and all patients, both living in Belgium and abroad. We draw 5 main conclusions.

First, day-care activity is significantly more developed in Flanders than in the other regions and given the continuation of historic trends, the gap with the other regions will further increase if no policy action is undertaken to level out the regional differences. The share in day-care volume of patients living in Flanders amounts to 65%, compared to 27.2% and 7.7% for individuals residing in Wallonia and Brussels. The Flemish share further increases to 65.3%. This is almost 8 percentage points above the population share.

Second, the division in inpatient stays more closely resembles the population share. 58.1%, 32.9% and 9% of all inpatient stays are attributable to patients located in Flanders, Wallonia and Brussels, respectively. While there is a projected increase in inpatient stays in all regions, the projected need grows more or less equal in all regions between 2014 and 2025 and the respective relative shares barely change. It is remarkable that the need for hospital care for the population in Brussels increases almost with the same growth rate as in Flanders, despite the more important population ageing in Flanders. This can be explained by the more important increase in population size in Brussels.

Third, the ALOS differs importantly in the three regions. In 2014, the ALOS for individuals living in Brussels equals 8.28 days which is almost 1 day longer than for patients residing in Wallonia where the ALOS amounts to 7.26 days. In Flanders hospital stays are shortest with a duration of 6.85 days in 2014. Hence, despite the relatively older population, the number of inpatient days is relatively smaller in Flanders with a share of 56%, compared to 33.5% in Wallonia and 10.5% in Brussels. The trend projections for the ALOS show a stronger decline in Brussel and Wallonia, so that their respective shares in inpatient days decline slightly over time.

The care needs or usage patterns vary in the different regions. In Flanders there is a high and increasing need for G-beds. The forecast results additionally show an important future need for S-beds. The population in Brussels has a stronger need for M- and E-beds. Given the decrease in ALOS, the normative need for M- and E-beds reduces by about 18% and 11% in 2025, both in in Flanders and Wallonia. For the population in Brussels, on the other hand, the projected decrease in M-beds is smaller, about 12%, and the forecasts indicate a status quo in the need for E-beds. Moreover, in Brussels the projections indicate a rise in the need for chronic (S-)beds and at the same time a decline in the number of G-beds. This indicates that the increase in chronic beds is not solely related to population ageing, but also to a shift from acute care beds to chronic care beds. The Walloon population has a share in I-beds (37.3%) and N-beds (34%) well-above the relative part in the population.

Finally, the comparison between normative bed needs based on the residence of the patient and the licensed beds in 2014, based on the location of the hospital is somewhat artificial. In Brussels, the number of licensed beds is well-above the current and projected bed need, as shown in Table 16. In the other regions the gap is much smaller. In Wallonia, the normative need is even equal to or above the number of licensed beds for bed types D, G and I. The reason is of course that the high concentration of hospitals in Brussels attracts patients from across its regional border. This is less the case in Flanders and Wallonia.

Table 14 – Summary of baseline forecast results and bed capacity for Flanders: all hospitals, for years 2005, 2010, 2014, 2020, 2025

	2005	2010	2014	Licensed beds 2014*	2020	2025	Abs. difference 2014-2025	Abs. difference Licensed-2025	Rel. difference 2014-2025	Rel. difference Licensed-2025
Day-care stays	906 846♣	1 610 919	1 833 791		2 171 148	2 454 027	620 236		33.8%	
Bed types day care										
Medical places	2 357	4 921	5 720		6 855	7 777	2 057		36.0%	
Surgical places	1 270	1 523	1 615		1 830	2 039	424		26.3%	
Inpatient stays	1 005 392	1 055 081	1 080 052		1 147 663	1 215 479	135 427		12.5%	
Inpatient days	8 001 654	7 771 165	7 402 512		7 220 917	7 126 737	-275 775		-3.7%	
Bed types inpatient care										
Total beds	26 587	25 741	24 419	28 701	23 758	23 379	-1 040	-5 322	-4.3%	-18.5%
D	8 644	7 852	7 137	7 997	6 940	6 847	-290	-1 150	-4.1%	-14.4%
C	7 221	6 668	5 897	7 963	5 193	4 638	-1 259	-3 325	-21.3%	-41.8%
G	3 860	4 201	4 241	4 305	4 398	4 573	332	268	7.8%	6.2%
S (=S1, S2, S3, S4, S5, S6)	2 761	2 982	3 283	3 446	3 565	3 855	572	409	17.4%	11.9%
M	1 474	1 481	1 347	1 728	1 217	1 104	-243	-624	-18.0%	-36.1%
E	1 287	1 173	1 077	1 472	1 015	955	-122	-517	-11.3%	-35.1%
I	853	848	935	1 102	932	932	-3	-170	-0.3%	-15.4%
N (=NIC, N*)	485	513	478	653	475	453	-25	-200	-5.2%	-30.6%
L	2	3	2	8	2	2	0	-6	0.0%	-75.0%
BR	-	20	22	28	21	20	-2	-8	-9.1%	-28.6%

Note: including stays and days of foreign patients (i.e. patients living abroad) and stays and days in isolated categorical hospitals.

*♣ For day care the number of stays registered in 2006 is used; * The number of licensed beds is based on information from December 2014 provided by FPS Health. The official number is complemented with information from the file unitindex of the minimal hospital data to account for N*-beds and to create a division between BR-, C-, D-, E- and I-beds. Moreover, licensed CD-beds are attributed for 50% to C-beds and for 50% to D-beds. Note that licensed beds are determined based on the hospital located in the region whereas necessary beds are determined based on the region of residence of the patient.*

Table 15 –Summary of baseline forecast results for Wallonia: all hospitals, for years 2005, 2010, 2014, 2020, 2025

	2005	2010	2014	Licensed beds 2014*	2020	2025	Abs. difference 2014-2025	Abs. difference Licensed-2025	Rel. difference 2014-2025	Rel. difference Licensed - 2025
Day-care stays	371 622♠	715 381	768 100		897 543	1 011 438	243 338		31.7%	
Bed types day care										
Medical places	957	2 242	2 395		2 836	3 206	811		33.9%	
Surgical places	530	620	678		755	840	162		23.9%	
Inpatient stays	578 637	593 513	611 385		641 242	679 259	67 874		11.1%	
Inpatient days	4 727 404	4 522 200	4 439 888		4 243 765	4 216 069	-223 819		-5.0%	
Bed types inpatient care										
Total beds	15 766	15 046	14 699	16 158	14 030	13 898	-801	-2 260	-5.4%	-14.0%
D	5 334	4 879	4 755	4 755	4 610	4 589	-166	-166	-3.5%	-3.5%
C	4 300	3 744	3 384	4 396	2 933	2 611	-773	-1 785	-22.8%	-40.6%
G	1 716	1 912	2 154	2 035	2 078	2 203	49	168	2.3%	8.3%
S (=S1, S2, S3, S4, S5, S6)	1 801	1 994	1 985	2 069	2 108	2 299	314	230	15.8%	11.1%
M	967	917	811	995	732	668	-143	-327	-17.6%	-32.9%
E	744	639	630	800	593	560	-70	-240	-11.1%	-30.0%
I	565	621	665	626	661	667	2	41	0.3%	6.5%
N (=NIC, N*)	337	330	305	467	306	293	-12	-174	-3.9%	-37.3%
L	2	2	2	0	2	2	0	2	0.0%	-
BR	-	8	8	16	7	6	-2	-10	-25.0%	-62.5%

Note: including stays and days of foreign patients (i.e. patients living abroad) and stays and days in isolated categorical hospitals.

*♠ For day care the number of stays registered in 2006 is used; * The number of licensed beds is based on information from December 2014 provided by FPS Health. The official number is complemented with information from the file unitindex of the minimal hospital data to account for N*-beds and to create a division between BR-, C-, D-, E- and I-beds. Moreover, licensed CD-beds are attributed for 50% to C-beds and for 50% to D-beds. Note that licensed beds are determined based on the hospital located in the region whereas necessary beds are determined based on the region of residence of the patient.*

Table 16 – Summary of baseline forecast results for Brussels: all hospitals, for years 2005, 2010, 2014, 2020, 2025

	2005	2010	2014	Licensed beds 2014*	2020	2025	Abs. difference 2014-2025	Abs. difference Licensed-2025	Rel. difference 2014-2025	Rel. difference Licensed - 2025
Day-care stays	111 591♠	223 423	218 140		257 855	289 530	71 390		32.7%	
Bed types day care										
Medical places	289	708	670		800	900	230		34.3%	
Surgical places	157	185	203		232	258	55		27.1%	
Inpatient stays	165 661	166 315	167 657		178 368	187 994	20 337		12.1%	
Inpatient days	1 558 671	1 476 164	1 388 892		1 328 452	1 294 449	-94 443		-6.8%	
Bed types inpatient care										
Total beds	5 174	4 871	4 572	7 136	4 375	4 256	-316	-2 880	-6.9%	-40.4%
D	1 429	1 269	1 134	1 887	1 111	1 097	-37	-790	-3.3%	-41.8%
C	1 253	1 009	833	1 952	728	648	-185	-1 304	-22.2%	-66.8%
G	820	906	907	1 052	817	785	-122	-267	-13.5%	-25.4%
S (=S1, S2, S3, S4, S5, S6)	704	754	743	895	774	812	69	-83	9.3%	-9.3%
M	382	406	387	453	364	341	-46	-112	-11.9%	-24.7%
E	253	218	245	379	251	248	3	-131	1.2%	-34.6%
I	157	166	183	298	182	181	-2	-117	-1.1%	-39.3%
N (=NIC, N*)	146	110	112	191	120	118	6	-73	5.4%	-38.2%
L	30	32	28	30	28	26	-2	-4	-7.1%	-13.3%
BR	-	1	0	0	0	0	0	0	-	-

Note: including stays and days of foreign patients (i.e. patients living abroad) and stays and days in isolated categorical hospitals.

*♠ For day care the number of stays registered in 2006 is used; * The number of licensed beds is based on information from December 2014 provided by FPS Health. The official number is complemented with information from the file unitindex of the minimal hospital data to account for N*-beds and to create a division between BR-, C-, D-, E- and I-beds. Moreover, licensed CD-beds are attributed for 50% to C-beds and for 50% to D-beds. Note that licensed beds are determined based on the hospital located in the region whereas necessary beds are determined based on the region of residence of the patient.*

1.8 Projection results scenario with accelerated substitution to day care

In this section, we evaluate the potential effects of a health care policy aimed at incentivizing the substitution from inpatient care to day care for a number of surgical procedures and chemotherapy. The baseline forecast results already project a steady growth in day-care activity between 2014 and 2025 in continuation of past trends and the demographic evolution.

As discussed in section 1.5.2, substitution from inpatient care to day care partially explains the substantial growth of day-care activity in the past and its projected increase in the baseline forecast results. The substitution effects that we are quantifying in this section come on top of effects already incorporated in the baseline forecasts. They could relate to the introduction of new healthcare policy aimed to speed up the shift of certain surgical procedures and chemotherapy to a day-care setting, e.g. by providing financial incentives favouring day-care procedures, and/or by developing clear clinical guidelines and pathways, and/or by expanding the availability and expertise of community care services.[71] Alternatively the effects could be the result of a (disruptive) innovation that allows to perform certain procedures better in a day-care setting (e.g. new surgical or aesthetic techniques).

Substitution of day surgery

Based on the analyses performed for the KCE report 282, we have selected 134 surgical procedures (see section 1.8.1 for the selection criteria) for which the substitution from inpatient to day care could be accelerated.[71] For each of these procedures, the day-surgery rate in 2014 – the last available data year – of each hospital is computed. The aim is to build a policy scenario of accelerated day-care substitution by raising the day-surgery rate in hospitals performing below a pre-determined threshold. We analyse two scenarios with different threshold values:

- In a first scenario, the threshold equals the national proportion of the surgical procedure performed in day care over the period 2011 to 2013 by hospitals that performed at least 10 of these procedures in that period.
- In a second scenario, the threshold is set at the P75 value (i.e. 75% of the hospitals have a day-surgery rate below the pre-determined threshold). As for the national average, the P75 value is computed over the period 2011 to 2013 including only hospitals that performed at least 10 of these procedures in that period. The second scenario has a more ambitious substitution objective.

In both scenarios, the substitution effects are gradually superadded to the baseline results over the period 2018 to 2022. From that point onwards the policy – i.e. the threshold targets set out by the scenario – will have reached its full potential.

Remark that this policy change is limited in scope, since it only concerns surgical day care. Surgical day care covers about 22% of total day-care activity in Belgium (see Table 12), whereas medical day care (including the mini lump sum) has a share of 78%. However, our focus is on the former, given that detailed and up-to-date information to develop realistic scenarios is readily available for day surgery thanks to the recent KCE report 282, in which the potential for a further expansion of day surgery in Belgium is analysed.[71]

Substitution of chemotherapy

In a third scenario, the substitution for day surgery is the same as in the second scenario. However, we add substitution from inpatient to medical day care for chemotherapy (APR-DRG 693). We assume that all inpatient stays with a duration of 2 days or less will be gradually shifted to medical day care between 2018 and 2022.

Overview

In short, we evaluate the following three scenarios:

- Scenario 1: Accelerated substitution to day surgery for 134 surgical procedures in hospitals with a share in day surgery below the national average.
- Scenario 2: Accelerated substitution to day surgery for 134 surgical procedures in hospitals with a share in day surgery below the P75 value.
- Scenario 3: Accelerated substitution to day surgery for 134 surgical procedures in hospitals with a share in day surgery below the P75 value. Accelerated substitution to chemotherapy for short inpatient stays (LOS ≤ 2 nursing days).

In what follows, we first detail the methodology of the scenario analysis and subsequently discuss the results.

1.8.1 Methodology

List of selected surgical procedures

In a first step, a list is drawn up of surgical procedures which can be safely performed in a day-care setting. The list comprises 134 procedures which satisfy three criteria:

1. During the period 2011 to 2013, the surgical procedure was performed on average 400 times per year either in an inpatient or day care setting. The threshold of 400 stays intends to single out surgical procedures which are large enough so that substitution from inpatient care to day care might have a noticeable effect on the required hospital capacity.
2. During the period 2011 to 2013, the surgical procedure was performed in a day-care setting for at least 5% and at most 90% of the cases. The rationale for the lower threshold is a reassurance that the surgical procedure can effectively be performed in day care. Procedures with a share in day care above the upper threshold can in the future only benefit from small substitution gains and are therefore not included in the scenario analysis.
3. During expert meetings organized by the KCE in the context of report 282, a majority of experts has not qualified the procedure as impossible to perform in day care.[71]

More information on the selected surgical procedures can be found in the Data Manual (available upon request).

Selection of hospital stays to be substituted

In a second step, the day-surgery rate is computed for each hospital and each procedure separately using the hospital registration data of 2014, i.e. the last available data year. The calculations only include hospital stays where the patient is alive at the time of discharge, the stay is non-urgent and is assigned a severity of illness level of 1 or 2.

For each procedure, hospitals with a proportion of day-care procedures above the scenario-specific policy threshold are considered not affected by the policy incentives. No additional substitution on top of the baseline trends is modelled for these hospitals.

For each hospital below the threshold, we quantify the substitution potential, i.e. the number of inpatient stays that needs to be shifted to day surgery in order to surpass the scenario-specific policy threshold. This substitution potential equals the total number of stays on which the procedure was performed in 2014, comprising both inpatient and day care, multiplied by the difference between the policy threshold and the hospital-specific day-surgery rate in 2014. In order to get an integer value, this number is rounded upwards.

Once the substitution potential is determined for each procedure and hospital, a selection of substitutable inpatient stays is made. Substitutable inpatient stays are selected per procedure and hospital until the substitution potential is reached, applying the following selection order:

1. Preference for inpatient stays in bed types ‘C’ or ‘D’ and not in bed types related to chronic or intensive care, i.e. ‘I’, ‘S1’, ‘S2’, ‘S3’, ‘S4’, ‘S5’, ‘S6’.
2. Preference for inpatient stays that have only one of the selected surgical procedures.

3. Preference for inpatient stays that are classified as ‘elective’.
4. Preference for inpatient stays of patients residing in Belgium, since we have superior demographic information about these patients.
5. Preference for inpatient stays with lower LOS.
6. Preference for inpatient stays with lower SOI.
7. Preference for inpatient stays of patients with lower age.

Except for criterion 4, this order is chosen to reflect the increased likelihood that inpatient stays can be shifted to day care.

Selection of substitutable chemotherapy stays

The group of selected substitutable chemotherapy stays is more easily identified. It comprises all inpatient stays in APR-DRG 693 ‘Chemotherapy’ with a duration of two days or less in 2014, irrespective of the hospital. In the subsequent analysis, they are treated similar to the selected substitutable day-surgery stays.

Effects and timing of the policy

Selected substitutable stays are tagged and are gradually shifted from inpatient care to day care between 2018 and 2022. It is assumed that the potential policy is introduced in 2017/2018. Each year 20% of the additional substitution effort is effectively carried out, with the first achievements perceptible in 2018. More specifically, this means that for the scenario results in 2018, 80% of the selected substitutable stays are still counted as inpatient stays while 20% is shifted to day care. The weight factors for inpatient/day care used to obtain the scenario results are adjusted to 60/40, 40/60 and 20/80 in the years 2019, 2020 and 2021, respectively. From 2022 onwards, the substitution policy has reached its full potential and the selected substitutable stays are fully attributed to day care.

Aside from the additional substitution from inpatient care to day care, all scenario results account for the baseline trends in ALOS, admission rates and demographics. The difference between the baseline forecast results and the scenario results can be entirely attributed to the assumed policy change.

Figure 30 – Hospital inpatient stays: observed evolution, baseline forecast results and scenario results for substitution to day care

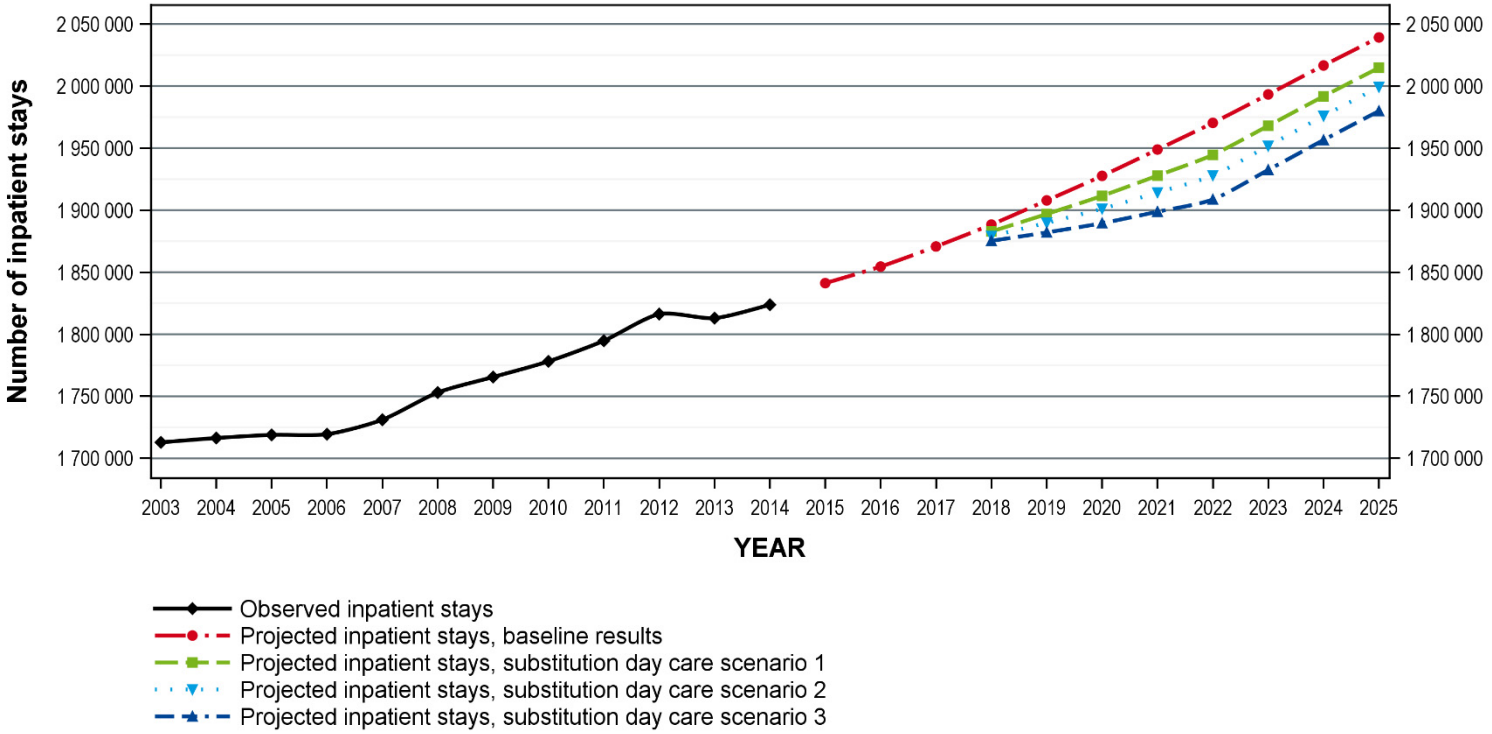


Figure 31 – Hospital inpatient days: observed evolution, baseline forecast results and scenario results for substitution to day care

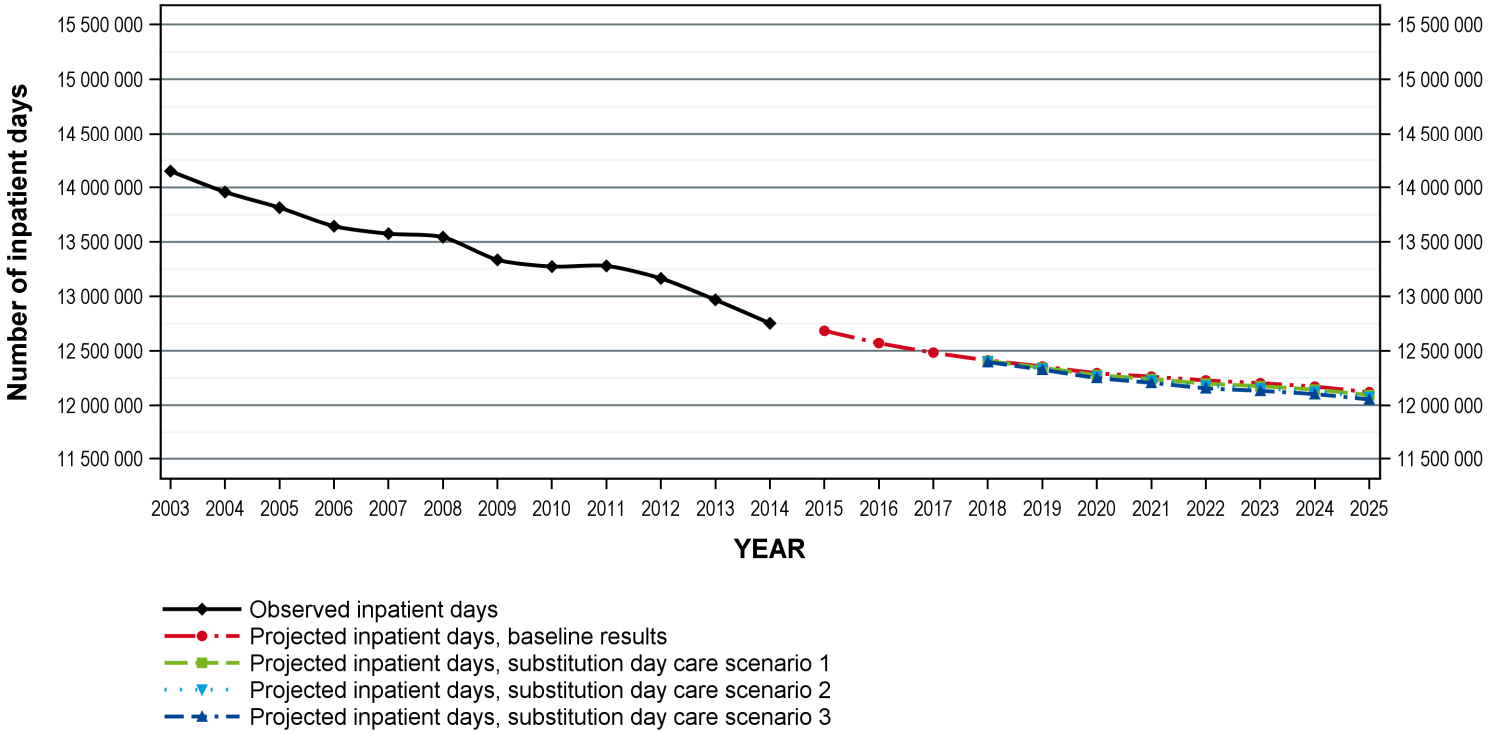
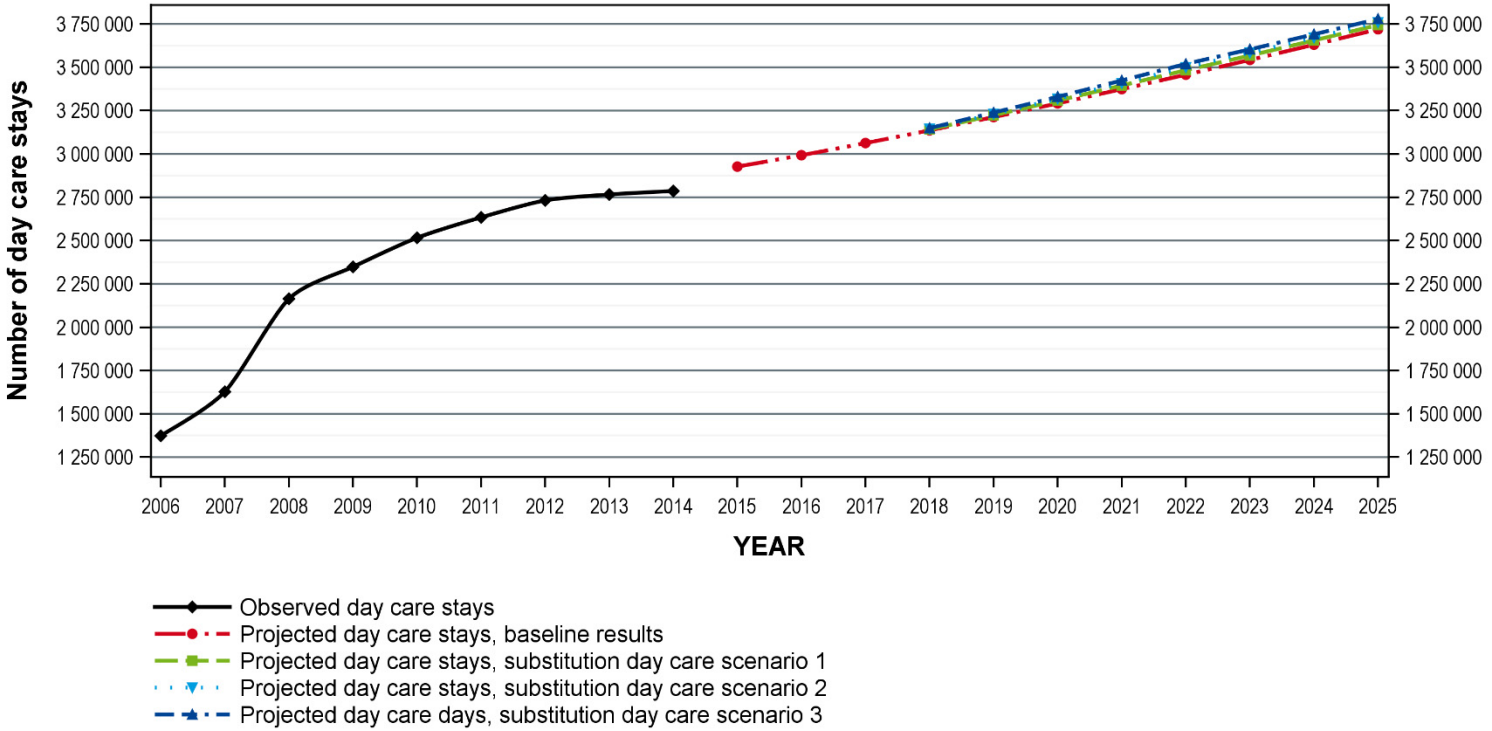


Figure 32 – Hospital day care: observed evolution, baseline forecast results and scenario results for substitution to day care



1.8.2 Results

Figure 30, Figure 31 and Figure 32 show the scenario results at the national level for hospital inpatient stays, inpatient days and day-care activity, respectively. In each figure, the baseline forecast results are added as point of comparison (see Figure 16, Figure 19, Figure 26). As before, the forecast results in the figures do not include capacity for foreign patients nor isolated categorical hospitals.

The main results, including bed capacity requirements, are summarized for the different scenarios separately in Table 17, Table 18 and Table 19 The tables not only show the scenario results, but also the difference with the baseline forecasts. The forecast results in the tables incorporate capacity requirements of all patients residing in Belgium and of foreign patients, but exclude capacity in isolated categorical hospitals.

Limited substitution effects

The policy impact on the number of inpatient stays, days and day-care volume in the three scenarios is limited. By 2020, we project that on top of the baseline changes about 16 000, 27 000, and 38 500 inpatient stays are shifted to day care in scenario 1 to 3, respectively. By 2025, the number of substituted inpatient stays rises to about 24 500, 40 000, and 60 000, respectively. As such, the substitution effect amounts to 1.3%, 2.2%, and 3.3% of the number of inpatient stays registered in 2014. The magnitude of the effect is comparable to the effect of the increase in admission rates on inpatient stays (see section 1.7.1.1).

As there are more day-care stays, the substitution effect is more modest when expressed in terms of day-care stays. It equals 0.9%, 1.4%, and 2.1% of the number of day-care stays registered in 2014 in scenario 1 to 3, respectively.

In scenarios 1 and 2, only policy effects of a shift to day surgery are simulated. Hence, it makes sense to evaluate its relative impact on day surgery exclusively. The policy contributes to a non-negligible increase of 3.9 or 6.4 percentage points on top of the (much) more important increase projected in the baseline results. In scenarios 1 and 2, there is no change in medical day care.

The effect of a further expansion of chemotherapy in a day-care setting is limited. The majority of hospital visits related to chemotherapy already occur in day care, i.e. 365 000 stays in day care compared to 27 000 inpatient stays. The projections show that by 2025 an additional 20 000 stays can be shifted to medical day care. This leads to a further need of 79 places in medical day care or an increase of almost 1 percentage point in addition to the capacity expansion projected in the baseline results. The restriction of the third scenario to chemotherapy is a methodological choice (i.e. the ease of identifying patients in the administrative data) which is an important study limitation given that chemotherapy represent only a fraction of medical inpatient stays with the potential to be shifted to day care.

The reduction in the number of inpatient days is of the same magnitude as the number of substituted inpatient stays, with a decline in 2025 by about 26 500, 44 500 and 68 000 inpatient days in scenario 1 to 3, respectively. The close correspondence between the number of inpatient stays and days reflects the short LOS of the substitutable stays. In 2014, 84.6%, 81.5%, and 78.9% of all selected substitutable stays had a duration of 1 day in scenario 1 to 3, respectively. In addition, 10.7%, 12.6% and 21.1% of all selected substitutable stays had a duration of 2 days in scenario 1 to 3, respectively. In relative terms, the number of inpatient days is reduced with an additional 0.2, 0.3 or 0.5 percentage points by 2025 in scenario 1 to 3, respectively. Figure 31 illustrates the limited effect.

Further reduction of C and D-beds

The effects of a policy supporting day surgery on bed capacity are straightforward (see Table 17 and Table 18). The number of inpatient beds dedicated to surgical procedures (C-beds) can be further reduced, on top of the cutbacks predicted in the baseline results. The number of surgical day-care places needs to be increased to accommodate the influx of substituted procedures. Other bed types are hardly affected.

The further expansion of chemotherapy, on the other hand mainly affects the number of D-beds, with a projected potential decline of 76 beds (see Table 19).

Discussion

The effects of a policy supporting the expansion of day care has limited effects on the number of substituted inpatient stays, days and the reduction in inpatient bed capacity. The effect on total day-surgery activity is somewhat more pronounced, but still rather small in comparison with the projected increase in the baseline forecast results. An accelerated transfer of the remaining inpatient stays in chemotherapy to day care has only small effects on medical day care. As medical day care constitutes 78% of total day care volume, any policy that aims at enhancing substitution to day care in a more ambitious way probably needs to target a large range of medical procedures as well.

In addition, it seems that incentivizing day care only for procedures that are already being sufficiently performed in a day-care setting in Belgium, such as chemotherapy and most of the selected surgical procedures, will only generate small substitution effects. If substitution is desirable from a policy perspective, one should consider increasing incentives for surgical procedures that are currently not performed (or very limited) in day care in Belgium, but have good prospects to be performed in day care in the future. For this, one can look at medical practices and experience in other countries, follow-up on medico-technical progress, or facilitate the development of well-adapted organisational circumstances to allow shorter stays and transfer activity to day care.

Table 17 – Summary of forecast results of day care substitution scenario 1 at the national level

	2014	Licensed beds 2014*	2020	Difference with baseline	2025	Difference with baseline	Abs. difference 2014-2025	Rel. difference 2014-2025	Difference with baseline
Day-care stays	2 820 031		3 342 723	16 156	3 779 540	24 542	959 509	34.0%	0.9%
Bed types day care									
Medical places	8 784		10 490	0	11 883	0	3 099	35.3%	0.0%
Surgical places	2 496		2 880	64	3 235	98	739	29.6%	3.9%
Inpatient stays	1 851 612		1 942 431	-16 132	2 048 253	-24 503	196 641	10.6%	-1.3%
Inpatient days	12 906 895		12 429 767	-16 846	12 242 296	-26 535	-664 599	-5.1%	-0.2%
Bed types inpatient care									
D	13 026	14 638	12 660	-1	12 532	-1	-494	-3.8%	-0.0%
C	10 114	14 310	8 798	-56	7 813	-84	-2 301	-22.8%	-0.8%
G	7 246	7 340	7 243	-1	7 515	0	269	3.7%	0.0%
S (=S1, S2, S3, S4, S5, S6)	5 080	5 439	5 441	0	5 890	-1	810	15.9%	-0.0%
M	2 545	3 176	2 313	0	2 113	0	-432	-17.0%	0.0%
E	1 951	2 651	1 858	-2	1 761	-2	-190	-9.7%	-0.1%
I	1 784	2 026	1 776	0	1 780	-1	-4	-0.2%	-0.1%
N (=NIC, N*)	895	1 311	900	0	864	0	-31	-3.5%	0.0%
L	33	38	32	0	30	0	-3	-9.1%	0.0%
BR	30	44	28	0	26	0	-4	-13.3%	0.0%

Note: including stays and days of foreign patients (i.e. patients living abroad)

** The number of licensed beds is based on information from December 2014 provided by FPS Health. The official number is complemented with information from the file unitindex of the minimal hospital data to account for N*-beds and to create a division between BR-, C-, D-, E- and I-beds. Moreover, licensed CD-beds are attributed for 50% to C-beds and for 50% to D-beds. The number of licensed beds does not account for beds of categorical hospitals which fall under the competence of the communities.*

Table 18 – Summary of forecast results of day care substitution scenario 2 at the national level

	2014	Licensed beds 2014*	2020	Difference with baseline	2025	Difference with baseline	Abs. difference 2014-2025	Rel. difference 2014-2025	Difference with baseline
Day-care stays	2 820 031		3 353 284	26 717	3 795 277	40 279	975 246	34.6%	1.4%
Bed types day care									
Medical places	8 784		10 490	0	11 883	0	3 099	35.3%	0.0%
Surgical places	2 496		2 922	106	3 297	160	801	32.1%	6.4%
Inpatient stays	1 851 612		1 931 863	-26 700	2 032 514	-40 242	180 902	9.8%	-2.2%
Inpatient days	12 906 895		12 416 934	-29 679	12 224 228	-44 603	-682 667	-5.3%	-0.3%
Bed types inpatient care									
D	13 026	14 638	12 660	-1	12 532	-1	-494	-3.8%	-0.0%
C	10 114	14 310	8 756	-98	7 757	-140	-2 357	-23.3%	-1.4%
G	7 246	7 340	7 243	-1	7 515	0	269	3.7%	0.0%
S (=S1, S2, S3, S4, S5, S6)	5 080	5 439	5 441	0	5 890	-1	810	15.9%	-0.0%
M	2 545	3 176	2 313	0	2 113	0	-432	-17.0%	0.0%
E	1 951	2 651	1 857	-3	1 760	-3	-191	-9.8%	-0.2%
I	1 784	2 026	1 775	-1	1 780	-1	-4	-0.2%	-0.1%
N (=NIC, N*)	895	1 311	900	0	864	0	-31	-3.5%	0.0%
L	33	38	32	0	30	0	-3	-9.1%	0.0%
BR	30	44	28	0	26	0	-4	-13.3%	0.0%

Note: including stays and days of foreign patients (i.e. patients living abroad)

** The number of licensed beds is based on information from December 2014 provided by FPS Health. The official number is complemented with information from the file unitindex of the minimal hospital data to account for N*-beds and to create a division between BR-, C-, D-, E- and I-beds. Moreover, licensed CD-beds are attributed for 50% to C-beds and for 50% to D-beds. The number of licensed beds does not account for beds of categorical hospitals which fall under the competence of the communities.*

Table 19 – Summary of forecast results of day care substitution scenario 3 at the national level

	2014	Licensed beds 2014*	2020	Difference with baseline	2025	Difference with baseline	Abs. difference 2014-2025	Rel. difference 2014-2025	Difference with baseline
Day-care stays	2 820 031		3 365 125	38 558	3 815 134	60 136	995 103	35.3%	2.1%
Bed types day care									
Medical places	8 784		10 539	49	11 964	81	3 180	36.2%	0.9%
Surgical places	2 496		2 922	106	3 297	160	801	32.1%	6.4%
Inpatient stays	1 851 612		1 920 018	-38 545	2 012 656	-60 100	161 044	8.7%	-3.2%
Inpatient days	12 906 895		12 402 011	-44 602	12 200 852	-67 979	-706 043	-5.5%	-0.5%
Bed types inpatient care									
D	13 026	14 638	12 612	-49	12 457	-76	-569	-4.4%	-0.6%
C	10 114	14 310	8 754	-100	7 755	-142	-2 359	-23.3%	-1.4%
G	7 246	7 340	7 243	-1	7 515	0	269	3.7%	0.0%
S (=S1, S2, S3, S4, S5, S6)	5 080	5 439	5 441	0	5 890	-1	810	15.9%	-0.0%
M	2 545	3 176	2 313	0	2 113	0	-432	-17.0%	0.0%
E	1 951	2 651	1 856	-4	1 757	-6	-194	-9.9%	-0.3%
I	1 784	2 026	1 775	-1	1 780	-1	-4	-0.2%	-0.1%
N (=NIC, N*)	895	1 311	900	0	864	0	-31	-3.5%	0.0%
L	33	38	32	0	30	0	-3	-9.1%	0.0%
BR	30	44	28	0	26	0	-4	-13.3%	0.0%

Note: including stays and days of foreign patients (i.e. patients living abroad)
** The number of licensed beds is based on information from December 2014 provided by FPS Health. The official number is complemented with information from the file unitindex of the minimal hospital data to account for N*-beds and to create a division between BR-, C-, D-, E- and I-beds. Moreover, licensed CD-beds are attributed for 50% to C-beds and for 50% to D-beds. The number of licensed beds does not account for beds of categorical hospitals which fall under the competence of the communities.*

1.9 Projection results scenario with accelerated population ageing

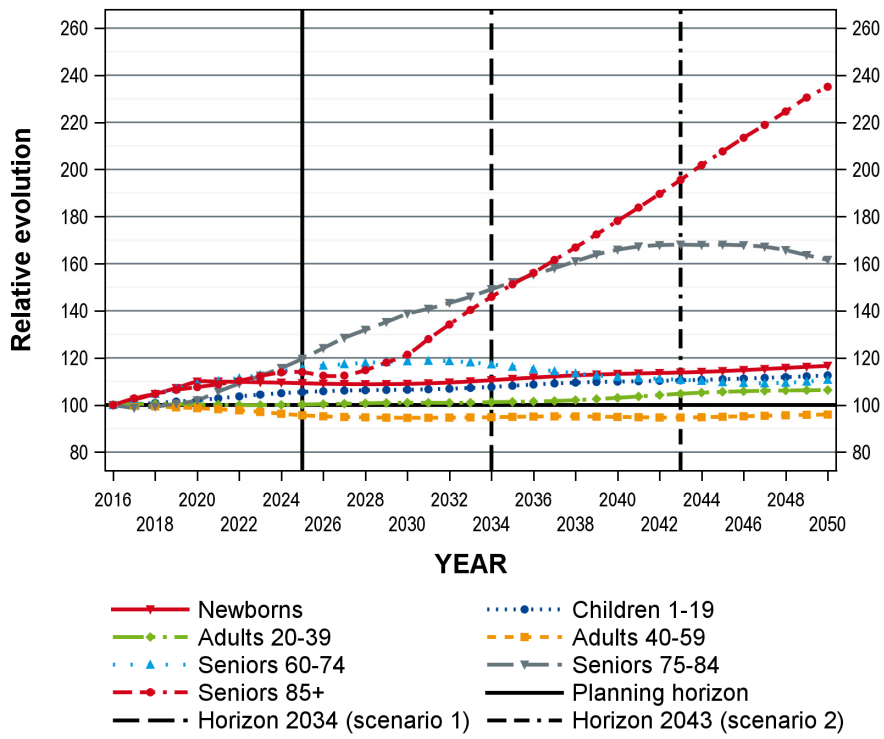
In this section, the effects of accelerated population ageing on the requirements for hospital capacity are explored. As is shown in Figure 33, the ageing of the population will accelerate from 2030 onwards, beyond the planning horizon applied in this report. Especially the number of individuals aged 75 or more will increase at rapid pace. It is already established in section 1.7 that the increase in hospital care is driven by population dynamics in older age categories. Hence, the population ageing beyond 2030 is expected to exert a strong upward effect on hospital care usage in the future. To account for future population ageing, we will elaborate two scenarios:

- Scenario 1: Accelerated population ageing through adjustments in the makeup of the population in line with the projected demographic evolution up to 2034.
- Scenario 2: Accelerated population ageing through adjustments in the makeup of the population in line with the projected demographic evolution up to 2043.

As can be seen in Table 5, older persons between 75 and 85 represent 6.4% of the population but account for 16.5% of all inpatient stays, 25.7% of all inpatient days and 13.5% of all day-care stays; older persons aged 85 or more represent 2.5% of the population but account for 8.8% of all inpatient stays, 17.5% of all inpatient days, and 3.4% of all day-care stays. There is a clear association between age and hospital care usage and hence an important leverage effect of population ageing on the need for hospital capacity.

The objective of the scenario analysis of accelerated ageing is to uncover and emphasize potential pressure points in the long-term. First the methodology of the scenario analysis is discussed and then the results are presented.

Figure 33 – Relative evolution of the population (Reference = 2016)



1.9.1 Methodology

Accelerated ageing is introduced in the model by modifying the population projections from 2017 onwards. Population projections are used to reweight hospital care usage by socio-demographic group (see sections 1.5.1.2 and 1.5.4.2).

Two scenarios to accelerate the effect of the ageing population

In the two scenarios that are developed, the population projections for 2015 and 2016 are used as they are and the pace of population ageing is adjusted afterwards:

- In the first scenario, the pace of population ageing is doubled from 2017 onwards. More specifically, this means, that for the year 2017, we use the population projections for 2018 to reweight hospital care usage, subsequently, we use the years 2020, 2022 … up to 2034. In the end, each projection year of the baseline results is matched to a new year. The trajectory is shown in Figure 34.
- In the second scenario, the pace of population ageing is tripled from 2017 onwards. More specifically, this means, that for the year 2017, we use the population projections for 2019 to reweight hospital care usage, subsequently, we use the years 2022, 2025 … up to 2043.

Important to the methodology is that only adjustments are made for the makeup of the population, not the population size. This allows to evaluate the effects of population ageing on hospital care use, independent from the effect of the change in population size on care usage. Hence, the years that are vertically below each other in Figure 34 have the same population size, corresponding to the baseline year, but differ in the age-gender distribution of the population. For example, when the baseline forecast year is 2017, the population size equals to 11 394 684 for the baseline as well as the two different ageing scenarios. However, the composition of the population in scenarios 1 and 2 differs from the baseline and corresponds to the distribution projected for 2018 and 2019, respectively. Figure 35 shows the difference in makeup of the population for the different scenarios corresponding to the baseline projection years 2020 and 2025. In both scenarios, an increase in the population share of individuals aged 75 or more is observed, compensated by a decrease in the population share primarily of individuals aged between 40 and 60. Moreover, at the end of the planning horizon it is also compensated by a decrease in the population share of individuals aged between 60 and 75. The change is more pronounced in scenario 2 where the difference with the baseline in population share of older persons above 75 years of age mounts to 5 percentage points.

The trend projections for ALOS and admission rates remain the same and correspond to the matching baseline projection year indicated in Figure 34.

Figure 34 – Timeline population projections for the scenario analysis

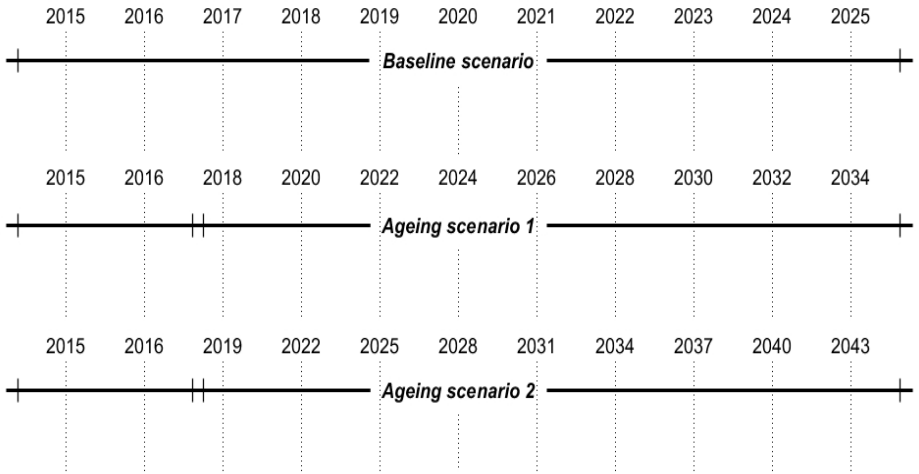
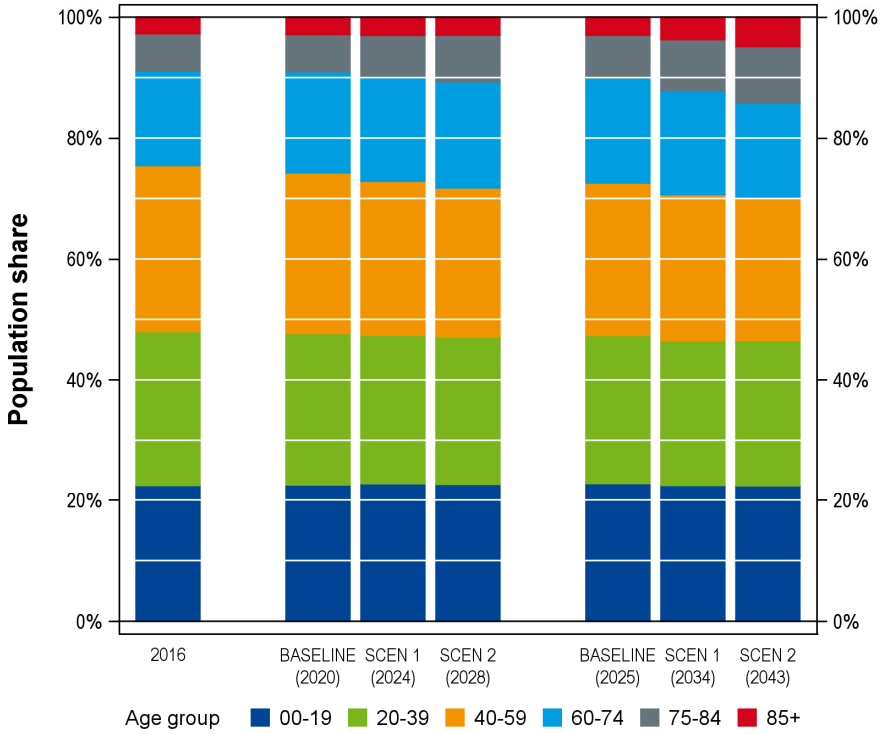


Figure 35 – Makeup of the population for the different scenarios for the baseline projection years 2016, 2020 and 2025



Not a forecast

Remark that the scenario results should not be interpreted as forecasts for the indicated years, given that the projections do not correct for population size and use different projection years for population composition and trends for ALOS and admission rates. They rather serve as illustration for future pressure points in hospital care capacity related to population ageing, and might give direction to healthcare policy in the longer term.

Neglecting the increase in population size leads to a downward bias in the scenario results. The mismatch between projection years for population composition and the trend for admission rates and ALOS is more difficult to predict. If admission rates continue to increase and ALOS continues to decrease well beyond 2025, the mismatch produces a downward bias in the scenario results related to the admission rates and an upward bias related to ALOS. However, it is difficult if not impossible to make such long-term predictions for the future evolution of both parameters.

1.9.2 Results

Figure 36, Figure 37 and Figure 38 show the scenario results at the national level for hospital inpatient stays, inpatient days and day-care activity, respectively. In each case, the baseline forecast results are added as point of comparison (see Figure 16, Figure 19, Figure 26). As explained above, the difference between the baseline results and scenario results is entirely driven by changes in the composition of the population. As before, the forecast results in the figures do not include capacity for foreign patients nor isolated categorical hospitals.

The main results, including bed capacity requirements, are summarized for each scenario separately in Table 20 and Table 22. The tables not only show the scenario results, but also the difference with the baseline forecasts. The forecast results in the tables incorporate capacity requirements of all patients residing in Belgium and of foreign patients. Forecast results for isolated categorical hospitals are not included in Table 20 and Table 22, but are provided separately in Table 21 and Table 23.

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Figure 36 – Hospital inpatient stays: observed evolution, baseline forecast results and scenario results for accelerated ageing

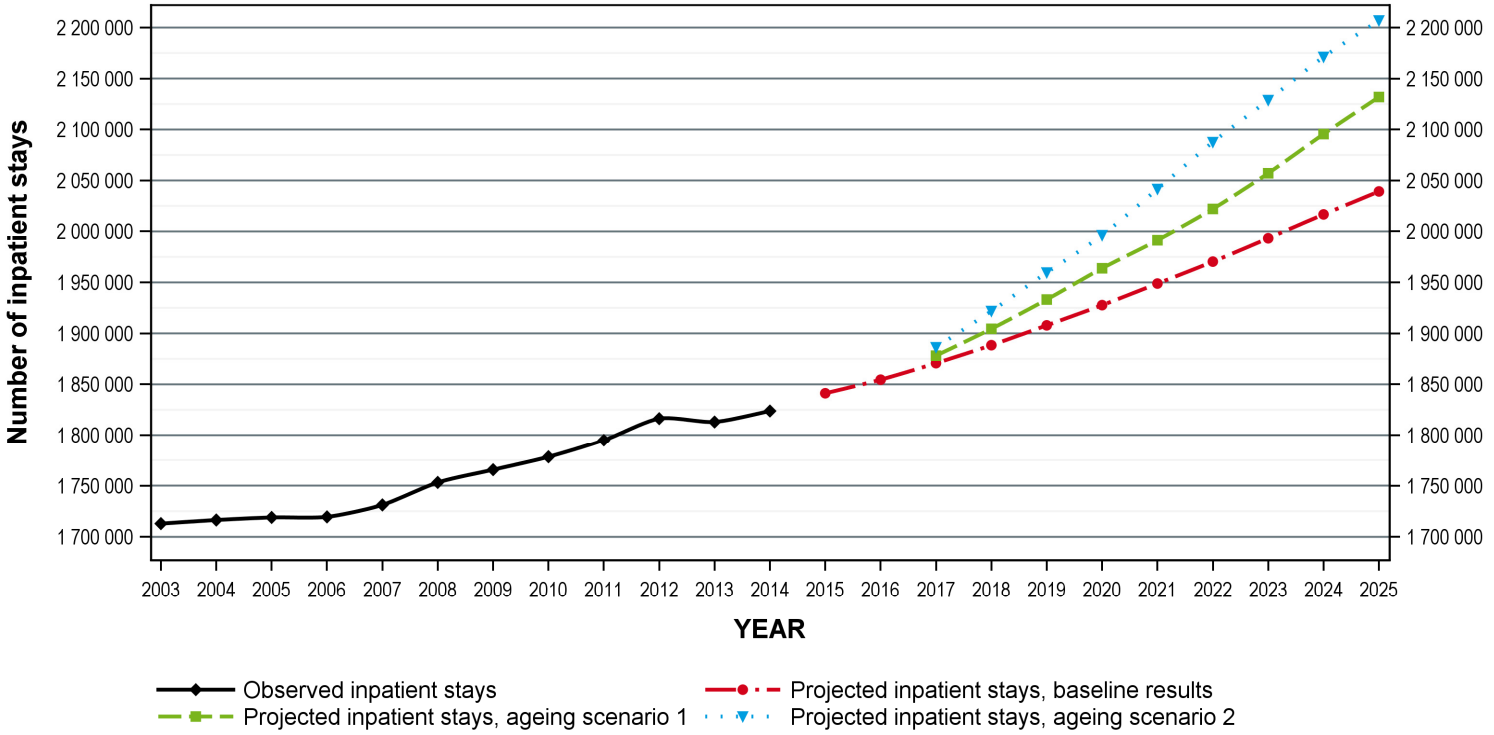


Figure 37 – Hospital inpatient days: observed evolution, baseline forecast results and scenario results for accelerated ageing

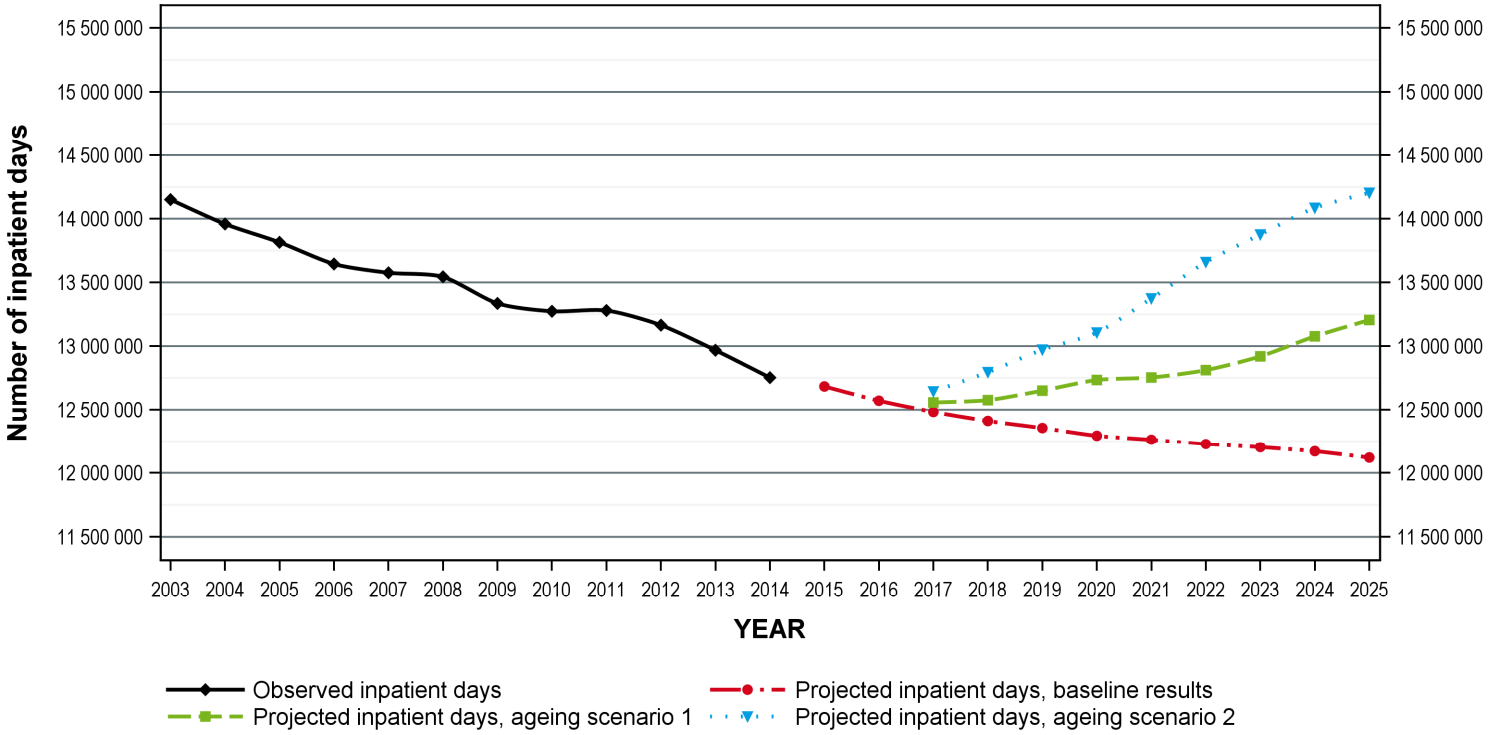
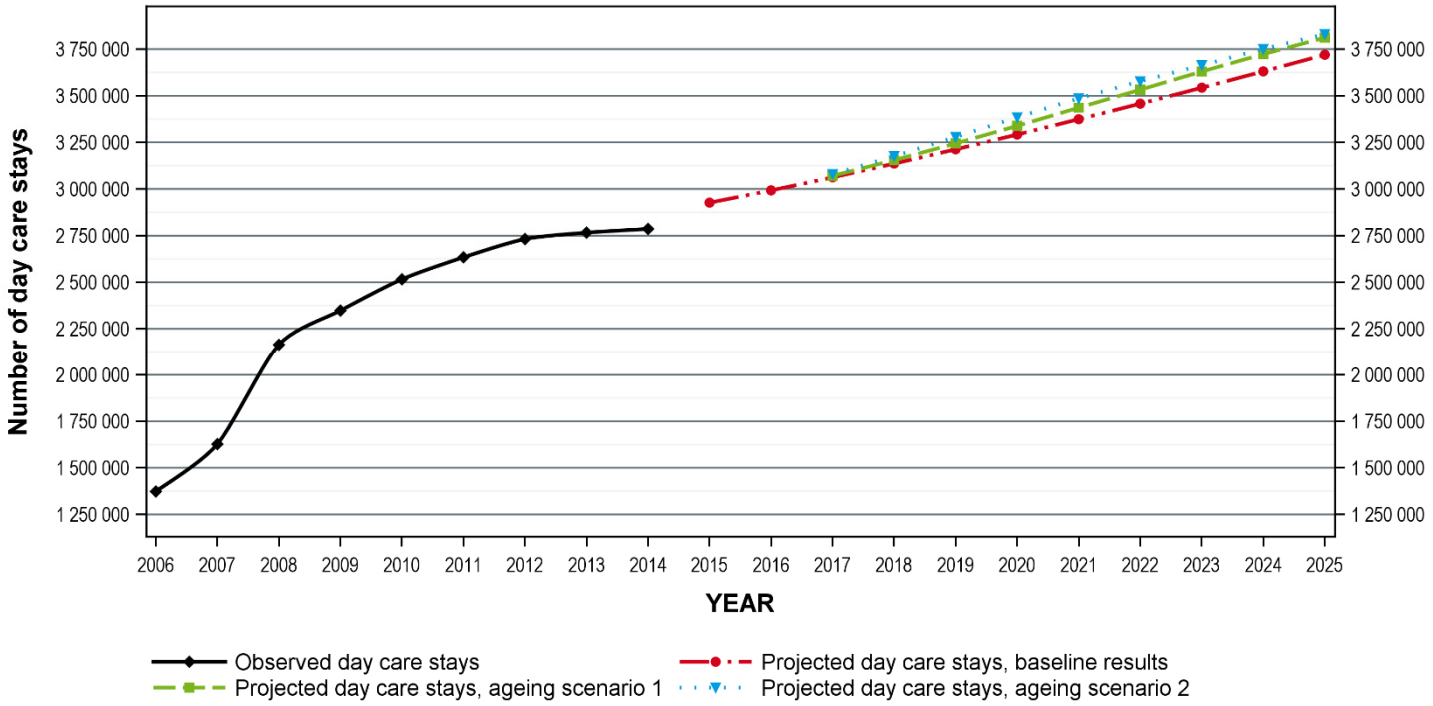


Figure 38 – Hospital day care: observed evolution, baseline forecast results and scenario results for accelerated ageing



Hospital activity increases sharply

Not surprisingly, the number of inpatient and day-care stays will both increase in case of accelerated population ageing. The upswing is more pronounced for inpatient care than for day care. Older persons aged 75 or more typically make more use of the hospital system, and inpatient care in particular. Therefore inpatient care is more responsive to population ageing. This is most noticeable when comparing the results for both scenarios in baseline projection year 2025. In this year, both scenarios differ significantly on the number of oldest old, i.e. the above 85 year olds (see Figure 35). This is associated with a clear difference in the projected number of inpatient stays in both scenarios (see Table 20 and Table 22): an additional 93 000 inpatient stays are projected in scenario 1 above the baseline, whereas in scenario 2 the difference rises to 168 000. For day-care activity on the other hand, the evolutions in scenario 1 and 2 are more similar having a difference with the baseline in 2025, equal to 91 000 and 110 000 stays for scenario 1 and 2, respectively.

Hospital inpatient days show a deviation from the trend once the accelerated ageing is introduced. Where the baseline results projected a decline in inpatient days, both ageing scenarios show an increase in days. This emphasizes the power of the leverage effect of an increased number of older persons on the Belgian hospital system.

Population ageing has a stronger impact on inpatient stays with long duration

The growth in inpatient stays related to population ageing is most pronounced for inpatient stays with a long duration. Again this is not surprising given that older patients are more likely to have more co-morbidities, a higher severity of illness and hence longer hospital stays. In addition, as we have elaborated above, older age groups make more use of chronic care (S-beds), care related to health status and aftercare which typically have a longer duration than other care types.

The ALOS of all inpatient stays can be computed as the ratio of inpatient days to inpatient stays. For the baseline forecast results, the ALOS in 2025 is 5.9 days (see Table 6 and Table 7), the additional stays due to population ageing have an ALOS of 11.7 days in scenario 1 and 12.4 days in scenario 2.

Bed capacity

The increase in inpatient stays with longer duration is further substantiated by the required bed types. In line with the baseline forecasts, but much more pronounced, bed capacity for S-beds and G-beds is projected to increase. In the scenarios of accelerated ageing, normative usage of G-beds will rise by 25% up to 51%, i.e. 22 and 47 percentage points above the baseline forecasts. Normative usage of S-beds will increase by 27% up to 36%, i.e. 11 and 20 percentage points above the baseline forecasts. For G-beds and – to a lesser extent – S-beds, normative usage in 2014 corresponds closely to the number of licensed beds, hence a substantial capacity extension is necessary.

Population ageing additionally leads to an increased need for D-beds, C-beds and I-beds. For all three bed types, the projected normative usage in 2025 remains below the number of licensed beds in both scenarios. Remark that D-beds and C-beds are sometimes used as an alternative for G-beds when the latter would actually be more appropriate but are unavailable due to capacity restrictions. In fact the increase might actually be a latent additional need for G-beds.

Finally, the projected decline in usage of M-beds, N-beds and E-beds is further intensified in the ageing scenarios as the relevant age groups get less weight.

Isolated categorical hospitals

The forecast results for categorical hospitals, presented in Table 21 and Table 23, show similar growth rates for chronic care as set out above. On top of the baseline increase in the number of S-beds, an additional normative need of 78 and 137 beds are projected in scenario 1 and 2, respectively. These cannot be accommodated by the current number of licensed S-beds in categorical hospitals.

Discussion

If it was not yet clear from the baseline results, the inpatient hospital admissions of older persons are an important future pressure point. The baseline results show that in the short to medium term, we could accommodate this in the current hospital capacity given the continued decline in ALOS, a reconversion of M-, E-, C-, D- and N-beds to G- and S-beds, and an increase in day-care activity.

However, as population ageing intensifies, this might no longer hold. There is an important leverage effect of population ageing on the need for hospital capacity. Future healthcare policy could consider various options to decrease the leverage effect by e.g. exploring and developing alternatives for hospital care specifically for the elderly, such as tele-health, home care, community care or care in nursing homes. However, the effects of such alternatives on hospital capacity should not be overestimated as is described elsewhere in this report (see Chapters 2 and 8).

As an alternative to or in combination with reducing the leverage effect, one could also further tap into efficiency gains through medico-technical and organisational innovations, e.g. by further reducing inpatient ALOS beyond 2030 or substitution from inpatient to day care. The previous scenario has shown that gains from enhanced substitution could be small (see section 1.8) and inpatient ALOS probably cannot be reduced limitless. Remark that the projected cutback in necessary hospital capacity in the baseline forecasts is driven by an important future decline in ALOS.

Another alternative option is to meet the increased need for hospital care induced by the ageing population by providing the required hospital capacity beyond 2030.

Table 20 – Summary of forecast results of ageing scenario 1 at the national level

	2014	Licensed beds 2014*	2020	Difference with baseline	2025	Difference with baseline	Abs. difference 2014-2025	Rel. difference 2014-2025	Difference with baseline
Day-care stays	2 820 031		3 373 074	46 507	3 846 402	91 404	1 026 371	36.4%	3.2%
Bed types day care									
Medical places	8 784		10 663	173	12 224	341	3 440	39.2%	3.9%
Surgical places	2 496		2 830	14	3 161	24	665	26.6%	1.0%
Inpatient stays	1 851 612		1 994 785	36 199	2 165 435	92 642	313 823	16.9%	5.0%
Inpatient days	12 906 895		12 886 150	439 552	13 354 417	1 085 580	447 522	3.5%	8.4%
Bed types inpatient care									
D	13 026	14 638	13 115	450	13 443	903	417	3.2%	6.9%
C	10 114	14 310	9 094	225	8 306	382	-1 808	-17.9%	3.8%
G	7 246	7 340	7 725	481	9 080	1 563	1 834	25.3%	21.6%
S (=S1, S2, S3, S4, S5, S6)	5 080	5 439	5 697	256	6 471	581	1 391	27.4%	11.4%
M	2 545	3 176	2 271	-43	2 067	-47	-478	-18.8%	-1.8%
E	1 951	2 651	1 858	-2	1 734	-29	-217	-11.1%	-1.5%
I	1 784	2 026	1 838	62	1 889	108	105	5.9%	6.1%
N (=NIC, N*)	895	1 311	880	-20	843	-19	-52	-5.8%	-2.1%
L	33	38	31	-1	30	0	-3	-9.1%	0.0%
BR	30	44	28	0	26	0	-4	-13.3%	0.0%

Note: including stays and days of foreign patients (i.e. patients living abroad)

** The number of licensed beds is based on information from December 2014 provided by FPS Health. The official number is complemented with information from the file unitindex of the minimal hospital data to account for N*-beds and to create a division between BR-, C-, D-, E- and I-beds. Moreover, licensed CD-beds are attributed for 50% to C-beds and for 50% to D-beds. The number of licensed beds does not account for beds of categorical hospitals which fall under the competence of the communities.*

Table 21 – Summary of forecast results of ageing scenario 1 for isolated categorical hospitals

	2014	Licensed beds 2014*	2020	Difference with baseline	2025	Difference with baseline	Abs. difference 2014-2025	Rel. difference 2014-2025	Difference with baseline
Inpatient stays	7 474		9 027	314	10 705	722	3 231	43.2%	9.7%
Inpatient days	324 378		359 348	12 825	396 840	28 413	72 462	22.3%	8.8%
Bed types inpatient care									
G	56	52	53	3	56	10	0	0.0%	17.9%
S (=S1, S2, S3, S4, S5, S6)	931	971	1 041	36	1 153	78	222	23.8%	8.4%

** The number of licensed beds is based on information from December 2014 provided by FPS Health.*

Table 22 – Summary of forecast results of ageing scenario 2 at the national level

	2014	Licensed beds 2014*	2020	Difference with baseline	2025	Difference with baseline	Abs. difference 2014-2025	Rel. difference 2014-2025	Difference with baseline
Day-care stays	2 820 031		3 418 925	92 358	3 865 335	110 337	1 045 304	37.1%	3.9%
Bed types day care									
Medical places	8 784		10 826	336	12 285	402	3 501	39.8%	4.6%
Surgical places	2 496		2 850	34	3 177	40	681	27.3%	1.6%
Inpatient stays	1 851 612		2 027 159	68 573	2 240 468	167 675	388 856	21.0%	9.1%
Inpatient days	12 906 895		13 258 537	811 939	14 352 064	2 083 227	1 445 169	11.2%	16.1%
Bed types inpatient care									
D	13 026	14 638	13 520	855	14 051	1 511	1 025	7.9%	11.6%
C	10 114	14 310	9 303	434	8 508	584	-1 606	-15.9%	5.8%
G	7 246	7 340	8 079	835	10 912	3 395	3 666	50.6%	46.9%
S (=S1, S2, S3, S4, S5, S6)	5 080	5 439	5 927	486	6 907	1 017	1 827	36.0%	20.0%
M	2 545	3 176	2 249	-65	2 074	-40	-471	-18.5%	-1.6%

E	1 951	2 651	1 839	-21	1 731	-32	-220	-11.3%	-1.6%
I	1 784	2 026	1 894	118	1 947	166	163	9.1%	9.3%
N (=NIC, N*)	895	1 311	862	-38	842	-20	-53	-5.9%	-2.2%
L	33	38	31	-1	30	0	-3	-9.1%	0.0%
BR	30	44	28	0	27	1	-3	-10.0%	3.3%

Note: including stays and days of foreign patients (i.e. patients living abroad)
** The number of licensed beds is based on information from December 2014 provided by FPS Health. The official number is complemented with information from the file unitindex of the minimal hospital data to account for N*-beds and to create a division between BR-, C-, D-, E- and I-beds. Moreover, licensed CD-beds are attributed for 50% to C-beds and for 50% to D-beds. The number of licensed beds does not account for beds of categorical hospitals which fall under the competence of the communities.*

Table 23 – Summary of forecast results of ageing scenario 2 for isolated categorical hospitals

	2014	Licensed beds 2014*	2020	Difference with baseline	2025	Difference with baseline	Abs. difference 2014-2025	Rel. difference 2014-2025	Difference with baseline
Inpatient stays	7 474		9 300	587	11 253	1 270	3 779	50.6%	17.0%
Inpatient days	324 378		370 118	23 595	420 347	51 920	95 969	29.6%	16.0%
Bed types inpatient care									
G	56	52	56	6	68	22	12	21.4%	39.3%
S (=S1, S2, S3, S4, S5, S6)	931	971	1 071	66	1 212	137	281	30.2%	14.7%

** The number of licensed beds is based on information from December 2014 provided by FPS Health.*

PART II: HOSPITAL USE BY PATIENTS WITH DEMENTIA

THE EFFECTIVENESS OF INTERVENTIONS TO AVOID OR REDUCE HOSPITAL USE

2 HOSPITAL USE BY PATIENTS WITH DEMENTIA

2.1 Background and aim of the study

This chapter provides an in-depth analysis of the hospital use of people with dementia. This subgroup of older patients was chosen because it represents a large and growing group of people.

The aim is to get insight in:

- the possible **impact of prevalence and care needs of patients suffering from dementia on (Belgian) hospital use** in coming years;
- **interventions** (either outside or inside the hospital) **that may influence hospital use of patients suffering from dementia**.

What is dementia?

Dementia is a neurodegenerative disease and is characterized by progressive deterioration in cognitive ability and capacity for independent living. There are several subtypes of dementia of which Alzheimer's disease is the most common. In general, onset of dementia appears slowly, mostly after the age of 60, and the disease is rather difficult to detect. Dementia is a chronic and progressive condition, characterized by memory loss, mood swings, and difficulties in communication, mobility, reasoning and self-care. Dementia is irreversible and leads to a slow decrease in functioning and finally to death. Reports on survival after a diagnosis of dementia vary from 3 to 12 years[72] or from 4 to 8 years, yet some live as long as 20 years with Alzheimer's disease[73].

Patients with dementia often have several co/multi-morbidities. For example, a review by Scrutton & Brancati[74] states that the prevalence of comorbid conditions in people with dementia is high and that studies have estimated that 61% of people with Alzheimer's disease have three or more comorbid diagnoses, with hypertension and diabetes the most frequent. According to the systematic review of Bunn et al.[75] prevalence rates of

diabetes in people with dementia varied from 6% to 39%, and prevalence rates of stroke varied from 3% in hospitalized older people in the United Kingdom (UK) to 34% in a sample of urban and rural community dwelling people with cognitive impairment in the United States of America (USA). This makes the patient with dementia vulnerable for (frequent) hospital emergency department (ED)-visits and hospital admissions.

Dementia is now already on the first place of death causes in 2014 in the Netherlands and in 2015 in the UK, causing more deaths than cardiac events or cancers.[76, 77]

Patients with dementia are known to be high healthcare users (informal care, primary care, hospital care and residential care) and causing high (societal) costs.[73]

Organisation of care for patients with dementia in Belgium

Types of facilities and services

In 2009 Van Audenhove et al.[78] gave an extensive description of the care offer in Belgium for persons with dementia. They conclude that there is a wide and varied range of extramural, transmural and intramural services and facilities, some of which are specially developed to meet the needs of people with dementia and their caregivers. According to this study the large majority (>60%) of persons with dementia reside at their own home with support of informal caregivers, home nursing and other primary care services, some of them specialised in dementia. There are also day-care facilities where home residing patients with dementia can go to for one or more days a week. However, many patients with dementia come to a degree of care-dependency that necessitates some kind of residential care (e.g. home for the elderly). With regard to homes for the elderly[f], there were in 2013 132 250 places in Belgium (http://www.riziv.fgov.be/), but it has been calculated that many more (up to 40%) are needed in the future.[79, 80]

Within Belgian hospitals there are specialised services for elderly and geriatric patients (geriatric wards (G) and psychogeriatric wards (S6)), geriatric day-care hospitals, memory clinics and a 'geriatric care programme'. Data about the current capacity on G-wards and S6-wards can be found in Part I of the current report.

With regard to memory clinics, there are 12 hospitals with a memory clinic that are certified by the National Institute for Health and Disability insurance (RIZIV – INAMI; http://www.riziv.fgov.be/) but many other hospitals also offer specialised services (diagnostics and counselling) for persons with cognitive impairment and/or presumed dementia.

The geriatric care programme is aimed at patients with an average age of ≥75 years who need a specific approach for the following reasons: a frailty profile, active multi-pathology, a limited homeostasis, atypical clinical appearances of diseases, disturbed pharmaco-kinetics, risk for functional decline, risk for malnutrition, trend to be inactive and bedridden, with an increased risk for institutionalisation and for dependency in activities of daily living; psychosocial problems.[81] This programme is regulated by a Royal Decree (RD) published in 2007 and updated in April 2014[82]. In this it is specified that among other things:

- Each acute hospital with an acute geriatric unit should have a care programme for geriatric patients;
- Each hospitalised patient aged 75 years or older should be screened by a staff member of the unit on which the patient stays via a scientifically validated screening tool (younger patients are also eligible for screening based on clinical judgement).

The RD also specifies several licensing standards (e.g. composition and educational level of the inpatient geriatric consultation team, role and profile of the care programme coordinators, architectural norms) but the essence is that the care programme structures geriatric care in Belgian hospitals around five components: 1) acute geriatric wards (i.e. G-wards); 2) geriatric

[f] Formerly known as '*rustoorden voor bejaarden (ROB)'/'maisons de repos pour personnes âgées (MRPA)*' and *'rust- en verzorgingstehuizen (RVT)'/'maisons de repos et de soins (MRS)*' and currently known in Flanders as '*woonzorgcentra (WZC)*'.

ambulatory consultations; 3) geriatric day hospitals; 4) inpatient geriatric consultation teams at non G-wards and; 5) external geriatric liaison function. With regard to geriatric consultation, in 2011 only 6% of patients aged 75+ and staying on a non G-ward, received such a consultation.[81]

Political awareness and initiatives on the field

Appropriate care for patients with dementia is on the political agenda in Belgium and many initiatives are taken to better support the patients and their caregivers and to give them the most appropriate care setting (e.g. specialised '*dementiekundige zorgverlener*' in primary care, reference persons dementia in elderly homes ('*referentiepersoon dementie*'), care pathways, etc.). There is also a programme for innovative projects on elderly care, in which some of them are targeted to patients with dementia.[83]

2.2 Method

The research questions in this study are:

1. What is the (expected) prevalence and incidence of dementia in general society?
2. What is the prevalence of patients with dementia in acute care hospitals?
3. What is the hospital use (admissions, length of stay) of patients with dementia?
4. What is the effectiveness of interventions to avoid/reduce hospital use by patients with dementia?

For all 4 questions we searched for international figures and specific Belgian data. For questions 1 to 4 a review of international and Belgian literature was performed and for questions 2 and 3 an analysis of Belgian hospital registration data was additionally performed. The method for both approaches is described below.

2.2.1 Literature review

Search sources and strategies

- Peer-reviewed publications: PubMed: ("Dementia"[Mesh] OR dementia [tiab]) AND ("Hospitalization "[Mesh] OR "Length of Stay"[Mesh] OR "hospitalization*" OR "hospital use" OR "hospital capacity" OR "hospital admission" OR "acute care" OR "acute setting"). Filters: Publication date from 2012/01/01
- Grey literature: Google advanced: (dementia OR alzheimer OR dementie OR demence) AND ("hospital use" OR "hospital capacity" OR "hospital admission" OR "ziekenhuisopname" OR "hopital") AND filetype:pdf (limited to 2012 and younger)
- Suggested by colleagues
- Cited search with relevant references

In-/exclusion criteria

We retained reports and articles that contained information on patients with dementia and about incidence/prevalence in society or in hospital or studies about interventions targeted to patients with dementia (or cognitive impairment) and that *reported outcomes on hospital use* (ED-visits, hospital (re)admissions, length of stay). All study designs were included. A date limit to 2012 or more recent was applied, with exception for some relevant Belgian studies that were suggested by colleagues.

Data-analysis

Relevant references were categorized into

- Type of study
- Country of origin
- Incidence/Prevalence
  - in society
  - in hospital
- Hospital use
  - ED-visits
  - hospital admissions
  - length of stay
- Interventions
  - outside hospital
  - inside hospital
  - fall prevention

Results of studies are only described narratively, and no attempts were made to do statistical analyses. No methodological assessments of the studies were performed.

As much as possible we focused on studies that were directed at patients with dementia themselves (DIRECT EVIDENCE), sometimes supplemented by studies that covered a broader study population, such as patients with cognitive impairment or frail elderly (INDIRECT EVIDENCE). Where possible we made the distinction between evidence of foreign origin and evidence of Belgian origin. Also, where possible, evidence from literature reviews is presented first, supplemented by other types of study designs.

For the interventions studied, we organised results as much as possible in the following order: evidence obtained by reviews with direct evidence, followed by comparative studies with direct evidence followed by reviews and comparative studies with indirect evidence. Only interventions with a reported effect on hospital use by patients with dementia are described, i.e. interventions with an effect on reducing hospital ED-visits and hospital (re)admissions or with an effect on shortening (inappropriate) length of stay.

Searches resulted in slightly more than 1 000 references, of which 414 were assessed full text and 231 were considered as containing relevant information for this review.

Within the relevant studies, there were 61 literature reviews. Included studies originated from 24 different countries, but by large from the USA and the UK. We identified 12 studies with a Belgian origin.

2.2.2 Analysis of Belgian hospital registry data

Data sources

Box 3 – Data sources

MZG – RHM: Minimal Hospital Data. Database containing the medical data of all hospital stays (all inpatient and day-care hospital stays and emergency room contacts) in Belgian general hospitals. Each general hospital sends its MZG – RHM registration to Federal Public Service (FPS) for Health, Food Chain Safety and Environment (FOD – SPF) regardless of patient insurability.

AZV – SHA: Anonymous Hospital Stays (inpatient) and ADH – HJA (Anonymous Day-care Stays). Database containing billing data of all hospital stays for patients affiliated to a Belgian sickness fund. The Belgian sickness funds collect the billing information data of their affiliated patients. The IMA – AMI (Intermutualistic Agency) gathers the information of the different sickness funds into one national database.

TCT: Technical Cell Data. Each year, the Technical Cell links MZG – RHM with AZV – SHA and with ADH – HJA data, but only for patients covered by the national health insurance (and hence affiliated to a Belgian sickness fund). The global coupling represents approximatively 98% of the billing data.

For the present study, we analysed the whole MZG – RHM database for 2010-2014, whether coupled or not. Coupled data were only used to retrieve information on the billing of the geriatric consultations of patients 75+ staying in a G-unit. Since the coupling of geriatric day-care stays is not as good as the global coupling, it was decided not to use the unique identifier of a patient as unit of analysis.

Before 2015 when Belgium turned to ICD-10-BE (International Classification of Diseases-10th Revision-Belgium), diagnoses and procedures were coded according to the ICD-9-CM classification (International Classification of Diseases-9th Revision-Clinical Modification). This classification was used to select patients hospitalised with a diagnosis of dementia in the present analysis. A second classification presented in this study is the APR-DRG classification system and its associated four severities of illness, from 1 (minor) to 4 (extreme) (see Box 1).

Case selection

Since geriatric day care was introduced only in 2010, we analysed the MZG – RHM from that year onwards also for inpatient stays. All stays in general hospitals are included in the analyses, except ambulatory emergency contacts and complete psychiatric stays.

Table 24 gives the ICD-9-CM codes that were used to identify patients with dementia in hospitals, as well as the principal diagnosis and secondary diagnoses.

Table 24 – ICD-9-CM codes to select patients with dementia

ICD-9_CM code/category	Label	
290*	**Dementias,** i.e. :	
	2900	Senile dementia
	2901*	Presenile dementia (uncomplicated, with delirium, with delusional features, with depressive features)
	2902*	Senile dementia (with delusional features, with depressive features)
	2903	Senile dementia (with delirium)
	2904*	Vascular dementia (uncomplicated, with delirium, with delusions, with depressed mood)
	2908	Other specified senile psychotic conditions
	2909	Unspecified senile psychotic condition
2912	**Alcohol-induced persisting dementia**	
29282	**Drug-induced persisting dementia**	
294*	**Persistent mental disorders due to conditions classified** elsewhere, i.e.	
	2940	Amnestic disorder in condition elsewhere classified
	2941	Dementia in condition elsewhere classified
	2948	Other persistent mental disorders in condition elsewhere classified
	2949	Unspecified persistent mental disorders in condition elsewhere classified
3310	**Alzheimer's disease**	
3311*	**Frontotemporal dementia**	
3312	**Senile degeneration of brain**	
3317	**Cerebral degeneration in diseases classified elsewhere**	
33182	**Dementia with Lewy bodies**	

A minimum age of 40 years was applied since the onset of dementia is very rare under this age. The selection of ICD-9-CM diagnosis codes combined with the filters ended in identifying a total of 459 267 stays over the five year period (2010-2014). Important to note is that the unit of analysis is a patient stay and not an individual patient; as a consequence we could not identify how many patient-stays an individual patient had in the 2010-2014 period.

Analyses

Analyses were performed for patients with dementia, and compared to patients without dementia, for

- Principal diagnosis at admission
- Number and type of hospital admissions
- Type of hospital wards
- Occupancy rate
- Length of hospital stay
- Discharge destination

Where appropriate trends were analysed across a five year period (2010-2014). With regard to length of stay, a few patient stays had a length of stay=0 (n=1 691; 0.4%) and were allocated a 1 day length of stay instead of zero.

To compare the length of stay of patients hospitalised presenting dementia and patients hospitalised not presenting dementia in 2014, kernel density curves were drawn for a subgroup of patients 75 years and over (in order to avoid age bias in the case mix of the compared groups), for the 20 most frequent APR-DRGs (in the group dementia) separated into severity 1+2 and severity 3+4.

2.3 Results on epidemiological data

2.3.1 Incidence/prevalence of dementia

An important note to the following figures is that as many people with dementia are not always diagnosed as such, the actual number of cases is likely to be much higher than the figures suggest. For example, a systematic review[84] found that a dementia diagnosis was documented in only up to one-third of mild dementia patients and in less than two-thirds of moderate to severe dementia patients.

The same applies to the prevalence numbers in hospitals: identification and reporting of dementia is often poor in hospitals. In an Australian study, for instance, for almost half of the episodes for people with dementia, dementia was not recorded as either a principal or secondary diagnosis.[85] Other examples are a UK-study that states that in almost a third of hospital admissions of people with dementia there was no record of the person's dementia[86] and an Irish study[87] where they found that two thirds were not previously diagnosed as having dementia.

2.3.1.1 Incidence/prevalence of dementia in society

Across the globe

According to the recent World Alzheimer report[88], based on a systematic review with searches up to March 2015 and including 224 prevalence and 46 incidence studies from around the world, there are currently over 46 million people living with dementia worldwide, and this number is estimated to increase to 74.7 million in 2030 and to 131.5 million by 2050. The disease mainly affects people aged 60 years and above. In Western Europe countries, the overall prevalence is 6.8% in people aged 60 years and above, but going up to 12.4% in age category 80-84, 20.5% in age category 85-89 and to almost 40% in persons aged 90 and above. Prevalence of dementia in females is almost twice as that in males in Western Europe.

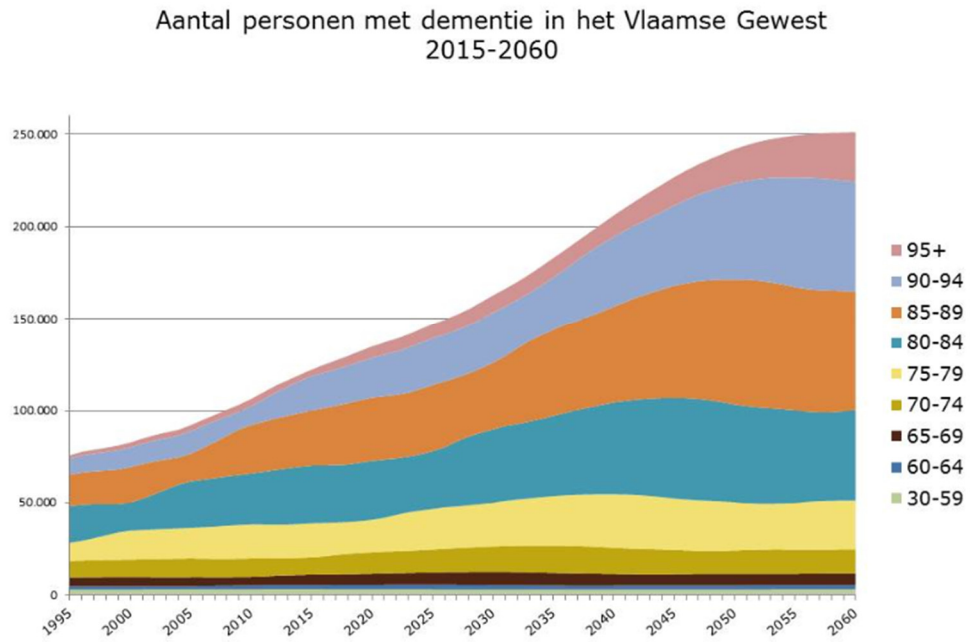
Alzheimer Europe[89, 90] made a cross-country comparison of the prevalence of dementia in the EU-28 countries and found that in 2012 1.55% of the EU-population is affected by dementia.

The current yearly incidence in Western Europe is almost 18 per 1 000 persons aged 60+. The incidence of dementia increases exponentially with increasing age.

Belgium

Prevalence rates of dementia in Belgium are not exactly known and differ[g] across sources from 0.64% to 1.8% in 2015. Rates are expected to increase in coming years to even double figures in 2060. For example, Alzheimer Europe[89, 90] comes to a prevalence of 191 281 persons or 1.77% in Belgium, ranking as fifth in the EU-28. Steyaert[91] estimated that on 01/01/2015 201 762 (1.8%) persons in Belgium were affected by dementia (122 161 in Flanders, 62 571 in Wallonia and 17 030 in Brussels). He also presents specific figures for future prevalence in Flanders (Figure 39), and concludes that the prevalence will be doubled in 2060.

Figure 39 – Prevalence of dementia in Flanders 2015-2060



Source: Steyaert (2016)[91]

[g] The large differences in prevalence rates (e.g. a prevalence of 41 000 persons with dementia in Flanders based on Intego (see Appendix 1.1) versus 122 000 based on Steyaert[91]) can be explained by different approaches and different sources researchers applied; apparently there is no standardized measurement way.

There are high concentrations of people with dementia in Belgian residential care settings, with prevalence estimations varying from 8%[92] to 33%[93].

2.3.1.2 *Incidence/prevalence of dementia in hospital*

Across the globe

A systematic review[94] based on 14 studies (searched up to March 2008) found that the prevalence of dementia in general hospital for patients aged over 55 years varied between 2.8% to 63.0%. Another systematic review[95] based on 25 studies (searched up to 2010) found prevalence rates between 3.4% and 43.3%. However, these figures should be interpreted with caution since the reported prevalence rates highly depend on the age categories and type of hospital wards that were included.

Also more recent publications show similar large variation between studies and/or countries (see Appendix 1.2).

Belgium

From the literature we found two estimates on the prevalence of patients with dementia in acute hospital settings in Belgium: Buntinx et al.[96] stated that 2.37% of hospital admissions could be attributed to persons with dementia and the '*Nationale Raad voor Ziekenhuisvoorzieningen – Conseil National des Etablissements Hospitaliers* (NRZV – CNEH)'[97] found in a questionnaire that from the patients that stay inappropriately in hospital and were waiting for discharge, 16.4% had a dementia diagnosis.

Based on the Belgian hospital data analysis

Between 2010 and 2014 there were 459 267 hospital stays for patients aged at least 40 years with an ICD-9-CM dementia code. Most (87%) had an inpatient stay and 13% were admitted as day-care patient; the number of patients with dementia increased by 15% from 2010 to 2014 (Table 25).

Table 25 – Number and type of hospital admissions for patients with dementia 2010-2014

	Year					
	2010	2011	2012	2013	2014	Total
Type of stay Frequency Column %						
Day care	10 226 12.10	12 177 13.70	12 286 13.18	12 833 13.44	14 191 14.60	61 713 **13.44**
Inpatient	74 277 87.90	76 734 86.30	80 909 86.82	82 647 86.56	83 017 85.40	397 584 **86.56**
Total	84 503	88 911	93 195	95 480	97 208	459 297

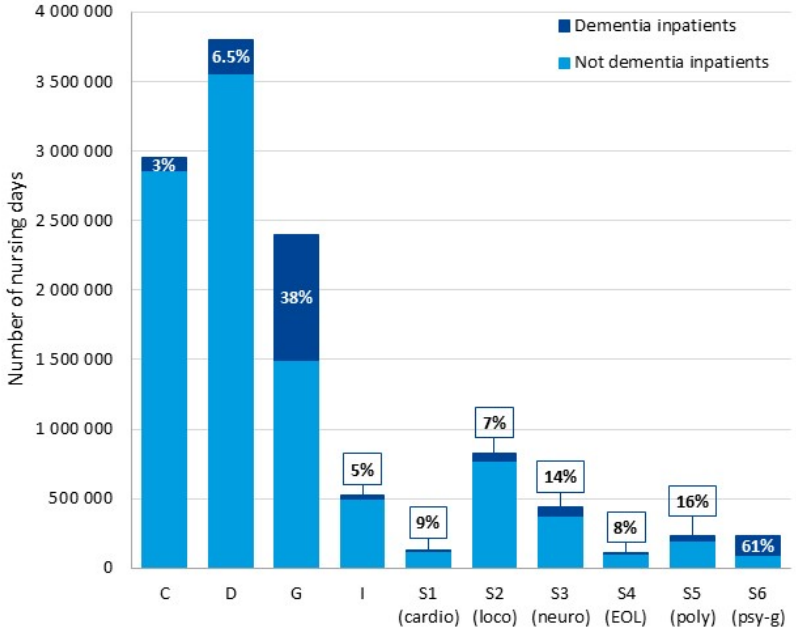
Most patients were female (64%). The mean age of hospitalised dementia patients was 82 years, which tended to increase slightly over time. Table 26 shows hospital stays of 2014 per age category (from 60 years on), showing that the proportion of patients with dementia increases per age category.

Table 26 – Proportion of hospital stays for patients with dementia per age category in 2014

Age	Day-care stays			Inpatient stays		
	Patient with dementia?			Patient with dementia?		
Frequency Row Percent	**No**	**Yes**	**Total**	**No**	**Yes**	**Total**
60-79 years	984 445 99.58	4 199 0.42	988 644	543 543 96.34	20 648 3.66	564 191
80-84 years	153 316 97.10	4 583 2.90	157 899	122 887 84.77	22 076 15.23	144 963
85-89 years	68 079 94.83	3 713 5.17	71 792	78 169 76.72	23 717 23.28	101 886
>= 90 years	21 642 93.18	1 585 6.82	23 227	39 306 72.16	15 167 27.84	54 473
Total	1 227 482	14 080	1 241 562	783 905	81 608	865 513

In 2014 patients with dementia occupied 12.1% of hospital beds, with especially high prevalence on the S6- and G-wards. Figure 40 shows the proportion of nursing days for patients with dementia per type of hospital ward.

Figure 40 – Proportion of nursing days for patients with dementia per type of hospital ward (2014)



S1=cardiopulmonary rehabilitation, S2=rehabilitation of the locomotor system, S3=neurologic rehabilitation, S4=palliative care, S5=poly-pathologies and S6=psycho-geriatrics

2.3.2 Hospital use by dementia patients

First results from the literature review are presented, followed by results from the Belgian hospital registration data.

2.3.2.1 Emergency department visits

In the literature review, studies from the USA found that community dwelling persons with dementia visit the ED frequently (34.5%[98] to 50%[99]) and do so more often than persons without dementia (34.5% vs 25.4%[98]; 49% higher rate of ED-visits[100]).

Persons with dementia staying in residential care also show to be frequent ED-visitors (USA: 55%[98], 67%[101], 74%[102] in 1 year period; Canada: 23%[103, 104]; France: 20%[105]) of which a substantial portion (36%[102]) is admitted to the hospital after their ED-visit. Also in these residential patients, the rate of ED-visits was higher in patients with dementia than in patients without dementia (23.8% vs 16.7%[105]). According to a small scale cohort study[106] feeding tube-related complications (e.g. dislodgement, blockages) were the most common cause of ED-visits, accounting for 47% of all visits, followed by evaluation after a fall, urogenital infections, skin infections, gastrointestinal infections, respiratory infections and fractures.

A remarkable finding in the literature was that a large proportion of the ED-visits by patients with dementia were deemed as 'preventable' or 'avoidable' (from 7.2%[98] over 25%[103, 104] to 50%[107]).

From the Belgian hospital data, we cannot estimate the number of ED-visits by patients with dementia since the diagnoses are not registered for ambulatory ED-visits.

2.3.2.2 Hospital admissions

Hospital (re)admissions rates are high for people with dementia and higher compared to those without dementia

In the literature review we found several studies on hospital admissions of patients with dementia. A systematic review[95], based on 25 studies, found that the probability or risk of hospitalisation for persons with dementia is between 1.4 - 3.6 times greater than it is for non-dementia persons; people with dementia are more frequently hospitalised due to infectious diseases, fractures, or nutritional disorders than non-dementia persons. Another systematic review[108], based on 10 studies, concludes that people with

dementia were more likely to have either orthopaedic (e.g. falls/fractures) or respiratory/urological (e.g. infections) precipitants of admission than those without dementia.

Important to note is that hospitalisations for patients with dementia frequently concern readmissions. For example, a review[109] found that compared to people in hospital without dementia, the rate of readmission within 30 days for people with dementia is nearly 1.5 times higher following an unplanned admission, and more than twice as high following a planned admission. A similar finding was found in the review of Rao et al.[110] who found that dementia patients had a significantly increased overall readmission rate (OR 1.18; 95% CI, 1.08-1.29, p < 0.001).

Recent primary studies[73, 85, 86, 98-100, 103, 104, 106, 111-137] from across the world confirm the review findings that patients with dementia are frequently hospitalised and more often than patients without dementia.

According to the USA Alzheimer's Association[73], people with Alzheimer's disease and other types of dementia have twice as many hospital stays per year as other older people.

An Australian report[85, 117] found that hospitalisation can occur due to dementia or unrelated conditions such as hip fractures and urinary tract infections. In 2009-10 only 15% of dementia hospitalisations where due primarily to dementia and no other conditions. Also other studies[73, 138] found that patients with dementia are in most cases hospitalised for other reasons than the dementia itself, such as falls, pneumonia, urinary tract infections, stroke and other.

Based on the Belgian hospital data analysis

Between 2010 and 2014, there were 459 267 hospital stays for people with dementia. For 78.5% of these hospital stays the principal diagnose was not dementia. Table 27 presents the 20 most frequent principal diagnoses in patients with dementia.

Table 27 – Principal diagnosis other than dementia in patients with dementia, 2014)

Rank	Principal diagnosis in 3 digits		N stays	Percent
1	820	Fracture of neck of femur	3 658	4.79
2	V57	Care involving use of rehabilitation procedures	2 841	3.72
3	428	Heart failure	2 586	3.39
4	486	Pneumonia, organism unspecified	2 560	3.35
5	599	Other disorders of urethra and urinary tract	2 343	3.07
6	434	Occlusion of cerebral arteries	2 067	2.71
7	491	Chronic bronchitis	1 796	2.36
8	780	General symptoms	1 583	2.07
9	038	Septicemia	1 481	1.94
10	276	Disorders of fluid, electrolyte, and acid-base balance	1 474	1.93
11	507	Pneumonitis due to solids and liquids	1 454	1.91
12	427	Cardiac dysrhythmias	1 442	1.89
13	250	Diabetes mellitus	1 203	1.58
14	560	Intestinal obstruction without mention of hernia	1 082	1.42
15	345	Epilepsy and recurrent seizures	952	1.25
16	435	Transient cerebral ischemia	875	1.15
17	V58	Encounter for other and unspecified procedures and aftercare	872	1.14
18	733	Other disorders of bone and cartilage	867	1.14
19	466	Acute bronchitis and bronchiolitis	828	1.09
20	996	Complications peculiar to certain specified procedures	776	1.02
21		**Other principal diagnoses**	43 578	57.10
			76 318	**100.00**

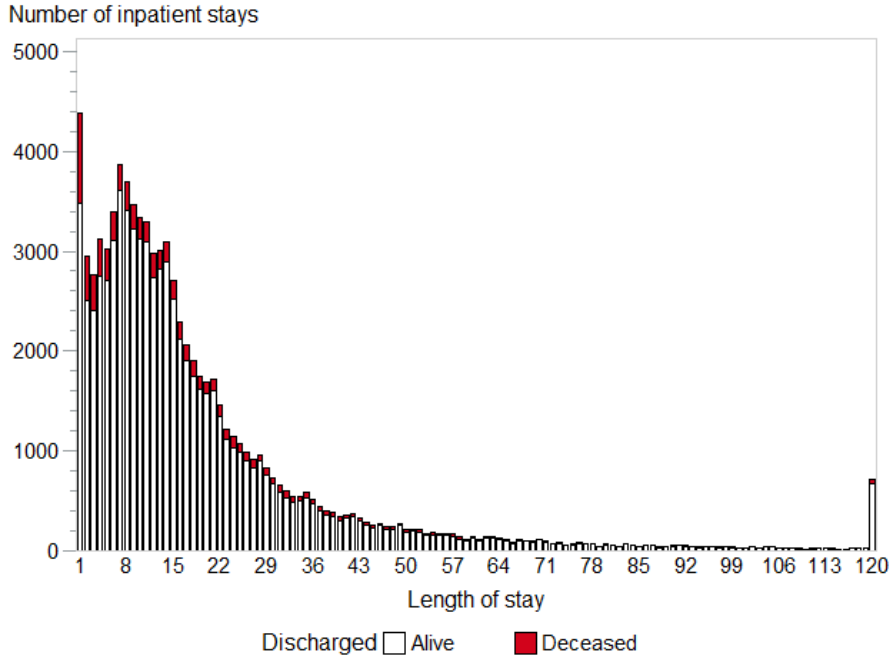
End-of-life hospital use is considerable among patients with dementia

In the literature review, several studies[125, 128, 136, 139] found that patients with dementia are often hospitalised in the last months/weeks/days of life; e.g. the USA study of Teno et al.[139] found that patients with dementia even in the last 4 months of their life were frequently hospitalised and also frequently admitted to the ICU (16.9% in 2000 and 38.5% in 2013) and often put on ventilators. A Spanish study[128] found that in the admitted nursing home residents almost one third of patients died in the first 48 hours, which suggests that many of these transfers were unnecessary.

Also a Belgian study had similar findings: Houttekier et al.[140] found that 19.5% of nursing home residents with dementia were hospitalised in the last month of life, including 4.6% of total who were admitted to an intensive care unit.

Based on the Belgian hospital data analysis, it was found that 7.6% of patients with dementia died during their hospital stay, of which many on the first day of admission or within seven days (see Figure 41). In a sub-analysis of patients with dementia aged 75+, the in-hospital mortality rate was 9.8%, which is larger than in patients of similar age without dementia (8%). Patients coming from a residential care had an in-hospital mortality rate of 14%.

Figure 41 – Length of hospital stay in patients with dementia per discharged alive or deceased



Avoidable hospitalisations

From the literature review, it was learned that, as was the case with ED-visits, many studies from across the world[85, 86, 98, 101, 103, 104, 106, 107, 111, 114, 115, 118, 120, 141-146] state that patients with dementia are often admitted to the hospital for reasons/conditions that are potentially avoidable and could (have) be(en) treated in the primary care or residential care setting and that often do not require hospital admission. The term 'ambulatory care sensitive conditions' is frequently used for this, as well as 'primary care sensitive conditions'. However, a systematic review by Purdy[147] showed that definitions of those conditions vary and also the number of conditions that are considered as ambulatory care sensitive differ; based on the different studies they came to a list of 36 possible ambulatory sensitive conditions. In Appendix 1.3 a table is given with studies reporting on (the extent of) ambulatory care sensitive conditions and how they defined it. Conditions that are commonly seen as primary care sensitive are: diabetes mellitus, pneumonia, urinary tract infections, dehydration, pressure ulcers and COPD.

The extent of avoidable ED-visits goes up to 25%[101, 103, 104] and to 50%[107] and for avoidable hospital admissions up to 20%[85] and to 50%[86].

Complications during hospital stay

In the literature review, several studies[85, 109, 110, 148-164] demonstrated the increased frequency of complications during hospitalisation for people with dementia. Frequent in-hospital complications are falls, delirium and urinary tract infections. Also in-hospital mortality is higher in patients with dementia compared to those without dementia[109, 110, 120, 127, 154, 155, 165, 166]

For example, Rao et al.[110] performed a review from 11 studies (based on administrative databases) and could compare 1 044 131 dementia patients to 9 639 027 elderly patients without dementia and found that patients with dementia had higher complication rates for urinary tract infections (RR 2.88), pressure ulcers (RR 1.84), pneumonia (RR 1.66), delirium (RR 3.10), and, dehydration and electrolyte imbalance (RR 1.87); with regard to in–hospital mortality they found a rate of 15.3% in dementia patients compared to 8.7% in non-dementia cases (RR 1.70).

These complications frequently lead to a longer length of stay; an Australian study[151] found a mean LOS of 9.7 days for dementia patients that did not have a complication versus an average length of stay (LOS) of 15.4 days for dementia patients that acquired an in-hospital complication. A UK-report[158] found that an in-hospital fall caused an excess of 22.8 hospital days in patient with dementia that were electively admitted and an excess of 17.7 days in dementia patients that were non-electively admitted.

Also here 'avoidable' complications are mentioned. Bail[150], for instance, showed that surgical dementia patients had higher rates than non-dementia patients in seven of the 12 preventable complications, that are known to be sensitive to nursing care: urinary tract infections, pressure ulcers, delirium, pneumonia, physiological and metabolic derangement (all at $p<0.0001$), sepsis and failure to rescue (at $p<0.05$). Medical dementia patients also had higher rates of these complications than did non-dementia patients. The highest rates and highest relative risk for dementia patients compared with non-dementia patients, in both medical and surgical populations, were found in four common complications: urinary tract infections, pressure areas, pneumonia and delirium.

Length of stay

From the literature review, several studies[94, 109, 115, 120, 123, 124, 126, 127, 130, 131, 138, 151, 152, 154-156, 158-160, 167-180] show that length of hospital stay for dementia is mostly extensive and mostly longer than in patients without dementia; two studies[165, 181] showed a shorter length of stay for patients with dementia.

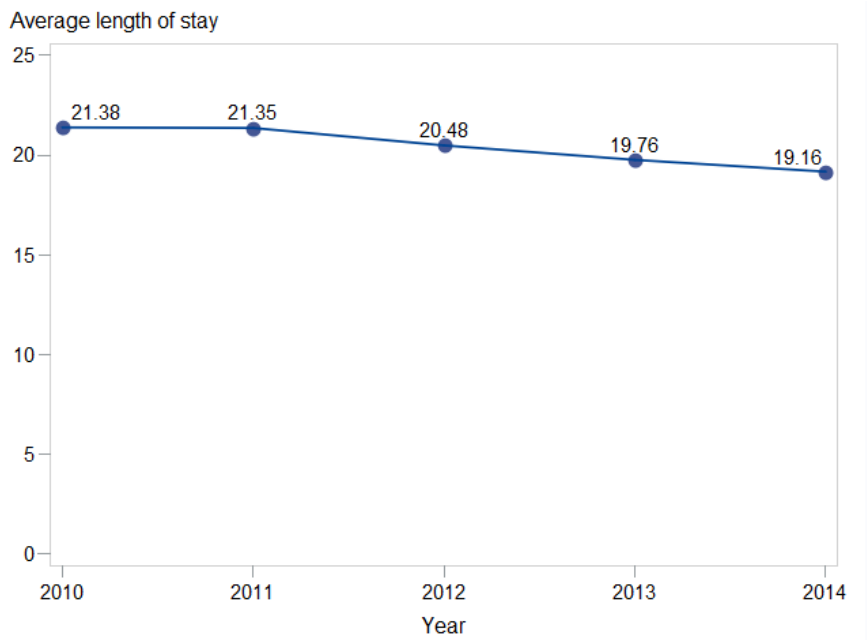
For example, a review[109] found that patients with dementia have a significantly longer LOS of between 6-30 days compared to patients without dementia and that the LOS can be up to twice as long for patients with dementia (average LOS = 16.4 days) compared to those without dementia (average LOS = 8.9 days). In 0 an overview is given of studies in which LOS was compared for patients with dementia, versus patients without dementia.

As pointed above longer LOS can be due to in-hospital complications, but can also be caused by difficult discharge arrangements that may cause medically unnecessary hospital stay. The systematic review of Mukadam[94] and other studies[128, 182-188] concluded that patients with dementia in the acute

hospital are more at risk of delayed discharge. Other studies found that 25% of patients staying inappropriately in hospital had a diagnosis of dementia.[160, 189] Also a Belgian study[97] found that overall 4.8% of hospital beds was occupied by patients for whom the medical decision for discharge was taken at least 24 hours; in these patients that stayed medical unnecessary in hospital, 16.4% had a diagnosis of dementia and 13.4% a 'Cd'-category on the Katz-scale, pointing to dementia. However, of the patients staying medically unnecessary 28.8% stayed on geriatric (G) wards, 23.5% on internal medicine (D) wards, 16.2% on surgery (C) wards and 11.5% on rehabilitation (S) wards. Of the patients that stayed inappropriately on the G-wards, 32.6% had dementia. The mean length of inappropriate stay in the hospital was 32.14 days; the main reason (in 50% of cases) for not having been discharged yet was unavailability of another appropriate care setting.

Based on the Belgian hospital data analysis, the average length of stay for patients with dementia in 2014 was 19.2 days (SD=23.6, median=13, P5=1; P95=58). The average length of stay decreased from 21.4 in 2010 to 19.2 in 2014, as shown in Figure 42.

Figure 42 – Average length of hospital stay in patients with dementia, 2010-2014



Some patients with dementia stay rather short, while others stay for a very long time. Long length of stays were particular seen in patients that are discharged to a residential care setting (Figure 43). And especially a long average length of stay was observed in patients that entered hospital from their own home and were discharged to a residential care setting (Table 28).

Figure 43 – Average length of stay for patient with dementia according to discharged home or discharged to residential care, 2010-2014

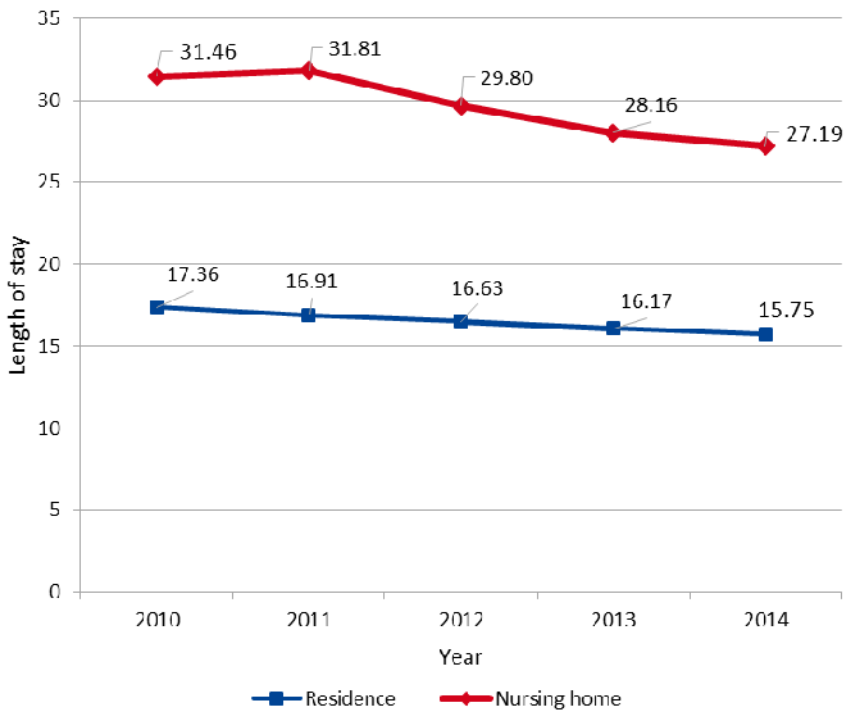


Table 28 – Length of stay per admission origin and discharge destination, 2014

Place before admission		Destination after discharge	
		Place residence	**Residential care**
Place of residence	Frequency (N stays)	34 154	14 400
	Mean length of stay in days (SD)	**15.75** (17.44)	**27.19** (27.73)
	Median length of stay in days	11.00	19.00
Residential care	Frequency (N stays)	1 585	15 958
	Mean length of stay in days (SD)	**12.50** (12.30)	**14.00** (12.68)
	Median length of stay in days	9.00	11.00

We compared also the length of stay of patients with and without dementia by means of kernel density curves (available on request) for the 20 most frequent APR-DRGs (in the group of dementia) in a subpopulation of patients aged 75 years and older. In almost all APR-DRGs (and severity of illness subgroups), a longer length of stay was observed for patients with dementia (Table 29). Across all APR-DRGs the mean LOS in patients with dementia was 20 days compared to 15 in patients without dementia.

Table 29 – Average length of stay per APR-DRG in patients (75+) with dementia compared to patients (75+) without dementia, 2014

APR-DRG (Severity of illness)	N stays		Average length of stay	
	Dementia?		Dementia?	
	NO	YES	NO	YES
042 Degenerative Nervous System Disorders Exc Multiple Sclerosis (SOI 1-2)	1 319	4 475	13.13	21.12
042 Degenerative Nervous System Disorders Exc Multiple Sclerosis (SOI 3-4)	582	2 690	21.42	26.61
045 Cerebral Vascular Accident and Precerebral Occlusion with infarct (SOI 1-2)	4 052	815	12.58	14.80
045 Cerebral Vascular Accident and Precerebral Occlusion with infarct (SOI 3-4)	3 586	1 051	24.89	24.14
058 Other Disorders of Nervous System (SOI 1-2)	1 659	399	7.68	15.13
058 Other Disorders of Nervous System (SOI 3-4)	523	275	18.53	23.00
137 Major Respiratory Infections & Inflammations (SOI 1-2)	661	398	11.56	11.95
137 Major Respiratory Infections & Inflammations (SOI 3-4)	1 694	1 151	18.49	18.29
139 Other Pneumonia (SOI 1-2)	3 661	1 060	9.76	12.28
139 Other Pneumonia (SOI 3-4)	6 098	2 369	15.10	18.36
140 Chronic Obstructive Pulmonary Disease (SOI 1-2)	4 031	448	7.98	11.35
140 Chronic Obstructive Pulmonary Disease (SOI 3-4)	6 361	1 092	14.54	17.57
144 Respiratory Signs, Symptoms and Minor Diagnoses (SOI 1-2)	3 490	764	7.19	10.65
144 Respiratory Signs, Symptoms and Minor Diagnoses (SOI 3-4)	2 188	915	13.51	17.23
194 Heart Failure (SOI 1-2)	7 312	1 055	9.22	12.21
194 Heart Failure (SOI 3-4)	7 276	1 537	15.21	19.44
201 Cardiac Arrhythmia & Conduction Disorders (SOI 1-2)	6 040	587	4.28	9.96
201 Cardiac Arrhythmia & Conduction Disorders (SOI 3-4)	2 498	524	11.03	17.30
254 Other Digestive System Diagnoses (SOI 1-2)	5 031	538	3.99	8.64
254 Other Digestive System Diagnoses (SOI 3-4)	1 376	368	11.67	15.43
301 Hip Joint Replacement (SOI 1-2)	8 972	1 284	14.43	18.12
301 Hip Joint Replacement (SOI 3-4)	1 746	385	31.65	36.92
308 Hip & Femur Procedures For Trauma, Except Joint Replacement (SOI 1-2)	3 501	1 183	19.76	13.98

308 Hip & Femur Procedures For Trauma, Except Joint Replacement (SOI 3-4)	2 009	857	32.86	28.87
347 Other Back & Neck Disorders, Fractures & Injuries (SOI 1-2)	5 219	881	11.16	16.24
347 Other Back & Neck Disorders, Fractures & Injuries (SOI 3-4)	2 249	692	21.78	25.52
351 Other Musculoskeletal System & Connective Tissue Diagnoses (SOI 1-2)	2 820	605	9.21	15.19
351 Other Musculoskeletal System & Connective Tissue Diagnoses (SOI 3-4)	1 536	616	18.77	20.90
384 Contusion,Open Wound & Other Trauma To Skin & Subcutaneous Tissue (SOI 1-2)	2 010	565	7.81	12.57
384 Contusion,Open Wound & Other Trauma To Skin & Subcutaneous Tissue (SOI 3-4)	979	498	18.94	21.57
463 Kidney & Urinary Tract Infections (SOI 1-2)	2 620	941	8.05	11.61
463 Kidney & Urinary Tract Infections (SOI 3-4)	2 495	1 528	14.66	17.92
720 Septicemia & Disseminated Infections (SOI 1-2)	906	253	9.90	12.67
720 Septicemia & Disseminated Infections (SOI 3-4)	2 954	1 054	14.90	16.84
757 Organic Mental Health Disturbances (SOI 1-2)	268	2 215	12.03	19.27
757 Organic Mental Health Disturbances (SOI 3-4)	169	1 448	21.11	26.87
860 Rehabilitation (SOI 1-2)	7 351	1 177	34.81	42.89
860 Rehabilitation (SOI 3-4)	3 677	948	44.94	46.39
861 Signs, Symptoms & Other Factors Influencing Health Status (SOI 1-2)	5 084	1 369	6.93	15.36
861 Signs, Symptoms & Other Factors Influencing Health Status (SOI 3-4)	1 996	748	13.82	23.16
All APR-DRGs and SOIs	**127 999**	**41 758**	**15.03**	**20.08**

2.4 Results on interventions to reduce hospital use by dementia patients

Disclaimer. Before reading this intervention-section, we like to 'warn' the readers to keep in mind, we only looked at effects of interventions on hospital use. In case we state that there is limited or inconclusive evidence of effect of these interventions, this only applies to hospital use. It can well be the case that these interventions do have positive effects on other outcomes, such as mobility, patient satisfaction or quality of life.

Only interventions with a reported effect on hospital use by patients with dementia are described, i.c. interventions with an effect on reducing hospital ED-visits and hospital (re)admissions or with an effect on shortening (inappropriate) length of stay. A difficulty is that some studies/reviews had (frail) elderly, including patients with dementia, as population; it is not always clear if the (no)-effects apply to the specific subpopulation of patients with dementia. Therefore, in the discussion we will start with reviews and comparative studies that were targeted directly to dementia patients, followed by findings from other more indirect studies.

In general, hospital use can be reduced by better care outside the hospital (before and after) and during the hospital stay/ED-visit itself.

There is plethora of interventions believed to have an impact on hospital use by dementia patients; varying from improvements in home care, primary care and residential care to improvements at the front door of the hospital, interventions during the hospital stay, at the back door and after hospital discharge to whole healthcare system changes. For example, a review[109] included 81 publications regarding interventions aimed at improving patient outcomes or the quality of care provided to hospitalised patients with cognitive impairment; another review[190] included 131 papers about services intended to support and sustain people with dementia to live at home.

2.4.1 Strategies outside the hospital with an impact on hospital use

Interventions in primary care and their impact on hospital use

Bardsley et al.[191] evaluated over 30 *different community-based interventions* (generally targeted to elderly, but some also specifically to patients with dementia) in the UK and whether those service changes have led to a reduction in emergency admissions and the associated cost to the National Health Service (NHS). The results have been almost overwhelmingly negative, with the one exception, the Marie Curie Nursing Services for terminally ill patients. However, they warn that several factors can be involved that hindered the interventions to show effectiveness (e.g. too small samples, too short time frame) and 'to not throw out the baby with the bathwater'.

Also the review of Dawson et al.[190] about *services intended to support and sustain people with dementia to live at home*, conclude, based on 131 studies, that there is 'a limited evidence base'; the review reveals that the quality and extent of the evidence base for what works in care at home for people with dementia remains limited.

In Table 30 community-based interventions and their effects based on direct studies targeted to patients with dementia are listed.

Table 30 – Effect of community-based interventions for dementia patients on hospital use

Intervention	DIRECT STUDIES Type of study/source	Results
Screening and detection of cognitive impairment	Review[192]	No comprehensive data available
Community-based case management	Reviews[193, 194]	No evidence of effect
Community-based comprehensive multidisciplinary geriatric assessment	Review[193]	No evidence of effect
Home rehabilitation in dementia patients after hip fracture	Reviews[195, 196] Comparative[164, 197]	No evidence of effect Conflicting evidence
Community-based palliative care	Comparative[198, 199]	Less hospital use
Annual review by general practitioners for dementia patients	Comparative[200-203]	Less hospital use
Individualized assistance to caregivers of persons with dementia	Comparative[204]	Less hospital use
Services intended to support and sustain people with dementia to live at home	Review[190]	Limited evidence

Interventions in residential aged care and their impact on hospital use

No dementia direct reviews were identified concerning interventions in the residential care setting. However, an indirect review of Malhotra[143] that looked at several interventions, concludes there is limited literature currently available about measures that support reduction of hospital admissions residential care settings.

Table 31 gives an overview of direct studies in residential care and their effects.

Table 31 – Effect of interventions in residential care for dementia patients on hospital use

Intervention	DIRECT STUDIES Type of study/source	Results
Specialised dementia care units in residential care settings	Comparative[205]	Less hospital use
Support services for nurses in residential care	Comparative[206, 207]	No evidence of effect
Specialist staff in the nursing home		No direct studies found
Hospital in the nursing home		No direct studies found
Function focused care	Comparative[208]	No evidence of effect
Advance directives/ advance care planning	Comparative[106, 209 210, 211]	Less hospital use

However, we found indirect (weak) evidence of effect for support services for nurses in residential care[212 213, 214], specialist staff in the nursing home[85], advance directives/advance care planning[109, 210, 211, 215-217] and there was conflicting indirect evidence on hospital in the nursing home[218, 219].

2.4.2 Strategies in the hospital

A review[220] states that there is a paucity of intervention studies directed at hospitalised cognitively impaired individuals, with dementia or other causes of cognitive impairment.

For in-hospital interventions specifically targeting patients with dementia we discovered, there is in general no or weak evidence of effect with regard to hospital use. A more extensive description can be found in Appendix 1.5. A short description is given with only studies that were directed specifically to patients with dementia in Table 32.

Table 32 – Effect of in-hospital interventions for dementia patients on hospital use

Intervention	DIRECT STUDIES Type of study/source	Results
Interventions at the emergency department	Review[221, 222]	No evidence of effect
Specialized (dementia) units in the acute hospital	Review[196, 221] Comparative direct[223-229]	No evidence of effect
Liaison psychiatry and geriatric liaison in the acute hospital	Review[222]	No evidence of effect
Comprehensive geriatric assessment		No direct studies found
Case management in hospitals		No direct studies found
Family-centred, function-focused care intervention	Comparative direct[230]	No effect on length of stay; a modest positive effect on hospital readmissions.
Transitional care:	Review[190, 231]	No evidence of effect
Discharge planning	Review[190] Comparative direct[232]	No evidence of effect Mean length of stay was reduced by 1.9 days and 26% reduction in re-attendances to emergency department
Integrated care interventions		No direct studies found
Screening in the hospital:		No direct studies found
Training	Reviews[109 221, 233]	No evidence of effect
Specialist (dementia) nurses	Review[234]	No evidence of effect
Volunteers to provide person-centred support for people with dementia in an acute hospital	Review[221]	No evidence of effect

However, for some of above mentioned in-hospital interventions, we are aware of some studies that were directed to elderly in general. These studies showed that there is (weak) evidence of effect on hospital use. However, it is not clear to what extent such effects can be extrapolated to patients with dementia. For example, indirect reviews [235-237] and indirect comparative studies[238, 239] found evidence of effect of geriatric assessment units and ortho-geriatric units in reducing the length of stay. Also indirect (weak) evidence of effect was found for in-hospital case-management[240] and conflicting evidence for discharge planning[235, 240-245].

2.4.3 *Strategies with regard to fall prevention*

Since falls and hip fractures are a common reason for hospital admission or are a frequent adverse event during a hospital stay causing prolonged hospital stay, we looked what evidence there is related to fall prevention for patients with dementia. We identified two direct reviews[246, 247] and one comparative direct study[248], from which no firm conclusions could be drawn.

Additionally we identified four reviews[249-252] on fall prevention of adults with cognitive impairment (including patients with dementia), of which three[249-251] conclude that there is inconclusive evidence and one[252] found that physical exercise had a significant effect on preventing falls in older adults with cognitive impairment.

Finally, the Flemish '*Expertisecentrum Val- en fractuurpreventie Vlaanderen'* (www.valpreventie.be) developed clinical guidelines for fall prevention in elderly at home, in residential care settings and in hospital, but they state that the effectiveness of multi-factorial fall evaluation and intervention has only been demonstrated in cognitively intact elderly. For elderly with cognitive impairment and dementia, there is currently insufficient evidence regarding the effectiveness of fall prevention strategies.

2.5 Discussion and conclusion

From the literature we conclude that dementia is a condition that affects a large and rapidly growing number of elderly. Patients with dementia have a large hospital care use in terms of ED-visits and hospital (re)admissions, and long lengths of stay. Patients with dementia have larger impact on hospital use than comparable patients without dementia. Patients with dementia are prone to complications and adverse events during their hospital stay. Reasons for hospital use are by large for other conditions than dementia, such as fall-related injuries or infections. There is a considerable amount of evidence that many hospital ED-visits and admissions are for conditions that also could (have) be(en) treated outside the hospital. Also there is good evidence that shows that lengths of stay have a large proportion of days in which there is no longer a medical reason to keep the patients in hospital.

These findings from the literature review are to a great extent confirmed by the Belgian hospital registration data:

- there is an 15% increase in hospital admissions for patients with dementia in 2014 compared to 2010
- in 2014 12.1% of all hospital beds were occupied by patients with dementia
- in 78.5% of the cases principal admission diagnosis was another than dementia; frequent reasons for admission were hip fracture, heart failure, pneumonia and urinary tract infection
- the mean length of stay decreased from 21.4 in 2010 to 19.2 days in 2014
- in 2014 the mean length of stay for patients with dementia is 19.2 days (median=13), but with a large proportion of patients that has a much longer stay
- length of stay for patients with dementia is longer than for patients without dementia, admitted for a similar condition

- length of stay for patients with dementia was especially long for those patients that were discharged to a residential care setting (mean 27.2 days in 2014, but this was in 2010 still 31.5 days)
- 7.6% of the patients with dementia died during their hospital days, of which many on the first day and many others within the first week after admission.

Secondly, we found that there is a plethora of interventions suggested to have an impact on hospital use by patients with dementia. However, direct evidence of effect of those interventions is scarce and not convincing, with the exception of advance care planning and community palliative care.

Although in many cases direct proof of evidence is lacking, most promising interventions to reduce hospital use of dementia patients seem to be to improve care for dementia patients in primary and residential care settings by more specialised nursing and medical staff and by more support and liaison services for them and for informal caregivers. Also more specialised dementia care in hospitals, such as geriatric assessment at the ED, specialised (ortho)geriatric units, seems warranted as well as investing more in discharge planning and transitional care interventions. Besides, most of these interventions are recommended and regarded as good clinical practice by several guidelines on care for patients with dementia. It may never be the case that interventions should not be given, because of a lack of demonstrated effect on hospital use, since many of these interventions do have proven positive effects on other outcomes, such as mobility, patients' satisfaction, delay of institutionalization or quality of life.

Lack of demonstrated evidence/effectiveness of interventions may have several reasons: lack of power, not well implemented interventions, heterogeneity between interventions, too short time frame for measuring outcomes, lack of contrast between intervention and control, heterogeneity in patient populations, etc. It has to be kept in mind that 'no evidence of effect' does not mean 'evidence of no effect'. It can well be the case that the interventions we encountered do have effect on hospital use, but that this still has to be demonstrated.

We encountered much literature about interventions in (frail) elderly or elderly with 'cognitive impairment', but it is unclear to what extent patients with dementia were in- or excluded in those studies and therefore it is uncertain to what extent this indirect evidence is applicable or not to patients with dementia. E.g. to what extent are interventions with a communication- and information-giving component still effective in dementia patients?

For practical reasons, we categorized interventions in a dichotomous way, outside or inside hospital. However, it has to be kept in mind that many interventions have cross-sectoral elements. And it can be assumed that magnitude of effect depends on the extent that there is good communication and cooperation between sectors. Or as the review from the Australian Institute of Health and Welfare[85] states: '*The findings of the review of strategies suggest that a multifaceted and integrated approach between hospital, mental health, residential aged care and community services is most likely to ensure that dementia care is delivered in the most appropriate and beneficial setting for the patient'.*

The concept of 'ambulatory/primary care sensitive conditions' (ACSC) deserves special attention. The literature frequently mentioned that patients with dementia visit in many occasions the hospital ED or are admitted to the hospital for conditions that also could (have) been treated outside the hospital. However, the definitions we found of those ACSC look at the problem largely from a medical point of view and don't take into account a social perspective. E.g. if a patient has no caregiver, or a surmounted informal caregiver, then a 'minor' fall, or other 'minor' event can be an understandable reason to go the hospital ED and it is also understandable that hospital professional caregivers decide in such circumstances to admit the patients since sending back home is no option and there is no immediate availability of beds in residential care settings. So, such ED-visits and hospital admissions may be avoidable from a medical perspective but this does not mean they are also avoidable when looked from a social, care taking perspective.

There are several limitations to the literature review we performed. Our search was not very sensitive, since we searched only one large medical literature database (Pubmed) and we restricted the searches to 2012-2016. Moreover, the searches were mainly based on 'PATIENT' (dementia); if searches would also have been undertaken with INTERVENTION perspective (e.g. search for 'case management' or 'comprehensive geriatric care') perhaps more relevant studies would have been found. The same applies if searches would have been undertaken with an OUTCOME perspective (e.g. hospital readmission reduction, bed-blocking), there is a chance we would have found more evidence. However, such extended searches would also have resulted in more indirect and/or older evidence, and it is uncertain if this would have changed the conclusions.

Another limitation of the review is that methodological quality of the studies was not assessed. However, such exercise would add not much in the case there is a limited amount of direct evidence.

A facet that did not receive much explicit attention in this review are the so called 'alternatives to hospital care', although we discussed some of it such as support services for residential care or hospital in the (nursing) home. We are aware that there are several reviews on hospital alternatives[189, 218, 219, 253-258], but all those are not specifically targeted to patients with dementia. The same applies to the evaluation of the Belgian scientific evaluation of projects of alternative forms of care or support of care for frail elderly and this evaluation is also not directed on the effects on hospital use.[83]

Another facet that is missing, concerns present and needed infrastructure to care for patients with dementia. For example: would an increase of residential care beds lead to less hospital use?

PART III: THE HOSPITAL LANDSCAPE IN SELECTED COUNTRIES

COMPREHENSIVE ANALYSIS OF THE HOSPITAL LANDSCAPE, REFORMS AND VISION OF THE FUTURE IN ENGLAND, FRANCE AND THE NETHERLANDS

3 ENGLAND

3.1 Background

3.1.1 Country context

England has a **National Health Service (NHS) system** which is mainly financed through general taxation such as income tax, VAT, etc. The Department of Health (DoH) and ministers are responsible for setting the government's objectives for the NHS and its budget. NHS England – the organisation mandated to meet these objectives - distributes funds (about 2/3 of the total NHS budget) and supervises and supports the 207 clinically led **Clinical Commissioning Groups** (CCGs).[259]

CCGs are responsible for the planning and purchasing of hospital activity and some community services (e.g. mental health services) for their geographically defined populations.[259] Although the idea was that CCGs are representing GPs of a particular geographical area to give them power to influence commissioning decisions for their patients, few of the GP practices have the feeling that they can really influence CCGs' decision making (unless they have a formal role).[260] Nevertheless, CCGs have secured better clinical engagement than previous forms of commissioning and are now seen by the majority of their GP members as an influential part of their local health economy.[261]

NHS England also directly procures 'specialised services' and 'highly specialised' services (see section 3.3 for more details). These are services generally provided in relatively few hospitals and accessed by small numbers of patients (e.g. rare conditions or specific specialised expertise required). By directly commissioning those services, NHS England aims to ensure that '*patients have equal access to services regardless of their location*'.

It is important to note that, in light of austerity measures, the historical **growth rate in NHS funding came to a halt**. The NHS is confronted with a funding that is slowing down which requires large productivity gains to prevent funding gaps.[262]

3.1.2 Hospital classification

Most of the secondary care (i.e. hospital) services purchased by CCGs are provided by NHS hospitals. Of the 238 NHS providers in England, 82 are known as trusts and 156 as foundation trusts. The latter are non-profit public benefit organisations (though still part of the NHS) with a degree of extra freedom with regards to how they are run. Hospitals can offer a large number of specialisms or be more specialised (focussing on, for example, children's care or cancer). Most general hospitals have a wide range of services and can be considered as large hospitals (see section 3.2). Nevertheless, there is a policy to concentrate specialised and highly specialised services in fewer centres in order to improve quality and control costs.[259]

Highly specialised services are often (but not exclusively) found in large cities within **teaching hospitals**. Despite the absence of an official definition to distinguish between teaching and non-teaching hospitals, the label of 'teaching hospital' is mostly used for hospitals located in large cities and providing secondary or tertiary care. In general, these hospitals are affiliated with a medical school, often with a large academic department and a reputation for excellence in research.[263]

Non-teaching or district hospitals are large providers of secondary care but generally lack the research component or at least they used to be. An increasing number of district hospitals is being involved in medical schools and research.

In England there are also, '**community hospitals'** often delivering rehabilitation services and which act on the interface between primary and secondary care, an organisational model that does not exist in Belgium (see section 3.2).

Although the NHS has always commissioned part of healthcare services from **private providers** (e.g. for-profit companies, social enterprises, charities), this has increased to about 10 per cent of NHS budget especially in areas with spare private capacity and where the NHS is facing problems to meet access targets.

3.1.3 Hospital capacity and use

Reduced capacity and higher use cause capacity problems

The number of general and acute 'available beds' (excluding for example, maternity and mental health beds) in England has been falling over the last decade by just under 1% per year – from around 127 000 in 2006 to 115 000 in 2015. At the same time the number of hospital admissions grew by around 16% between 2007 and 2013).[264] This increase in activity was at a faster pace than population changes, in part because of increased multi-morbidity, rising patient expectations (e.g. in relation to speed of care), earlier referrals from GPs for suspected cancer and technology advancements.[265]

The increase in admission rates is most pronounced among day cases and short inpatient stays (between 1-6 days). The capacity for extra hospital admissions is, therefore, partially the result of improved productivity, allowing hospitals to treat more patients with fewer beds. In 2016, 58% of hospital admissions concerned day cases - while they only represented 10% of bed days. Short inpatient stays (32% of hospital admissions and 25% of bed days) and especially inpatient stays of 7 days or longer (10% of hospital admissions and 65% of bed days) represent a lower proportion of admissions but a much larger proportion of bed days.[266]

Nevertheless, the occupancy rates increased substantially from around 85% in 2006 (which is commonly cited as optimal in the management literature[264]) to around 95% in 2016.[266] These high occupancy rates together with higher turnover rates (increased portion of shorter stays) cause capacity problems which escalate during periods of higher demand – such as winter months. Patient safety and quality problems have emerged: waiting times for treatment in accident and emergency departments have increased over the last two years or so partly because no beds are available to admit those

patients who need further care; infection risks have increased because of problems in maintaining cleanliness and infection control; unpleasant and disruptive patient experience, as patients are moved around to accommodate others, or placed on inappropriate wards (elderly patients on obstetrics wards, for example), etc. Pressure on services during winter can be intense. Even with the daily opening of around 3 500 additional beds (temporary beds with an equivalent of 5 to 6 additional hospitals) during the winter months of 2016/2017, average bed occupancy rates across the whole of last winter were around 95%. Moreover, on peak days several trusts reached occupancy rates of 100%.[267]

Capacity problems will continue to grow if no action is undertaken

Based on the current utilisation patterns it is expected that the number of hospital admissions will rise by 17% by 2030, with bed use increasing by 30% (in part driven by expected increase in length of stay due to more complex conditions in the ageing population).[266] It is estimated that there is a need for 9 500 extra beds by 2020, and 35 000 extra beds by 2030. Almost all of this increase can be attributed to the population of 65 years and older. Although Karakusevic (2016) also recommends investing in a reduction of short-stay admissions (e.g. avoiding admissions by redesigning assessment, diagnosis and short-stay care and shifts to GP and community care) the largest potential to free up hospital resources is expected to be by redesigning rehabilitation and discharge processes of inpatient stays of over 7 days.[266] After all, this group of longer inpatient stays (10% of admissions) uses the largest proportion of beds (i.e. 65%). This observation was already made in previous reports[268, 269] and contributed to the development of the Five Year Forward View, a plan with as main objective to shift a substantial share of hospital care outside the hospital (see section 3.6).

3.1.4 English hospitals underwent several changes in service reconfiguration

A report of Imison et al. (2014) evaluated service reconfigurations in English hospitals. They observed most service reconfigurations in urgent and emergency care; specialised services; maternity services and paediatric services. Most of these reforms were isolated while paediatric and maternity service reconfigurations were treated together.[270] We further elaborate on the reform of specialised services in section 3.3. We refer the reader to KCE report 263[271] for a description of the service reconfigurations in emergency care and to Chapter 8 of the current report for maternity services.

Service reconfigurations mainly driven by cost containment and workforce restrictions

Workforce, quality, cost and access should be taken into account simultaneously when reconfiguring services with the aim of optimising all four elements.[270] However, when studying recent English reforms Imison et al. (2014) concluded that cost and workforce (mainly doctors: senior doctors' out-of-hours availability and European directives regarding working hours of junior doctors) far outweighed the other two factors in driving service change. The areas where quality was the main driver for change were vascular surgery, stroke and trauma. Access was rarely a driver but loss of access was a commonly reported consequence of change.[270]

Resistance to change

Even the successfully implemented reconfigurations faced public and political opposition, including use of social media, petitions and public meetings. Since hospitals are a strong symbol of the welfare state, proposed changes to hospital services therefore often create high profile, contentious debates locally, and sometimes nationally.[272] As a consequence, about 40 per cent of reform proposals were not implemented as planned.[270]

The role of evidence in redesigning hospital services is important but should not be overstated

The terminology of 'reconfiguration' has often been used by English policy makers in a way that it was suggested that a problem could be solved by calculations of optimal design (e.g. optimising bed to population ratios, achieving 'rational' resource allocation). The report by Imison et al. (2014), however, stresses that '*calculations of optimal design'* are not the solution given the political nature of service change.

In addition, the evidence is often insufficient to take decisions on service reconfigurations. Therefore many of these reforms largely rely on rules of thumb endorsed by established professional organisations and institutes, rather than on careful evaluations. Yet, where evidence does exist, it should be taken into account, with the knowledge that the relevance of the research evidence is likely to be contested by stakeholders with different perspectives and values.[270] It is therefore crucial to pay close attention to the transparency, comprehensibility, and comprehensiveness of the evidence and to ensure it meets the needs of all decision makers.[273]

3.1.5 Financial sustainability NHS hospitals

Evaluating the financial sustainability is out of scope for this chapter. Nevertheless, it is important to note that several reports[274, 275] showed that the financial performance of NHS hospitals is rapidly deteriorating. A recent report[276] stated that, for the year 2015/16, 157 out of 240 trusts were in deficit. Reasons for these poor financial performance were: the high use of contract and agency staff; delayed transfers of care; financial sanctions (e.g. readmission penalties); costs of waiting list initiatives to avoid breaches of waiting time targets; the ability of hospitals to cope with demand and meet targets through productivity improvements has become harder in the short term.

It is within this tight and difficult budgetary context that organisational reforms will have to take place. The National Audit Office[274] already warned that the (financial) benefits of the redesigned models of healthcare should not be overestimated (especially not at the short or medium term) since they are new and untested.

3.2 Proximity services and small hospitals

Community hospitals

England has about 300 community hospitals.[277] Consensus about a definition for community hospitals does not exist but common elements in internationally used definitions are the fact that they are mostly led by family doctors with their own GP beds and that services are located in proximity of the patient. They can also have consultant long-stay beds, but in general specialists only support community hospitals on a visiting base or remotely.[278] Community hospitals have service models including rehabilitation, palliative care, intermediate and surgical care plus emergency and maternity facilities and collaborative arrangements with other healthcare organisations are common. Community hospital interventions, ranging from day surgery to medical inpatient episodes are characterised by care pathways that maximise local sources of support, including those outside the NHS and health care professionals.[277] As such they can be seen as acting on the interface between primary and secondary care[279] which may be particularly important in the design of future models of care (e.g. for patients with multiple chronic conditions).[278, 280] However, the evidence base about their effectiveness remains limited in geographical scope (i.e. England and Norway) and is primarily focused on post-acute care and chemotherapy.[278, 280] In addition, an intermediate evaluation of the sustainability and transformation plans (i.e. a system set up to reform the English healthcare landscape: see section 3.6), suggests that in several of these plans the role of community hospitals is reduced or even abolished, mainly driven by GP shortages.[281]

Small acute hospitals do not really exist – most have a large range of services

Compared to other Western countries, hospitals in England are relatively large. In fact, in the financial year 2012/13 there were 149 general acute hospitals (NHS foundation Trusts or NHS trusts).[282]

A NHS-Monitor[h] report[282] about the viability of smaller hospitals defined small as '*a provider with operating revenue (income) under £300 million'*. From Table 33 it can be observed that 75 (or about half of the hospitals taking care for one-third of the inpatient admissions) of English acute general hospitals meet this definition. When the classification is further divided, and when the smallest group is defined as a '*yearly revenue of <£ 200 million',* the average bed size is still 396 beds per hospital.

Most small hospitals have only one site while the average number of sites per large hospital is 2.1. Another difference between small and large hospitals is that small hospitals are located further from other providers. Although the range of services is lower in small (n=24) compared to larger hospitals (e.g. n=35 specialties), most of these hospitals still have a wide range of services in their service offer. In small hospitals the twenty most commonly provided service specialties represent 86% of inpatient admissions while this is 72% for larger providers. This difference is more pronounced in rural areas but then a differentiation should be made between factors related to size and those related to remoteness.[282]

Table 33 – Characteristics of English hospitals according to size

Hospital size (operating revenue)	<£200 m	£200m-£300 m	>£300 m
Number of providers	30	45	67
Number of sites	1	1.2	2.1
Beds	396	548	953
Services specialties*	24	27	35
Inpatient spells (=inpatient stays)	58 000	81 000	148 000
Average from nearest hospital with emergency department	26.8 km	23 km	21 km
Average distance from nearest major trauma centre	46 km	48.6 km	32.4km
Average inpatient catchment area	195 000	275 000	47 000
Average % inpatients from urban area	72%	83%	83%

** Defined as the 'Healthcare Resource Group (HRG, English Diagnosis Related Groups system) specialty' of the consultant that the patient is first admitted to. Source: NHS Monitor Report (2015)[282]*

h Sector regulator for health services in England which is now part of NHS Improvement.

Remoteness of hospitals is rare in a densely populated country

The organisation of hospital care for remote areas is almost a non-existing problem in England, which is relatively densely populated. In fact there are only 19 NHS hospitals (see Table 34) that are further than 30 km away from another hospital with an emergency department (average distance for these hospitals is 84.5 km). The average catchment are for these 19 hospitals is still 236 050 which is comparable with catchment areas of smaller urban hospitals. Despite the few genuinely 'remote' hospitals, staff recruitment and training issues are reported in smaller hospitals.[282]

Table 34 – Difference between urban and remote hospitals

From next provider with emergency department (ED)	Remote >30 km	Intermediate (between 20 km and 30 km)	Urban (less than 20 km)
Number	19	23	33
Average road distance tertiary care	83.5 km	38.6 km	20.8 km
Inpatient catchment area	236 050	256 300	236 900
Inpatients	54 111	59 044	64 477
Deprivation catchment area	17.8	18.7	23.3
Number of service specialties	26.5	24.8	25.3

Source: NHS Monitor Report (2015)[282]

A full range of services in all hospitals is no longer feasible nor desirable

Regardless of size, for every hospital the question '*which services can the hospital in question safely and sensibly deliver?'* should be evaluated. The traditional system – where smaller general hospitals attempt to provide a complete range of services by specialist teams with staffing pools too tight to make sensible rotas – cannot continue.[283] In several reports the idea about a flexible healthcare workforce is put forward in order to keep the work in smaller hospitals with less services attractable (in combination with work in other settings). Nevertheless, the feasibility of this idea is questioned since healthcare workers are typically part of their rural community, they identify themselves with the '*culture of the institution'* and are as a consequence very loyal to their organisation and its values.[283]

Smaller hospitals are (increasingly more) under pressure

Although there is no clear-cut evidence suggesting that the financial viability of smaller hospitals is lower than that of larger hospitals, there is a growing concern that in the near future the introduction of several quality standards (e.g. minimal medical and nursing staffing requirement) will jeopardize the financial sustainability of smaller hospitals. Yet, the only measurable factor that can explain differences in financial sustainability between smaller and larger hospitals is that smaller hospitals have a higher percentage of activities under the national tariff (fixed payment per hospital stay based on treatment; 70% vs 66%). This can be disadvantageous in case larger hospitals can negotiate better payments for the out-of-national tariff services.[284]

The Monitor report suggests that other non-measurable factors are more important than hospital size like, for instance, leadership; provider reputation and '*buyer power*' in procurement. Other factors that might play a role is having more than one site (duplicates management costs) and having more services (risk of having more services that operate under capacity).[282]

Smaller hospitals will have to join larger hospital networks to address workforce shortages, ensure comprehensive service provision (in particular specialist services) and to make further savings (e.g. back office, see section 3.5). Despite a clear national policy focus to further concentrate surgical and specialised services there is a strong pressure from local populations to maintain a sufficient wide range of services, even when they are loss-making (services operating below capacity).[282] Besides working together with other hospitals it will also be a must to collaborate with primary and social care. This is challenging within the current context because there is a risk for loss of income (e.g. losing patients equals losing money) and there is a lot of uncertainty about payments and risk-sharing.[282]

3.3 Concentration of specialised services

3.3.1 Specialised services are commissioned by NHS England

What are specialised services?

In England, there are two forms of specialisation of services. The first form are treatment centres specialised in specific service lines such as elective orthopaedic surgery (e.g. knee and hip replacement). The main reason to concentrate these specific services is to obtain economies of scale. Since there is no competition with unplanned care, these services can also be better carried out as planned (i.e. care is not postponed because of interruptions by unplanned care). Typically, these centres do not treat complex patients. It is, however, unclear that this is so because of financial ('cream skimming') or clinical reasons (e.g. no back-up facilities in case something goes wrong).[285] Examples of these specialised centres are discussed in section 3.5.2.

A second form of specialisation involves the concentration of services with as main aim quality improvement. The idea is that for patients suffering from rare conditions or requiring complex treatments the concentration of care is required to assure that specialist multidisciplinary teams see a sufficient number of patients to be able to develop and maintain expertise and to deliver best outcomes.[270, 285, 286] A well-known example is the concentration of stroke care services in London (see Box 4)[270] were from 2011 onwards stroke patients were admitted into one of eight hyper-acute stroke units resulting in improved outcomes.[287]

In this section we focus on the latter form of specialised services for which the following definition is used by NHS England:

> *'Those services provided in relatively few hospitals, to catchment populations of more than one million people. The number of patients accessing these services is small, and a critical mass of patients is needed in each treatment centre in order to achieve the best outcomes and maintain the clinical competence of NHS staff. These services tend to be located in specialist hospital trusts in major towns and cities. Concentrating services in this way ensures that specialist staff can be more easily recruited and their training maintained. It is also more cost-effective and makes the best use of resources such as high tech equipment and staff expertise.'*[288]

This general definition was supplemented with four factors to determine whether services should be directly commissioned by NHS England instead of by the Clinical Commissioning Groups (CCGs):[286, 289]

- the number of individuals who need it;
- the cost of the service or the facility;
- the number of capable providers; and
- the financial implications for CGCs in case they would have to commission the services themselves.

Some services, including those for very rare diseases (usually no more than 500 patients per year), are only provided by one or a very small number of centres across the country and are called '**highly specialised services'**. Examples of highly specialised services include liver transplant services, enzyme replacement therapy, and proton beam therapy for specific cancer treatments.

How does the process of commissioning specialised services work, and what budget does it represent?

The Secretary of Health decides, based on a recommendation of the 'Prescribed Specialised Services Advisory Group', which services to commission centrally. The advisory group includes representatives from CCGs, NHS England, Royal Colleges and general public.[286]

National Programmes of Care (NPoC), each having several Clinical Reference Groups (CRGs), were established around six domains: internal medicine, cancer, mental health, women and children, blood infection and trauma. For the different NPoC programmes, a board is in charge of coordinating and prioritising the work and Clinical Reference Groups (CRGs) are in charge of providing clinical advice and leadership. The methods that these advisory groups should follow (e.g. topic identification, public consultation, evidence review) are described in a manual. A key part of the CRGs' work is the delivery of the 'products' of commissioning. The rules, scope and definitions of the specialised services are published in the 'Prescribed Specialised Services (PSS) manual' which is updated at least annually.[286] For 2016/17 this manual included a list of 149 specialised services of which around 50% relate to services for patients admitted to hospital.[286] The list of specialised services is diverse and includes besides rare conditions and complex procedures also more common but costly services. Some specialised services cover the majority of care for patients with these conditions while for most conditions the specialised services only concern a part of the entire care pathway (see Appendix 2.1 for the complete list).

The central commissioning of NHS England is currently delivered through four regional specialised commissioning teams. Each region has specialised commissioning hubs with a total of 10 commissioning hubs for the country.

This national decision-making process about specialised services was only recently introduced (April 2013) with the aim to improve outcomes for patients; ensure patients have equal access to services regardless of location; and improve productivity and efficiency. Before April 2013 all services except 68 highly specialised services were commissioned locally by the primary care trusts (the local commissioners that were the predecessors of the CCGs). These 68 highly specialised services were commissioned by 10 specialised commissioning groups of collaborative primary care trusts (in line with the 10 strategic health authorities) and a national team. The functioning of these ten groups (e.g. contract setting and negotiations) was very heterogeneous resulting in variety in prices, services standards and accessibility. To deal with this large variability NHS England now commissions centrally but with ten area teams. The budget and funding mechanism also changed drastically. Before 2013, the 68 highly specialised services represented an estimated budget of £ 6 billion. With the reform a specific NHS budget for specialised services (£ 14.5 billion in 2015/16) was earmarked.[269]

The evaluation of the central commissioning highlights several shortcomings

A recent evaluation conducted by the National Audit Office pointed out that several of the objectives that were formulated at the start of implementation of the central commission of specialised services were not met. The following problems were observed:

- Despite the definition and criteria to identify specialised services, the list of services is heterogeneous. In addition, there is a general consensus that for several services that are centrally commissioned more input from local commissioners is needed. Reforms about the system are currently discussed and one possible outcome of this discussion is the move towards collaborative commissioning between CCGs and NHS England to enable a better adaptation of the commissioned services to the local context.[269] The increased use of collaborative commissioning arrangements is supported in the published 'commissioning intentions for 2017/18 and 2018/19' and progress is mainly expected on the

national priority domains: cancer, mental health and learning disabilities.

- It is hard for the NHS to get the budget for specialised services under control: the increase in effective but expensive new drugs are the main driver. The budget for specialised services rapidly increased (6.3% per year compared to a total NHS budget increase by 3.5% per year) amounting to £ 14.6 billion in 2015/16 or 14.4% of the total NHS budget. Yet, despite these yearly budget growths, the budget is yearly overspent. Although the range of specialised services is wide, only a few areas (cancer: 19%; mental health: 10%; renal dialysis: 5%; cardiac surgery: 5%) account for most of its spending. The main cost drivers are: a rising demand (ageing population, cancer), higher costs (innovations, especially high-cost drugs such as new drugs to treat hepatitis C and cancer treatments cause a higher cost per patient); changes to the specialised services portfolio (e.g. hand transplantation; proton beam therapy); changes in the system (more concentration of services where services are classified as 'specialised': e.g. neurosurgery appointments in specialised centres increased while they decreased in non-specialised services). The NHS England tried to control its budget by reducing the prices paid for NHS services. However, these measures caused financial problems for the trusts since the tariffs were not always sufficient to cover the costs. Yet, trusts that have a high portion of their income from specialised services are still in a better financial position than those trusts with less specialised services (see also section 3.2). The financial challenges faced by NHS providers have been recognised in the tariff arrangements for 2016-17. Monitor and NHS England reduced the tariff efficiency requirement to 2% (instead of 3.5%), and have suspended the marginal tariff for specialised services.
- There are too many specialised services and downsizing is required. The large number of services threatens the financial stability of the NHS because there is a faster increase in NHS specialised services budget than in other services and NHS England doesn't have the essential information (e.g. costs; access to services; outcomes) to manage the pressure on its budget for specialised services and to gain assurance that its objectives for these services are being met.
- Investments in commission capacity. The decision to commission at the central level, strengthens NHS position to influence providers and reduce prices but also requires investments in commissioning capacity. These investments increased from £ 20 million and 307 full-time equivalent staff (FTE) in 2014/15 to £ 38 million and 489 FTEs in 2015/16. It is questioned whether the ten commissioning hubs have sufficient (commercial) expertise to capitalise the stronger power position after centralisation. An example where NHS England successfully used its bargaining power and secured substantial reduction in prices was for a ten-year contract for PET-CT (positron emission tomography–computed tomography) scans. However, this commercial capability is not always present. An additional limitation is that the current specialised services are commissioned with one year contracts which hinders NHS trusts to plan services for the long term.[269]
- NHS England also lacks sufficient information to fine-tune its policy. For 1/3 of the services a national tariff is set and NHS England exactly knows how much it spends. For the remaining services (including some high-cost drugs) the prices vary and there is lack of uniform national data.[269]
- Access still varies across the country. Data analysis indicates that there is still great variability in access to centrally commissioned services. In 2014/15, for instance, the number of cancer patients (aged 25-74) receiving chemotherapy per 100 new cancers varied from 42 to 74 across CCGs.

Box 4 – Centralisation of specialised services: the example of stroke

Major system change in healthcare is seen as having the potential to increase the provision of evidence-based care and improve clinical outcomes. One such change is service centralisation, whereby service provision across a given region is concentrated in a reduced number of hospitals. The impact of centralisation on outcomes has been demonstrated in several specialist healthcare settings. However, evidence on how changes of this scale are implemented, and the relationship between implementation approaches and the impact of changes on quality of care and costs, remains limited.[290] Implementation outcomes, for instance, are likely to influence overall intervention outcomes, including provision of evidence-based care, clinical outcomes, patient and carer experience, and cost-effectiveness.

In 2010, London and Manchester implemented a major system change of their acute stroke services. These services were reorganised in order to improve rapid access to evidence-based care (e.g. assessment by specialist stroke clinicians, rapid brain scanning, and thrombolysis where appropriate). Yet, the organisational configuration chosen to implement these evidence-based processes differed in both regions. Although both Manchester and London developed hyper-acute stroke units their role differed. In London, all patients were eligible for treatment in a hyper-acute stroke unit (the '24 h pathway' on a 24/7 basis) while in Manchester patients were only referred to a hyper-acute stroke unit when they could arrive there within 4 hours (the '4 h pathway') of symptoms developing (in order to facilitate administration of thrombolysis) and only during office hours. Patients presenting later were transferred to their nearest district stroke centre which was designated to provide all aspects of acute stroke care required beyond the first 4 h.

Also in London, besides the hyper-acute stroke units, 24 other stroke units were developed to take up a role in the provision of care in the acute rehabilitation phase. Yet, patients were only transferred after the acute phase. Another difference is that in London stroke services were closed in five hospitals as part of the reform while in Manchester no services closed. These significant differences in the type of models implemented in the two regions reflect the limited evidence at the time on optimal service models for providing evidence-based care. Indeed, it was the role of the 'stroke clinical networks', which brought together representatives of all relevant stakeholder groups under a central leadership team, to 'review and organise delivery of stroke services across the care pathway'.[290]

Although mortality rates dropped in both London and Greater Manchester, only in London it decreased more than in other urban areas in England.[287] The different choices in the implementation process are one possible explanation for these different results. After all, it was illustrated that stroke patients in London had higher chance of receiving evidence-based care compared to Manchester because more patients were treated in hyper-acute stroke units (39% in Manchester compared to 93% in London).[291] As such, it is recommended to design a simple and inclusive model (i.e. all stroke patients) rather than a complex and selective (i.e. only patients below a certain time threshold). Other differences that contributed to the different results were:

The launching of the system:

- London: one single day
- Manchester: phase implementation

The level of support of clinical networks:

- London: hands-on support
- Manchester: networks only served as a learning platform

Leadership and management of local resistance:

- London: a combination of 'top-down' system leadership with 'bottom-up' clinical leadership
- Manchester: more bottom-up and consensus-driven. Programme leaders had to rely on consensus being reached between all local partner organisations (resulting in a less radical service redesign).[292]

From the evaluation of both cases it is clear that: the care pathway should be based on evidence as much as possible; a 'top-down' approach should be combined with a 'bottom-up' approach; all relevant stakeholders should be involved; hands-on support should be provided during the implementation phase and that service standards should be clearly defined and linked to financial levers.[292]

3.4 The role of acute care hospitals in integrated care

There are several reports that stress the importance of integrated care (e.g. ageing population, societal trends, multi-morbidity and chronic conditions) and the position of hospitals within this context.[293-295] It is beyond the scope of this study to make an in-depth analysis of these reports. Yet, it is clear that hospitals can no longer act alone and will have to be part of a web of services that go beyond the hospital walls: hospitals will work with community services to deliver integrated care and will construct networks with other hospitals; health systems will be formed by uniting hospitals and other care organisations within one organisation, etc.[293] The shift from isolated institutions towards inter-connected and collaborating organisations is a vision that is shared by NHS England and for which vanguard projects are started to put this vision into action (see section 3.6.2). It is also one of the main drivers in the pursuit of new collaborations and governance models (see section 3.5). Nevertheless, based on the available evidence it seems wise to not overestimate the beneficial effects (i.e. cost saving because of decreasing hospital capacity use) of these reforms on the short or medium term (see section 3.6.3).

3.5 Collaboration forms between hospitals

3.5.1 Mergers: the dominant form of structural collaboration form between English hospitals

Hospitals trusts were introduced in the nineties to initiate competition

The English hospital sector underwent several reform waves during the last two decades. In the nineties the conservative government established with 'hospital trusts' an organisation form that aimed for greater managerial and financial autonomy and increased competition between providers. These were free-standing entities led by a single management board responsible for financial and quality outcomes but still part of the NHS that remained responsible for regulating both the financing as the quality. Hospitals competed for contracts from purchasers who were funded on a risk-adjusted capitation basis.[296] As such, in England there is competition on the provider side (like, for instance in Nordic countries) but not on the payer side (as for example in the Netherlands).

Around 2000 a large wave of hospital mergers to cut back (administration) costs

By the instalment of a Labour government in 1997, the policy focus moved to a certain extent from competition to collaboration by a large wave of hospital mergers (i.e. merging two or more hospital trusts into one trust with a single management board). The purchaser-provider split remained in place. One of the main reasons for these mergers was to cut back office and management costs (and not economies of scale of the patient-related hospital services) and to reduce the number of hospitals with financial problems.[297] Mergers were more realised in urban compared to rural areas.[297] The number of hospital admissions and the staff number did decrease compared to the pre-merger situation. Yet, Gaynor et al. (2012)[297] found little evidence supporting the by English policy makers envisaged benefits (e.g. better financial performance and productivity, less waiting times, better quality) at the time of their decisions to merge.

Competition by patient choice seems to work

The government policy was also characterised by stimulating freedom of provider choice for patients, a shift from selective contracting to payment per case and even greater autonomy for well performing hospitals (e.g. keep some surpluses, a system that already existed since the early 1990s). These reforms – in particular the fixed, nationally determined menu of tariffs for individual procedures - were expected to improve the incentives for hospitals to compete on quality (and not on prices). Despite the greater autonomy for hospitals, national targets – in particular for waiting times – remained in place and indeed were progressively tightened. In parallel, both NHS hospitals and the private/voluntary sector who treated patients paid for by NHS purchasers were subject to a developing framework of regulation through inspection and authorisation. Hospitals failing quality and financial standards were subject to intervention by regulators, up to and including the removal of the board of executive and non-executive directors and the

closure of wards and patients transferred to other hospitals. The impact of these reforms (i.e. competition by patient choice) appears positive (e.g. increased amount of competition in markets; good hospitals attract more patients post reforms; quality of care risen without increase in expenditure) while the evidence base underpinning these positive results remains weak. It is possible that some of these gains are due to better management since better management was observed in competitive environments.

Mergers slowed down but revived between 2010 and 2015

The number of mergers slowed down after 2004 but revived again between 2010 and 2015 with mergers involving NHS trusts, foundation trusts and primary care trusts[i]. By 2015, there were 150 acute foundation trusts and NHS trusts.[298] Hospital mergers (and, for example, the joint management of hospitals) continue to take place especially when hospitals reach a point of crisis with respect to financial or quality problems which have not been resolved through other means.

Collaboration between hospitals: beyond hospital mergers

The fact that most English hospitals are large results from policy programmes of hospital closures and mergers of co-located hospitals initiated around 1997. Between 1997 and 2006, 112 of the 223 general hospitals merged.[297] Mergers generally attempt to achieve cost savings and financial stability; improved clinical outcomes (e.g. improving care processes and redesigning the service offer); other organisational scale advantages (e.g. increased ability to recruit staff or to perform clinical research).[276] Evidence suggests that past mergers in the English NHS were not so successful in terms of better financial performance, productivity, or other process (e.g. waiting times) and quality outcomes.[276, 297, 298] Moreover, a King's Fund report suggests that organisations might pursue mergers chiefly to obtain extra funding (via financing packages that support the mergers) rather than the assumed merger benefits.[298]

Nevertheless, the success of mergers can be improved when:

- There is clarity about the strategic rationale, instigated by the involved providers with full commitment of the board;
- The merger is prepared and planned in a robust way allowing the time needed to achieve improvements;
- Stakeholders engagement is effective (particularly that of clinicians);
- Momentum is built to implement merger objectives without losing sight of core activities;
- Importance is given to create a common culture;
- The expected efficiencies are realistic.[276]

Although NHS Improvement made recommendations[276] for organisations that consider mergers or acquisitions, mergers are no longer the single option to establish collaboration. On the contrary, there is more and more support given to smaller hospitals to ensure their survival[282] being it with little policy guidance on minimal hospital size (e.g. no minimum catchment area or population size defined for hospitals).[299] Moreover, there is a policy intention to move away from stand-alone general acute hospitals with all having the full range of services. Instead smaller hospitals will be part of larger hospital networks.

[i] Primary Care Trusts (PCTs) were purchasing and not providing organisations. Mergers between PCTs were part of the government plans in 2010 in part to reduce their number (>300) and in part to save on administration and management costs. PCTs were reformed into CCGs.

Other collaboration forms than mergers are needed to go beyond the traditional models of care

In all cases neighbouring hospitals merged, mostly with a similar service offer resulting in the perpetuation of the traditional model of large, full-service hospital trusts.[298] This observation is in contrast with the vision depicted by the five-year-forward view of the NHS and thus alternative collaboration forms will be required. Delivering the new models of care that are described in the 'Five Year Forward View' will necessitate a shift from isolated organisations towards different forms of collaboration both between hospitals and between hospitals and other organisations in primary, social care, etc. Nevertheless, it should be noted that over the past years the estimated budgets that are used to finance mergers are still much higher than the £ 200 million that is provided to realise the transition towards the new models of care as depicted in the five-year-forward view.[298] The report states that hospitals should stop pursuing mergers to solve their financial problems (sometimes quality). Instead alternative and less risky and disruptive collaboration forms such as federations, joint ventures, outsourcing and place-based systems of care should be explored.

It is worthwhile to note that in case of mergers (and other forms of collaboration) a tension between collaboration and competition emerges. As a consequence, the CMA (Competition and Markets Authority) often gets involved in the approval process of mergers (and sometimes also in case of other collaboration forms) to make sure that the loss of competition is more than compensated by other gains of merger (or other collaboration forms) for patients.

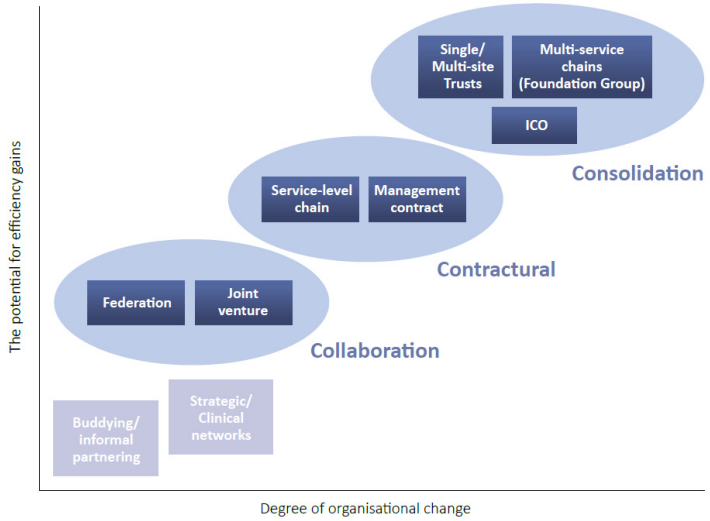
The 'Dalton review' evaluated the potential of new collaboration forms for NHS England

Hospitals are not islands, they are part of an interconnected web of care from the patient's home to the most specialist tertiary-level service. Clinical networks and new technologies offer opportunities to strengthen collaboration and coordination. In doing so it is important that services are planned such that the most efficient distribution of services is obtained, that service duplication is removed, and that patients receive the right care, in the right location, at the right time.[270] There are already light collaboration forms in the NHS that contribute to these objectives, such as:

- Strategic Clinical Networks: They bring together groups of health professionals to support commissioners to improve services for a particular condition in order to improve the quality of care and outcomes for patients.[288] Examples of Strategic Clinical Networks are: cancer; cardiovascular; maternity and children; mental health, dementia and neurological conditions.
- Operational Delivery networks: NHS England is also responsible for Operational Delivery Networks (ODNs) that were launched in April 2013. ODNs are focussed on coordinating patient pathways between providers over a wide area to ensure access to specialist resources and expertise. ODNs are organised in 12 geographical regions. The network is hosted by an agreed lead provider within the geographical area. The first ODNs in England were developed from established managed networks with national coverage: adult critical care; neonatal critical care; major trauma; burns care.[288]

In this section, however, we focus on more far-reaching collaboration models. A review, also known as 'The Dalton Review'[300], was undertaken to evaluate which organisational forms have the potential for wider adoption across NHS providers. The Dalton Review evaluated the following collaboration forms: federations, joint ventures, service level chains, management contracts, integrated care organisations and multi-service chains or Foundation Groups (see for an in-depth description of these models Appendix 2.1; see also Figure 44 with models ranked according to degree of organisational change and potential for efficiency gains).

Figure 44 – Collaboration forms according to degree of organisational change



Source: The Dalton review[300]

3.5.2 Collaborative organisation forms

Federations

Federations can be best described as a 'collaboration on one or more services or back-office provisions' with the following characteristics:

- Organisation sovereignty retained;
- Legal agreement not required;
- Best practice: Memorandum of Understanding (MoU) specifying that one organisation leads the governance, quality and finance;
- Extremely flexible collaboration form;
- Lack of structural integration and thus no fear of being subsumed in a larger group.

NHS trusts and foundation trusts are free to enter into a federation while the private sector would be unlikely to get involved in a federation especially given the lack of a firm legal structure. In England there are already successful federations in operation. An example of a federation that is spread across a large territory are Academic Health Science Networks.[301] There are generally no infringes of the competition law since for most federations the relevant market is less than 10%.[300]

Joint ventures

In joint ventures, two or more organisations pool their sovereignty in a:

- Corporate Joint Venture which involves a new legal entity to manage a particular service line with shared risk. Financial and clinical business of the joint venture is separated from that of each partner. The joint venture can do its own strategic planning.
- Contractual Joint Venture to create a shared services agreement with another organisation. In contractual arrangements one trust takes the lead responsibility for governance, quality, performance and finance reporting. All risks are born by host association.

Joint ventures typically have a narrow focus (one service line).

There are no legal restrictions for either NHS trusts or foundation trusts in terms of starting a joint venture or choosing a partner. NHS trusts and foundation trusts are free to enter into a joint venture, providing that the proposal meets competition requirements. There is no specific requirement for NHS Monitor approval unless the joint venture entails the movement of more than 25% of the foundation trust's total activity. Joint ventures between NHS organisations are comparatively rare when compared to the prevalence of the involvement of the private sector. Joint ventures of this kind are common and there are no restrictions on whether a trust/foundation trust can form a joint venture with the independent sector, providing that the joint venture meets all of the established standards, and goes through a requisite procurement process: start-up capital; track record in successful

joint ventures; subject expertise and proven track record. There are already a number successful joint ventures in existence in the English NHS, both NHS to NHS and also NHS or social enterprises with the independent sector (see Box 5 for an example of orthopaedic surgery). A lack of clarity regarding the establishment of special purpose vehicles and the different contractual mechanisms has meant that the organisational form is not as wide spread as potentially it could be.

Federations provide a fertile environment for the formation of joint ventures. This is especially true if a federation wishes to share service functions between some of its members, as often a joint venture will be required to execute this ambition. Joint ventures within a multi-service chain exist internationally but not in England. Successful joint ventures can also become the hub site in a service-level chain, with spokes in new, non-contiguous organisations using the same systems, processes and expertise as the hub (joint venture being expanded into a service-level chain).

Box 5 – Example of elective orthopaedic surgery

What? A Contractual Joint Venture established by four South West London acute trusts to deliver strategic change in the delivery of planned orthopaedic care: St George's Healthcare NHS Trust; Kingston University Hospital NHS Foundation Trust; Croydon Healthcare NHS Trust; and hosted through Epsom & St Helier University Hospitals NHS Trust. The orthopaedic clinic has 71 beds (two 27-bed post-operative wards and a 17-bed recovery suite including high dependency and level 3 critical care facilities) and has five orthopaedic operating theatres.

Where? Epsom hosts the operation on one of its own sites. The orthopaedic clinic itself is contained within the Denbies Wing of Epsom hospital, a separate building dedicated specifically to the project. A contiguous venture, with each trust within 40 minutes of the other.

Which features/characteristics? Standardised care pathway (patients are mobilised early and average post-op length-of-stay of 4 days); Common Procurement Initiative (the clinic runs the prosthetic contract for London).

Results? Financial status in Year One: Deficit of £ 4.2 million; Financial status currently: £ 3 million surplus, returning 9-10% margin versus average of 1% for comparable services.

How they achieved it? Innovative thinking with maintaining patient flows, such as running their own taxi service to get healthy patients out of beds and back home. Maintaining high levels of occupancy;

Governance drawbacks? Risk not evenly spread across the partners. It is a contractual joint venture and, as such, Epsom, the host site, runs both the site and all the contracts for the joint venture. It also takes responsibility for any breaches of 18 week RTT (Maximum Waiting Time from Referral to Treatment), even if the original referral was from another trust. Some confusion over the paths of accountability. The director of the elective orthopaedic surgery clinic reports not only to Epsom's Chief Operating Officer, but also to the elective orthopaedic surgery clinic's own Partnership Board, headed by an independently appointed head.

Financial drawbacks? Lack of reinvestment of surplus in the elective orthopaedic surgery clinic. The nature of the joint venture means that most of the surplus is distributed among the four trusts, and not back into the elective orthopaedic surgery clinic.[300]

3.5.3 Contractual collaboration forms

Service Level Chain

In a service level chain one provider provides services for other providers. The service level chain is further characterised as follows:

- Host and outreach provider maintain sovereignty;
- May share equipment and premises but rarely staff;
- Typically one specialism;
- Time-bound arrangements with control being temporarily transferred to another organisation;
- Several possible ways, e.g.:
  - Host provider outsourcing services to the service level provider;

- Service level agreement (SLA) where the host organisation holds the service level provider accountable for delivery;
- Paying a fee to use the policies and protocols of the first provider.

Service level chains are present in the English healthcare sector (see Box 6), so they are feasible. Geography and the service specialism provided may be constraining factors. Service locations far from the service provider headquarters may be more difficult to manage. Where patients cross the boundary between outreach and host organisation, liability arrangements must be well-thought through. NHS has both independent and public sector operators providing service level chains, and there is appetite in the sector for more chains to be set up. It is possible for a trust to act as a hosting organisation where the majority of the activity on the site is delivered by multiple service level chain operators, e.g. ophthalmology by one and dialysis by another service level chain such as the Queen Mary in Sidcup. However, this form has the potential to be challenging to manage. Interface between different service providers needs to be carefully managed as there are culture and infrastructure considerations, particularly if they use different IT systems or patient record systems. Patient cross over from one to another service provider (e.g. from cancer to cardio) could be complex in terms of liability.[300]

Box 6 – Service level chains operating in the NHS: some examples

Moorfields Eye Hospital

Largest ophthalmic provider in England. Approximately 50% of the activity delivered in the trust's 22 satellite locations. Moorfields geographical focus and reach for the future is shifting form 'hub and spoke' into a distributed network of more clearly defined facilities:

- Moorfields Eye Hospital, City Road: central London base, comprehensive general and specialist eye services and 24/7 emergency eye care
- District hubs: Co-located with general hospital services, providing comprehensive outpatient and diagnostic care and more complex eye surgery
- Local Hubs: provide more complex outpatient and diagnostic services alongside day-case surgery for the local area
- Community-based outpatient clinics: focus predominantly on outpatient and diagnostic services in community-based locations closer to patients' homes
- Partnerships and networks: Moorfields offers medical and professional support and joint working to eye services managed by other organisations.

Newmedica

- Independent sector operator providing specialist eye care services to NHS. Sub-tariff delivery of a NHS branded product. Thirteen active contracts across England.

The Walton Centre

- Biggest neurosurgical unit of England; Partnerships with 13 NHS trusts. Hub – The Walton Centre in Liverpool (40% of outpatients); Spoke – 50 satellite clinics and ward referral services around the region.

The Royal Marsden

- Two hospitals running an outsourced specialist cancer unit with diagnostic and outpatient services in another trust. Unit operates under a profit share arrangement.

Alder Hey

- One of Europe's busiest children's hospitals wants to offer paediatric services to other hospitals as part of its 5 year development plan.

Management contract

The collaboration form of 'management contracts' means that some or all management control of the operations of an organisation is awarded to another organisation with sufficient management expertise to manage for an agreed duration. It is a flexible form of collaboration.

Management contracts are commonly thought of as a means to address financial distress in NHS providers, but their potential uses are much wider. Nevertheless, the NHS has relatively limited experience of both management and operational franchises. At the time of the Dalton review there was only one management contract operational: 'Circle in Hinchingbrooke Health Care NHS Trust'.

The terms management contract and operational franchise are often used interchangeably when discussing these options in the NHS context. While there are differences, the legislative framework for NHS trusts and foundation trusts is such that any external management must sit within or underneath the existing governance roles and structures.

Foundation trusts have general powers to enter into contracts which would include taking on a management contract in an NHS trust or another foundation trust. A management contract at a foundation trust must not run contrary to the duties of foundation trust directors and governors, so there are limits on the type of arrangement that can be put in place. It is possible to enter a management contract at a foundation trust where directors still retain their decision making role and remain accountable to the governors e.g. through a partnership committee.

NHS trusts have general powers to do anything which appears to it to be necessary or expedient for the purposes of or in connection with its functions and in particular it may enter into contracts. The most likely mechanism to be used for trusts would be an NHS trust 'shell', which would retain the property, the staff, any protected assets and ultimate accountability. This is the form at Hinchingbrook. In addition, the Hinchingbrook Board was reduced to the statutory minimum to allow Circle (operating the management contract) greater operational autonomy.[300]

3.5.4 Consolidated collaboration forms

Integrated care organisation

An integrated care organisation (type of Primary and Acute Care System: see section 3.6.1) joins some or all of the acute, community, primary care, social care and mental health services in a variety of forms. Integrated care organisations are characterised by:

- The management of patients from a particular population through care pathways supported by shared data, IT and information systems;
- Risk-adjusted capitation based budgets;
- Controlling the whole care pathway by a single provider (formal or virtual via a network/alliance).

The commissioner enters into a contract with one organisation and that organisation sub-contracts with other providers to deliver care along the pathway.

There is currently no defined contractual mechanism for formal integrated care organisations in the NHS. Yet, there is increasing interest given the need to shift towards more community-based care models. Only a limited number of pilots and early adopters are exploring integrated care organisations as a first step towards accountable care organisations. There are no legal barriers to commissioning these forms of collaboration. Yet, it requires Clinical Commissioning Groups and NHS England to work jointly to derive the full potential benefits. The various collaboration forms that emerge in the NHS are (in order of increasing degree of organisational alignment):

- Independent provider contract:
  - Commissioner contracts separately with individual providers who each remain responsible for financial viability.
- Alliance contract:
  - Collaborative agreement without a new organisational form. There is one contract with an alliance of parties (informal joint venture) remaining all responsible for individual financial performance but

with a pre-agreed collective ownership of risks and distribution of gains.

- Lead contract:
  - Contract with one lead provider (who bares risks and benefits) that sub-contracts other providers to deliver care as agreed with the commissioner.
- Integrated providers:
  - A single new entity, that joins healthcare providers covering a range of domains, contracts directly with commissioner.
- Fully integrated system:
  - Same entity both pays and delivers care.[300]

Multi-site trust

A multi-site trust is the result of a merger of at least two organisations where a new organisation is created or where one organisation is acquiring the other one(s). This is the status quo, as this concerns the most prevalent collaborative form in NHS especially to reconfigure services in large cities. The Royal College of Surgeons, for instance, recommends a minimum catchment area of 300 000 people for a hospital with an emergency department. This might result in single and multi-site trusts in cities and smaller local rural and remote hospitals will be decommissioned.[300]

Multi-service chain (or foundation group)

In multi-service chains individual sites operate within a framework of delegated responsibility. They deliver services to multiple populations, not geographically defined. Headquarters set strategic goals and individual sites keep operational autonomy.

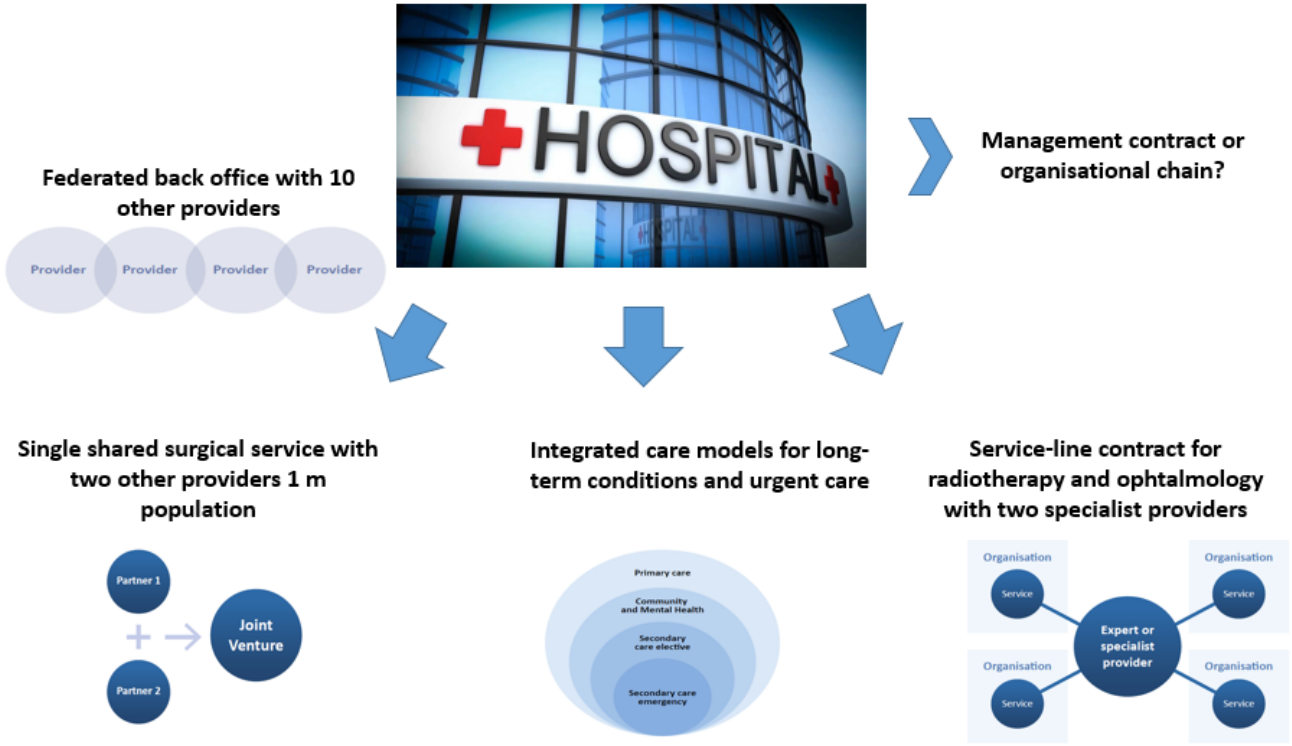
Multi-service chains dominate the private hospital market (e.g. BMI healthcare operates 69 hospitals and treatment centres in the UK) but none yet exist in the NHS. It is possible for trusts and foundation trusts to form chains but it should be noted that international examples of hospital chains generally consist of smaller hospitals than the typical NHS hospitals.

3.5.5 Adopt collaboration forms that suit local circumstances

The Dalton review does not put forward one collaboration form. On the contrary, the authors recommended to develop organisational forms to deliver the models of care which best suit local circumstances. They argue that local system leaders understand their own population needs, historically developed service offer and geographies best which is key in determining whether or not alternative organisational forms would be needed to deliver greater benefits to the populations they serve.[300, 302] In addition, they recommended to further encourage ambitious organisations with a proven track record to expand their reach and have greater impact.

There are currently already examples of many of the organisational forms underway – particularly federations, joint ventures, multi-site trusts and, increasingly, integrated care organisations, with trusts bringing together different combinations of acute, mental health and community services.[302] It is expected that the application of various collaboration forms will increase in the near future and that the stand-alone general acute hospitals as they exist now might disappear. The Dalton review envisages hospitals of the future as organisations that are integrated in a larger health service system where the boundaries between the different levels of care disappear. In Figure 45, the possible configuration of a hospital of the future is depicted. It is important that a shift takes place in the mind-set of provider boards from service change as the prospect of their organisation 'winning or losing' to one where organisations work together to 'win' for their patients and wider community. Indeed, greater collaboration and integration between organisations within local health economies holds great potential; however, it remains equally important that patients and communities know who they can hold to account for the services they receive, and what the process is for doing so.[300, 302]

Figure 45 – Hospital configuration of the future?



Source: The Dalton review[302]

3.6 Vision on the future

Several committees, professional organisations and academic groups are researching and reflecting on the future role of hospitals.[301, 303] In this section, however, we will focus on the Five Year Forward View of the NHS.

3.6.1 Five Year Forward View

Introduction

The NHS published in 2014 with 'Five Year Forward View' its vision on the future. It focuses on priority domains such as prevention and on the development of new organisational models. We briefly discuss prevention but focus in this section mainly on the new organisational models. These new models of care focus on dissolving the traditional boundaries between hospitals, primary care, social care, etc. Broadly speaking these models aim to:

- Manage systems, networks of care and no longer individual organisations;
- Increase out-of-hospital care activities;
- Integrate services around the patient;
- Learn faster from (inter-)national best practices and evaluate them when implemented.

Different from most other NHS plans, it is argued that England is too diverse for a 'one size fits all' care model to apply everywhere. But nor is the answer simply to let everyone develop its own model since this will risk to result in fragmentation and lack of coherence with the overall vision. Instead the plan outlines a number of care models that the different local health communities can adapt to put in place services that meet the needs of local populations. For the worthwhile initiatives (those that fit in the overall vision and meet local needs) the resources and support to implement them will be provided.[304] The implementation of the ambitious plan will require that serious support is given to local leaders.[305]

Prevention, patient empowerment and engaged communities

The report states that a radical upgrade in prevention is required: a policy that incentivises and supports a *healthy behaviour* (e.g. healthy diet, less alcohol consumption, smoking cessation, sport); *targeted prevention* (e.g. developing national evidence-based diabetes prevention programme); *to help people get and stay in employment*.

Patient empowerment will have to be stimulated by improving the access to information (e.g. clinical advice, about their condition and history); actively supporting self-management (e.g. group-based education sessions for people with specific conditions); by increasing the control of patients over their care (e.g. integrated personal commissioning pilots).

Engaged communities by supporting carers and volunteers (e.g. flexible working arrangements for NHS staff with major unpaid caring responsibilities; tax reduction for volunteers) will gain importance in the knowledge that two-thirds of hospitalised patients is over 65 years of age and that more than one-fourth of inpatients have dementia. The NHS will also strengthen its relationships with charitable and voluntary sector organisations and will market itself as a local employer reflecting the diversity of the local communities.

Focus on primary care and 'out-of-hospital care'

The NHS forward view aims first and foremost to strengthen primary care and 'out-of-hospital care'. Investments in primary care will include: the stabilisation of core funding for general practice nationally; increasing the impact of GPs on the NHS budget and encouraging a shift in budgets from secondary to primary care by means of GP-led Clinical Commissioning Groups; providing funds that support new ways of working and improved access to services; supporting the primary care workforce by expanding the number of GPs in training, community nurses and other primary care staff; informing the public about the right care at the right moment at the right place.

New models of care - the Multispecialty Community Provider

Multispecialty providers are fully integrated providers of out-of-hospital care built around the registered list (cf. GP lists) based on population size of at least 30 000 to 50 000 people. They are larger group practices to be also staffed with consultants (e.g. geriatricians, paediatricians and psychiatrists) and senior nurses who work alongside community nurses, therapists, pharmacists, psychologists, social workers, and other staff. It is assumed that, in the future, these multispecialty community providers will perform the majority of outpatient consultations and some will even take over local community hospitals or have admitting rights in hospitals. Without changes to commissioning and funding arrangements, the argument for new models of care will remain theoretical.[306] Therefore, it is foreseen that they could in time take on delegated responsibility for managing new capitated contracts for population health and care. Multispecialty community provider vanguards were launched to move this concept forward (see for more details: NHS England[301]; the King's Fund reports[305, 307]).

These multispecialty providers will use their risk-adjusted capitation budgets to decide if they will provide or commission services. This will require that they have capabilities such as contract negotiation, financial management, management of clinical quality etc. Integrated care funds will require the pooling of CCG-budgets and NHS-budgets (for primary care provision). *It is recommended that NHS commissioners work with interested and capable general practices who operate at a sufficient scale to establish multispecialty providers that take control of a capitated budget to deliver integrated out-of-hospital services.*[305]

New care model – Primary and Acute Care Systems (PACS)

Single organisations will be allowed, analogue to the accountable care organisations in the US, to provide primary, social, mental health and secondary care to registered patients. Sometimes it is more appropriate that the leadership is taken by a hospital (e.g. deprived urban communities characterised by a GP shortage). Under such a scenario, hospitals may open their own GP surgeries with registered lists, of course with safeguards set in place to ensure that hospitals reinforce out-of-hospital care, and do not do this to attract patients from primary care. When Multispecialty Community Providers (see section above) become mature, they also could take the leadership and could even take over the running of main district general hospitals. The most far-reaching form of a primary and acute care system is one that takes full accountability for the whole health needs of a registered list of patients, under a delegated risk-adjusted capitated budget.[305]

Collaborations between GP practices and hospitals are difficult given different historical, cultural backgrounds. Nevertheless, several examples of collaborations on the field exist and it is shown that a parallel development of federations or networks in general practice help to support such collaborations. Virtual organisations are deemed more realistic than single merged organisations. This can take the form of a general acute hospital that collaborates with a federation of general practices by using joint ventures or other contractual mechanisms. It should be noted that primary and acute care systems could have problems with the competition regulators since they could obtain a monopoly in their area. A way to handle with this constraint is to tender the management of primary and acute care systems for a period of 10 years in a form of competition for the market.[305]

New care model – urgent and emergency care networks

Urgent and emergency care networks are being created to ensure that patients receive the right care, at the right moment at the right place. We refer the reader for a more detailed description to KCE report 263.[271] Such a network will include adequate telephone triage (NHS 111 for triaging and dispatching primary care calls; 112 for emergency calls), specialised centres working in networks with general hospitals to ensure that the most serious needs get to specialist emergency centres (e.g. major trauma patients); primary care centres co-located at the emergency department to avoid inappropriate ED visits, etc.

New care model – viable smaller hospitals

As described above, England has compared to other Western countries already relatively large hospitals. Nevertheless, it was indicated by a Monitor report that the struggle to survive financially is greater amongst the smaller-sized hospitals.[282] Therefore, in order to ensure that smaller general hospitals can continue to deliver specialised care (for which no concentration is required) to the local population new care models will have to be developed. In line with the Dalton review[300], the Five Year Forward View recommends to:

- Develop hospital chains where smaller hospitals share the management of the entire hospital or a part (e.g. back office) with other similar hospitals;
- Have smaller hospitals where some of the services are provided by specialist providers on the site of the small hospitals (e.g. elective orthopaedic services provided by an orthopaedic centre);
- Form primary acute care systems (see above).

New care model – specialised care

The concentration of services for which evidence clearly states that a relationship between volume and quality of care exists. This process already started with stroke units and major trauma centres as notable examples (see also section 3.3.1). The five-year-forward view clearly wants to continue to follow this course. It is stated that evidence suggests that such a volume-outcome relationship is expected for most specialised surgery and for some cancer and other services. Further concentration of specialised services will be done under the form of geographically organised networks with different organisations and services to ensure that proximity and concentration are reconciled (e.g. complex cancer surgery and radiotherapy in a tertiary care hospital and chemotherapy in local hospitals; see also Chapter 6). Prime contracting and/or delegated capitated budgets will be used to support the implementation of such a model.

New care model – enhanced health in care homes

This model is detailed in Chapter 2 on dementia. The bottom line is that the boundaries between secondary care and nursing homes should be transcended to keep nursing home residents outside the hospital environment as long as possible. Examples are hospital consultants on call, specialist consultations (e.g. advanced practice nurse or geriatrician) in the nursing home, etc.

New care model – modern maternity services

Also this model will be detailed elsewhere (see Chapter 8 on maternity services). The aim for this high-volume group is to decrease their use of hospital services by shortening length of stay but also by an increased number of home deliveries (when this is the preferred choice).[301]

3.6.2 From vision towards implementation

Long-term plans combined with yearly operational plans

The NHS is required to deliver two connected plans:

- A five year sustainability and transformation plan (STP): every health and care system is asked to develop its own ambitious local blueprint for the 2016-2021 period based on a planning made for the local population and no longer for individual institutions. The plan covers all clinical commissioning and NHS England commissioned activities including specialised services (planned by one of the ten NHS England Commissioning Hubs) and primary medical care. Protected funding is foreseen for implementing new models of care (ambition that more than 50 per cent of the country will be covered by the new care models) across the territory but also beyond the vanguards. Indeed, the vanguards will act as blueprints for the future of the NHS so it is important to identify the successful ones with early and systematic evaluation methods.[301] The STPs with the highest quality and credibility will come first to receive extra money (from April 2017 onwards).

- A one year operational plan that is consistent with the STP for 2016/2017.

National guidance is provided by long-term goals and short-term deliverables (see Box 7 for an example).

Box 7 – Long-term goals and short-term deliverables: the case of emergency care, ambulances and referral to treatment

Overall 2020 goals:

- 95 percent of people attending the emergency department are seen within four hours;
- Urgent and Emergency Care Networks rolled out to 100 percent of the population;
- 75 percent of Category A ambulance calls are responded to within 8 minutes;
- At least 92% of patients on incomplete non-emergency pathways to have been waiting no more than 18 weeks from referral and no-one waits more than 52 weeks.

2016-17 deliverables:

- With NHS Improvement, agree improvement trajectory and deliver the plan for year one for emergency care;
- Implement Urgent and Emergency Care Networks in 20 percent of the country designated as transformation areas, including clear steps towards a single point of contact;
- With NHS Improvement, agree improvement trajectory and deliver the plan for year one for ambulance responses;
- With NHS Improvement, meet the 18-week referral-to-treatment standard, including implementing patient choice in line with the NHS Constitution; and reduce unwarranted variation between CCG referral rates to better manage demand.

Better Care Fund

The Better Care Fund aims to help organisational transformation with a special focus on the most vulnerable population groups. The fund entails £ 5.3 billion, *'a single pooled budget for health and social care services to work more closely together in local areas, based on a plan agreed between the NHS and local authorities'.* It is important to note that this is not new or additional money: £ 1.9 billion will come from CCG-allocations (equivalent to around £ 10 million for an average CCG) in addition to NHS money already transferred to social care. Better care fund plans must be aligned to other programmes including the new models of care as set out in the Five Year Forward View.[301]

3.6.3 *The envisaged benefits of the reforms plans are overestimated*

Estimated cost savings are not reached

Two recent reports[308, 309] state that the envisaged benefits of integrated care and, more in particular, the sustainability and transformation plans are not realistic especially in times when the demand for care keeps rising while funding is not. The National Audit Office evaluated the progress towards a better integration between health and social care. Despite the high ambitions of reform plans, key measures of performance are worsening (e.g. between November 2014 and November 2016 delays in discharging patients from hospitals increased by 37% due to waiting lists for nursing home placement or due to shortcoming in the care package at home).[309] The NAO concluded that despite efforts to integrate health and social care for nearly 20 years has not resulted in system-wide integrated services. While some isolated best-practice examples exist there is no sound evidence for systematic, sustainable reductions of care arising from integration of care. One of the reasons is that healthcare providers have large fixed costs. Unless whole wards or departments are closed, shifting some of the activities towards another care setting is insufficient to book large cost savings.[309] The estimated cost savings of integrated care reforms are generally overstated as they, according to the authors, were more based on optimism than on evidence. An example is that costs were expected to decrease by reducing

delays in transfers of care (estimates of a reduction of 293 000 hospital days were included in the local area plans equalling £ 90 million) while in practice they increased (number of delayed days increased by 185 000 in 2015/16 compared to the previous year costing £ 146 million more than planned). Despite that, in general, results were far below the expected level although some national successes were achieved (reduction in permanent admissions of older persons to nursing homes and reduced readmissions of older persons after hospital discharge).[309] Despite that it is too early[j] to draw final conclusions, the NAO indicated that NHS England's ambition to slow down the rise in hospital activity from 2.9% to 1.3% by 2020/21 and the converging cost savings of £ 900 million may be too optimistic.[309]

The Nuffield Trust report[308] came to similar results and conclusions. The authors described that moving care outside the hospital is a cornerstone of the 44 sustainability and transformation plans that were published in October 2016. The assumptions about what the impact of the local strategy will be on hospital activity (by 2020/21: predicted activity to be less than forecasts that are based on current trends) is highly variable and often unclear on what basis they are made:

- 15.5% fewer outpatient contacts (range 7-30%);
- 9.6% less elective inpatient activity (range 1.4-16%);
- 17% fewer emergency department attendances (range 6-30%);
- 15.6% fewer non-elective inpatient admissions (range 3-30%).

After a targeted review of the evidence (i.e. evidence review of type of interventions that are included in the sustainability and transformation plans) the authors conclude that the decreases in hospital activity that are predicted in the plans will not be realised. At least, not if the plans are not accompanied with a massive investment in out-of-hospital initiatives.

To be successful large investments in out-of-hospital initiatives and sufficient time to implement the changes are required

The following lessons can be drawn based on the evaluation of the evidence:

- Targeting particular patient populations seems to be the most beneficial. Examples are reduced avoidable admissions for patients following cardiac rehabilitation programmes and remote monitoring (e.g. tele-monitoring heart failure patients). Also programmes designed for people at risk such as end-of-life (end-of-life care in the community) and nursing home residents (e.g. increased clinical support in nursing homes) have large potential.
- Improved access to specialist care in the community (e.g. enabling GPs to access specialist opinion to help them manage patients in the community and avoid unnecessary referrals) is beneficial. Yet, some models (e.g. consultants working in the community; referral to GPs with a special interest) might increase overall costs.
- Appropriately supported and trained staff is often a key to success. An example is the training of paramedics to enable them to triage patients back to the community (and not transport them to the hospital). Other interventions that aimed to influence patient's behaviour prior to contacting urgent and emergency care are less successful and are suspected to introduce supply-induced demand (e.g. extended GP opening hours; urgent care centres that are not co-located at the emergency department).
- Addressing gaps in services rather than duplicating services.

Shifting the balance of care from hospitals towards the community has many advantages for patients but it is unlikely that this will save money in the short to medium term. Avoiding hospital admissions and accelerated discharges are, for instance, only possible when sufficient capacity and funding of

[j] Evaluation of new care models that are part of the Five Year Forward View are expected by the end of 2018.

alternative forms of care in the community is provided. The reports[308, 309] also drew the attention on the following areas:

- The workforce challenge: a shift towards primary and community care is challenging in light of the current and projected future shortages in these areas (e.g. GPs and district nurses);
- The multi-morbidity challenge: the lack of understanding a patient's complex health and social needs results in unrealistic assumptions about the impact of some of the initiatives;
- The misalignment of financial incentives (e.g. separate health and social care system; NHS payment systems that drive competition in hospitals);
- The use of prices rather than costs to predict economic efficiencies of the initiatives does not take into account that not all overhead or fixed costs can be fully taken out;
- Some initiatives might not be cost-saving but can, however, create value by addressing unmet needs;
- Instant results are not realistic, initiatives need time to mature;
- In- and out-of-hospital care do not have the same status (e.g. investments in infrastructure, staffing and prestige).
- Shared data and strong analytic capacity is important to make correct diagnoses and to monitor the implemented solutions. More investments in evaluations of the current initiatives is required to learn about what works and what doesn't;
- Although it is supported that initiatives have a strong local component a national programme overseeing all integration initiatives is required (e.g. shared learning; avoid duplication of efforts).

4 FRANCE

4.1 Background

4.1.1 Healthcare regionalisation

Regional Health Organisation Schemes introduced the regional level in French health policy

Already in 1991, the 'regional level' was introduced in French health policy by using regions as the reference level for healthcare planning. The Hospital Act of 1991[310] set up **Regional Health Organisation Schemes** ('*Schéma régional de l'organisation des soins*', SROS) as a tool for planning hospital services at the regional level. The 1996 Ordinance[311] created the **Regional Hospital Agencies** ('*Agences régionales de l'hospitalisation*', ARH) that were in charge of this planning. However, while the SROS should be defined on the basis of an evaluation of the local population needs, and hence be carried out at the regional level to account for local particularities, the territorial division used for planning was still nationally defined, according to a so-called '*carte sanitaire'*. This map has been defined in 1974. It divided France into 256 geographical sectors ('*secteurs sanitaires*'). The initial aim was to establish at least a hospital technical platform (operating rooms, medical biology, imagery, etc.) in each of the sectors and to geographically balance the supply of care. A hospital could open inpatient beds if it was located in a sector where a need was identified, based on an index defined as the number of beds/population.[312]

Health areas were defined to enable a further decentralisation of hospital planning

The 2003 Ordinance[313] suppressed the '*carte sanitaire*' and simplified the planning by using the SROS as unique tool. The third generation of SROS (SROS 3[k]) addressed the regulation of care activities rather than programming in terms of bed numbers (see section 4.1.3). A new territorial division was used for planning: health areas ('*territoires de santé*') were defined by the Regional Hospital Agencies themselves (see section 4.1.2). They also had to define quantitative targets for the supply of care in their region. These changes constituted an important step towards the decentralisation of healthcare planning, but they remained concentrated on hospitals.

The creation of Regional Health Agencies expanded the scope of decentralised planning to out-of-hospital services

The 2009 Hospital, Patients, Health and Territories Act ('*Hôpital, patients, santé et territoires'*, HPST)[314] is the last step of a long process of healthcare decentralisation in France. The 2009 HPST Act generalises the use of health areas to ambulatory care, health and social care, and prevention activities. This Act created the Regional Health Agencies ('*Agences Régionales de Santé'*, ARS) which merge and replace the ARHs and other regional bodies that were coexisting besides them. The ARSs are in charge of the full healthcare planning, delivery and finance.

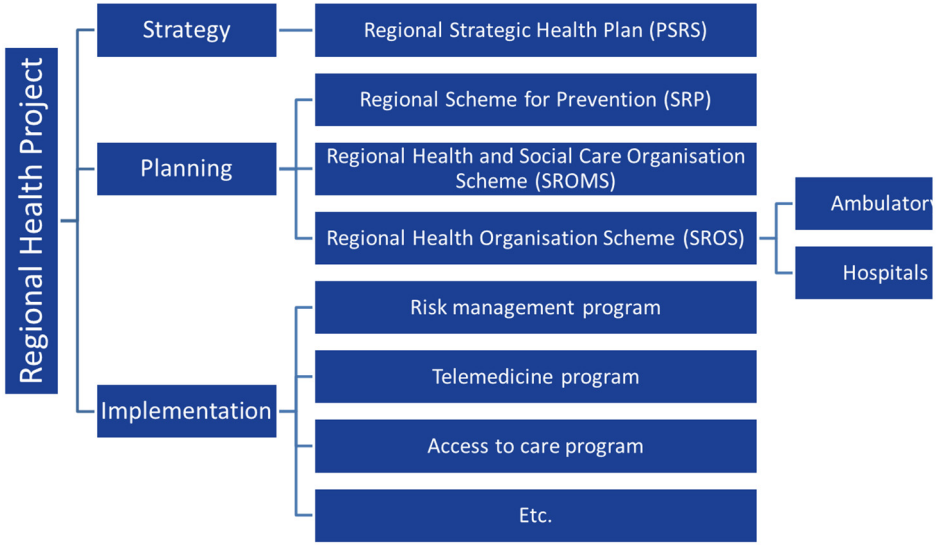
Following the HPST Act, 26 ARSs were created (April 2010): one in each of the 22 metropolitan regions of France, and 4 in the overseas departments. This number was reduced to 17 (13 in metropolitan regions and 4 overseas) in January 2016, following a reform of the regional division of France. They are responsible for the territorial organisation of healthcare supply, with the double objective of reducing inequality in access to care and improving efficiency. They are in charge of designing a Regional Health Project which gives the orientation of the regional policy. It defines the ARS's objectives for several years as well as the methods that will be used to reach them.

The Regional Health Project (see Figure 46) is composed of:

- A Regional Strategic Health Plan ('*Plan Stratégique Régional de Santé*', PSRS) that aims to coordinate ambulatory care, hospital care and health and social care, based on population needs.
- Three regional schemes:
  - the Regional Scheme for Prevention;
  - the Regional Health and Social Care Organisation Scheme;
  - the Regional Health Organisation Scheme (SROS) which is decomposed into a hospital part that is binding and an ambulatory part that is not binding.
- Several implementation programmes for risk management, telemedicine, etc.

[k] SROS 3 (2006-2011) follow the SROS 2 (1999-2004) and SROS 1 (1994-1999).

Figure 46 – Regional Health Project



Regional Strategic Health Plans are used to define the strategy per region every 5 years

The Regional Strategic Health Plan (PSRS) gives the orientation of the regional policy for healthcare. It is defined for five years and includes the following elements:

- A regional diagnosis based on an evaluation of the population needs and their future evolution constructed from demographic, health, social, territorial, etc. information. It also includes an analysis of the supply of care as well as of its evolution;
- A list of priority objectives that are identified from the diagnosis;
- Coordination measures with other health policies (child health, health at work, etc.);
- A description of the organisation of the follow-up and evaluation of the regional project implementation;
- The definition of the health areas (see section 4.1.2).

In the next revision of plans, starting in 2018, the PSRS will be replaced by a Strategic Orientation Framework (*'Cadre d'Orientation Statégique'*, COS) that will define the strategy for 10 years.[315]

Regional Health Organisation Schemes are used to plan current and future capacity

The Regional Health Organisation Scheme (SROS) is built on the regional diagnosis which is detailed in the PSRS in order to plan current and future capacity. This plan should take into account population needs, effectiveness requirements, and geographic accessibility issues.

The hospital part of the SROS must contain a section for each of the following activities: medical care; surgery; perinatal care; psychiatry; rehabilitation care; long-term care; interventional endovascular imaging in cardiology; emergency; reanimation, intensive care and continuous monitoring; treatment of chronic renal insufficiency by renal replacement therapy; cancer treatment; examination of genetic characteristics or genetic identification for medical purposes; medical imaging; palliative care; care for prisoners.

Rare and specialised services are planned at a supra-regional level

Aside from the SROS, some highly specialised care activities (heart surgery, neurosurgery, interventional endovascular imaging in neuroradiology, treatment of major burns, and organ transplantation and hematopoietic cell transplantation)[316] must be coordinated at the supra-regional level. Their organisation is defined in an Interregional Health Organisation Scheme ('*Schéma interrégional de l'organisation des soins*', SIOS). To that purpose, France is divided in seven supra-regions.[317]

Despite the regionalisation, decisions are still centralised

Although the reference level for healthcare planning is the region, regional authorities (including the ARSs) generally follow national guidelines, established by the directorate of the Ministry of Health and Social Affairs, namely the general directorate of care provision (‘*Direction générale de l’Offre de Soins’*, DGOS). In addition, the indicators used at the regional or local levels are often compared to norms, which are defined based on national averages. Therefore, the power of decision is still perceived as centralised, the autonomy of the ARS being qualified as ‘sham autonomy’.[318]

4.1.2 Health areas

Before the HPST Act: health areas (‘*territoires de santé*’) were delimited by the Regional Hospital Agencies

The following national recommendations[319, 320] were formulated:

- The regions were encouraged to transcend the traditional administrative boundaries.
- The health areas had to take into account physical and human geographic elements and populations’ behaviour with respect to the existing care supply.
- The regions could be divided in different areas depending on the activity (medical care, surgery, psychiatry, etc.) but, at the same time, consistency between the different activities concerned had to prevail, especially concerning the technical platforml and psychiatry.
- The organisation of healthcare supply had to be hierarchically structured and permit to easily identify the different support levels. Each level of care had to correspond with a territorial delineation. Five levels were suggested:
  - Proximity level: first-contact care level and continuity of care level involving general practitioners, nurses and pharmacists
  - Intermediate level: structured around internal medicine, first-level hospitalisation or technical platform
  - Referral level: specialised care level, corresponding to hospital catchment area
  - Regional level: includes specialised services not provided by the other levels
  - Supra-regional level: for certain highly-specialised activities such as major burns units or neurosurgery.

  A precise delineation of the territory corresponding to each level was not mandatory. Nevertheless, some regions have defined each of them precisely.
- Precise geographical boundaries were required for the definition of the health area, as planning zone for the organisation of care supply (the so-called ‘territoire de santé’). In general, the health area corresponds to the referral level mentioned above.

While the objective was to create coherent territories for global care supply, the health planning remained centred on hospitals’ technical facilities. Other activities, such as psychiatry, often had to adapt their supply to match the existing territories.[321]

[l] The term ‘technical platform’ (‘*plateau technique’*) represents all facilities and equipment (biomedical, technical and IT) allowing healthcare professionals to carry out diagnosis and treatment in the hospital. It generally includes operating rooms, recovery rooms, medical biology, imagery, pharmacy, etc.

The HPST Act: generalisation of health areas to ambulatory care, health and social care, and prevention activities

The Regional Health Agencies (ARSs) created by this Act had to define new health areas in order to reduce this compartmentalisation of activities. Several criteria were suggested to delimitate these areas:[322]

- Respecting the ARS' global competency, that covers hospitals, ambulatory care, health and social care, prevention, surveillance, and safety.
- Creating of a public space for debate, including all local stakeholders as well as population consultation.
- Seeking for homogeneity of population needs. The delineation of the area should take into account the spatial practices of the population (habits, behaviours, observed use of health services).
- Taking accessibility into account (time and distance to access services).
- Organizing health areas around proximity areas to ensure the homogeneity of the health area. The boundaries of each proximity area should be inside the same health area. A proximity area overlapping with two different health areas should be exceptional.
- Integrating the health services supply chain as a whole (hospitals, ambulatory, health and social care, and prevention) in order to converge towards global health.
- Seeking for consistency with public policies from other regional bodies (urban policy, social cohesion, education, etc.).
- Considering the ARS' ability to organise a conference within each health area. The number of health areas should be limited.

New health areas were created based on a variety of methods

The 2004 national Circular[319] recommended to use an 'innovative method' to design health areas. This suggests that the former care sectors were not appropriate. Nevertheless, seven regions (Bretagne, Centre, Ile-de-France, Limousin, Lorraine, Midi-Pyrénées, and Picardie) decided to maintain, group or slightly adapt the care sectors from the past '*carte sanitaire*'.

The other 19 regions, however, created new health areas. The methods used to design these area can be separated into three categories:[320]

- Delineation based on actual hospital patient flows using PMSI ('*Programme de médicalisation des systèmes d'information'*) data. The database[m] provides information on almost all claims paid by the Social Security System to hospitals and therefore on hospital activity. For each hospital stay, it provides the patient's municipality postcode. This is used to calculate 'majority in-patient flows'. In these flows, a municipality is linked to a hospital catchment area when the hospital catches the major part of the patients from this municipally. The methodology varies according to the region:
  - Some regions define explicit thresholds for a municipality to be linked to a hospital catchment area. For instance in Rhône-Alpes, the hospital should catch at least 50% of the stays from patients coming from this municipality or the hospital should be the most used hospital for the patients coming from this municipality, with at least 8% difference with the second;
  - Some regions use agglomerative hierarchical clustering;
  - Some regions use criteria for the minimum population covered by a health area, or for the minimum activity within a health area (the minimum number of stays of a given type in the area);

[m] Governed by the Technical Agency for Hospital Information ('*Agence Technique de l'Information sur l'Hospitalisation'*, ATIH, http://www.atih.sante.fr/).

  - Some regions give more importance to the consultation of stakeholders than others in the delineation of the health areas;
  - Some regions have defined a unique set of health areas for all medical activities, while others have segmented the delimitation by medical fields, by pathologies or by levels of care.

- Delineation based on hospital patient flows correlated with living areas (‘*bassins de vie’*, the smallest area on which population has access to the most common equipment and services (shopping, education, health, sport, transport, etc.[323])) or employment zones (‘*zones d’emploi’,* a geographic area within which most of the active population work[324]). Proximity areas are identified based on population travel behaviours regarding the most commonly used public or private services. An analysis of hospital ‘majority inpatient flows’ is then conducted but the delineation of the health areas is consistent with the proximity ones.
- Delineation based on actual hospital and ambulatory patient flows. Some regions calculated both hospital patient flows and patient flows for office-based care.

In any case, the delineation of the health areas remained mainly focused on hospital activity.

Most health areas correspond with the French departmental boundaries

With the HPST Act and the creation of the ARSs, the regions had to define new health areas that ensure consistency between hospitals, ambulatory care, health and social care, and prevention. As explained above, the integration of the health services supply chain as a whole, is one of the criteria that has to be taken into account in the delineation of the health area. Using this argument, most of the regions have chosen to define their health areas in accordance with departmental boundaries. For these regions, it was easier to establish their plans in accordance with plans for disabled or dependent persons for instance, which are defined by regional County Councils, at the departmental level.[321] Twelve regions delimitated their new health areas exactly as their departments, while four used groups of departments. Among the remaining regions, three have simply kept or slightly modified their previous health areas. Only seven regions (Aquitaine, Guadeloupe, Haute-Normandie, La Reunion, Picardie, Poitou-Charentes and Rhône-Alpes) have defined new health areas that are not (or not entirely) based on departmental boundaries.

4.1.3 Hospital and medical equipment planning

Quantitative targets based on population needs

The 2003-850 Ordinance[313] suppressed the ‘*carte sanitaire*’ and ended the planning in terms of bed numbers. Since then, the SROS (in particular its hospital part) is the main tool of planning. According to this Ordinance, each ARH had to define quantitative targets for hospitals and medical equipment, in response to population needs. Originally, there were three types of mandatory targets:

- Quantitative targets for care activities. For each of the 18 enumerated care activities, the ARH had to define, by health area, the number of facilities[n] ensuring the activity. The concerned care activites are: medical care; surgery; perinatal care; psychiatry; rehabilitation care; long-term care ; organ transplantation and hematopoietic cell transplantation; treatment of major burns; heart surgery; interventional endovascular imaging in cardiology; neurosurgery; interventional endovascular activities in neuroradiology; emergency; reanimation; treatment of chronic renal insufficiency by renal replacement therapy; clinical and biological activities related to medically-assisted procreation and biological activities related to antenatal diagnosis; cancer

[n] The facility refers here to the geographical location of the care activity, not to the legal structure that can cover several geographical locations.

treatment; examination of genetic characteristics or genetic identification for medical purposes.

- Quantitative targets for major medical equipment. For each of the 5 enumerated categories of equipment, the ARH had to define, by health area, the number of facilities with the equipment and the number of machines by facility. The concerned categories are: scintillation camera (gamma camera) / positron emission tomography (PET); magnetic resonance imaging (MRI); CT-scan; hyperbaric chamber; cyclotron.
- Quantitative targets for the volume of activity. For a limited list of activities[o] as well as for the major medical equipment, the ARH also had to define a target for the volume of care supplied. Indeed, delimiting the number of facilities was not considered as sufficient to ensure an adequate supply of care. These targets were characterised by:
    - A target value, measured in terms of number of stays, number of visits, number of days, number of patients, number of procedures, etc. depending on the activity.
    - A minimum value in order to maintain the activity on the considered health area and ensure access to care.
    - A maximum value beyond which supply would excess population needs, and would generate unnecessary procedures.

    The ARHs were encouraged to take into account the following elements in the determination of the targets: evaluation of population needs, patient flows for the existing supply, and the expected evolution of medical techniques and medical supply. Generally, the targets were defined as a deviation to the national average (personal communication with Isabelle Hirtzlin, Université Paris 1).

These targets were binding for the hospitals. In addition to these compulsory targets, the ARHs could define targets related to the accessibility (in terms of travel time and opening hours). While optional, these targets became binding as soon as they were included in the SROS. However, the option to define targets in terms of travel time had hardly been used.

The compulsory character of the targets was toned down

For the last generation of SROS, following the 2009 HPST Act, this quantitative planning has evolved. In particular, the targets for the volume of activity have been suppressed and replaced by optional, non-binding, monitoring indicators ('*Indicateurs de pilotage de l'activité'*, IPA). Indeed these targets have not been judged as an appropriate tool to regulate the supply of care. Several reasons were advanced: the targets were based on population needs, not on financial sustainability; sanctions in case of exceeding the target were not enforced; and data were considered to be insufficiently reliable.[325] For each health area, the ARS now defines the following targets:

- Quantitative targets for care activities, as before.
- Quantitative targets for major medical equipment, as before.
- Optional accessibility targets, enforceable if included in the SROS
    - Targets in terms of travel time, as before.
    - The targets in terms of opening hours have been suppressed, because they are now covered in another legal framework.
    - Targets in terms of waiting time for major medical equipment.
- Optional (but highly recommended) monitoring indicators. These indicators, which replace the quantitative targets for the volume of activity, are not enforceable. The concept of minimum-maximum is suppressed.

[o] Medical care (except chemotherapy); surgery; psychiatry; rehabilitation care; long-term care; interventional endovascular imaging in cardiology; interventional endovascular activities in neuroradiology; treatment of chronic renal insufficiency by renal replacement therapy

The 3-steps method described hereafter is suggested by the Health Ministry[325] to build the monitoring indicators. The first step is also recommended to define the quantitative targets for care activities and medical equipment.

Step 1 in the determination of the targets: analysing hospitalisation rates

The first step consists of studying the hospitalisation rates (see Box 8) for the considered activity of care. This analysis allows to identify the situations in which the supply of care is sufficient, insufficient or excessive.

Box 8 – Definition of hospitalisation rates

The **crude hospitalisation rate** is the ratio of the number of stays, days, visits, etc. (depending on the activity) for the residents of the area, regardless of whether they were hospitalised within or outside this area, to the number of inhabitants of the area. The rate is generally expressed for 10 000 inhabitants.

The (age and sex) **standardised hospitalisation rate** is obtained by applying the hospitalisation rate of each age and sex category of the area to the structure of the national population. It can be interpreted as the hospitalisation rate that would prevail in the area if the population structure of the area was the same as the national one.

The (age, sex, and health status) **adjusted hospitalisation rate** (only calculated for medical and surgery activities) is the hospitalisation rate that would prevail in the area if the population of the area had the same age-sex structure and the same health status (i.e. mortality[326]) as the national population.

By comparing the standardised and adjusted hospitalisation rates for a given health area with the rates at the national, regional or other health area levels, atypical situations are identified. Then, the factors are evaluated that can explain high or low hospitalisation rates such as: health status of the population (already taken into account if adjusted rates are analysed), poverty, practice differences, variation in medical supply, alternatives to hospitalisation, etc. This first analysis, at the health area level, is the basis of a more detailed study that should be carried out at the local level (at the level of the proximity areas[p] if they are defined, or at the level of the administrative districts or living area, see section 4.1.2). It is suggested to use crude hospitalisation rate at this level rather than the standardised or adjusted ones. The analysis at the local level has to allow to identify the hospital concerned and to take appropriate action. Consultation of the hospitals is also important to explain the atypical situations.

Step 2 in the determination of the targets: estimating consumption targets

The second step consists in estimating targets for consumption. For each health area and each care activity, the ARS should define the hypotheses of evolution of the rate of hospitalisation calculated in the first step. These assumptions depend on:

- Strategic choices of the ARS to balance the rates of hospitalisation across health areas;
- Demographic evolution;
- Medical supply;
- Supply of alternatives to hospitalisation;
- Possibly, the evolution trend of the rate of hospitalisation, based on past observation, for very dynamic activities;
- Possible inadequacies.

[p] Proximity areas are identified based on population travel behaviours regarding the most commonly used public or private services, see section 4.1.2.

Once these assumptions are made, they are used to calculate the projected rates of hospitalisation. The targets for consumption in the next period are obtained by multiplying the projected rates of hospitalisation by the projected population in the health area (see Box 9).

Box 9 – Estimation of targets for consumption

Crude rate of hospitalisation in t+1 in a given health area = crude rate of hospitalisation in t in a given health area * evolution rate assumed for the health area

Target for consumption in t+1 in a given health area = crude rate of hospitalisation in t+1 in the health area * projected population in t+1 in the health area

Box 10 – Example: targets for consumption, medical activity, ARS Nord-Pas-de-Calais

For the Region of Nord-Pas-de-Calais, applying the national methodology to estimate the target for consumption, resulted in an average annual decrease of 1.13% of the number of medical stays. This result is based on the following assumptions: evolution of the national rate of hospitalisation in the period 2007-2009 (0.9% per year); comparison between the regional adjusted rate and national rate (965 by 10 000 inhabitants in 2010); demographic projections (0.2% increase of the population per year in Nord-Pas-de-Calais); an assumption of stability of interregional flows.

The ARS argued that this national estimate does not take into account the following elements: the relative poverty of the region; the low number of specialists outside the hospital;

the link between pathologies for which mortality rates are higher in the region than at the national level (e.g. tobacco use, alcoholism, etc.) and medical activities for which the hospitalisation rates are higher than the national rate (e.g. pneumatology, toxicology, etc.); the willingness of the ARS to reduce delays in seeking for initial care. Even if the objective is to improve health status of the population, this policy will, at first, increase the use of care.

Therefore, the ARS proposed a 0.27% increase in the number of stays per year. This proposal is based on: the replacement of the objective of convergence to the national hospitalisation rate by an objective of convergence to the regional rate for each health area; projected demographic evolution; evolution of the national rate of hospitalisation after 2009 (+0.1% per year) ; and a rule for the convergence between health areas (decrease of 35% of the volume of activity for the health area with consumption above the national average, increase of 20% for the ones with consumption below the national average).

Source: ARS Nord-Pas-de Calais (2012)[326]

Step 3 in the determination of the targets: conversion of consumption targets in volumes of activity

In a third step, once the targets for consumption are defined, they can be converted into targets for the volume of activity (see Box 11) per hospital, taking into account patient flows on the one hand, and, on the other hand, regional objectives for the development of alternatives to hospitalisation.

Regarding patient flows, it is important to take into account that patients can choose a hospital that is outside the health area, or even outside the region. On the other hand, patients from outside the area can seek for care inside the area. The national recommendation is to hypothesise these flows as constant over time, due to the difficulty to obtain reliable projections of these flows. Table 35 provides an example for the health area Loudéac-Pontivy in Bretagne. The volume target for rehabilitation care activity in this area is established at 64 244 days for 2016 (it was 56 771 in 2010).

Box 11 – Target for the volume of activity

Target for the activity (e.g. number of stays) in t+1 in health area A =

(number of stays in t from residents of A in facilities of A) * assumed evolution rate in A

+ (number of stays in t from residents of B in facilities of A) * assumed evolution rate in B

+ …

+ number of stays in t from inhabitants of other regions (assumed to be proportionally unchanged)

Table 35 – Targets for activity, rehabilitation care, health area Loudéac-Pontivy, ARS Bretagne

A: Areas	B: Consumption (number of days) in HA8 by the patients of the Area (A) in 2010	C: Planned evolution of the number of days in the Area (A) (2010-2016)	D: Planned consumption (number of days) in HA8 by the patients of the Area (A) in 2016 D=B*(1+C)
Brest - Carhaix - Morlaix (Health Area 1)	569	4.8%	596
Quimper - Douarnenez - Pont l'Abbé (Health Area 2)	53	4.7%	56
Lorient - Hennebont (Health Area 3)	850	3.0%	875
Vannes - Ploërmel - Malestroit (Health Area 4)	2 221	18.9%	2 640
Rennes - Redon - Fougères - Vitré (Health Area 5)	255	10.9%	283
Saint Malo - Dinan (Health Area 6)	1 585	9.9%	1 742
Saint Brieuc - Lannion - Guingamp (Health Area 7)	7 786	9.0%	8 486
Loudéac - Pontivy (Health Area 8)	43 000	14.1%	49 058
Bretagne	56 319		63 736
Outside Bretagne	430	Stays 0.76% of the total for Bretagne (=430/56 319)	487
Errors	22	Fixed (0%)	22
Total (=production in Health Area 8)	56 771		**64 244**

Source: Adapted from Lecoq (2012)[327]

Licenses and contracts: time horizon of five years

The ARSs are responsible for the concrete implementation of the planning. In practice, each project for a new hospital, the creation, reconversion or merging of care activities, or the installation of major medical equipment, is subject to the authorisation of the ARS. Requests for licenses are submitted by the hospitals following a determined procedure and calendar. The license is granted when the three following conditions are met:

- The project answers to population needs identified in the SROS/SIOS;
- The project is compatible with the objectives of the SROS/SIOS;
- The project satisfies technical conditions for implementation and functioning.

The license is granted for five years. A conformity visit is organised by the ARS within six months after the decision. If the conditions are not satisfied, the license can be revoked.

The ARS also negotiates 'multiyear contracts for targets and resources' ('*contrats pluriannuels d'objectifs et de moyens*') with hospitals. These contracts are typically concluded for a period of five years. They require hospitals to obtain licenses from the ARS for their care activities and medical equipment, but also describe the responsibilities of each hospital and the volume of services to be provided, based on the targets previously defined. They also require an annual evaluation of existing capacity and service volumes. Hospitals may be financially penalised (up to 5% of total revenue) for failure to adhere to target contracts. However, up to now, no hospital has been penalised.[328]

4.1.4 Hospital landscape and trends

The capacity of inpatient beds decreased during the last decade

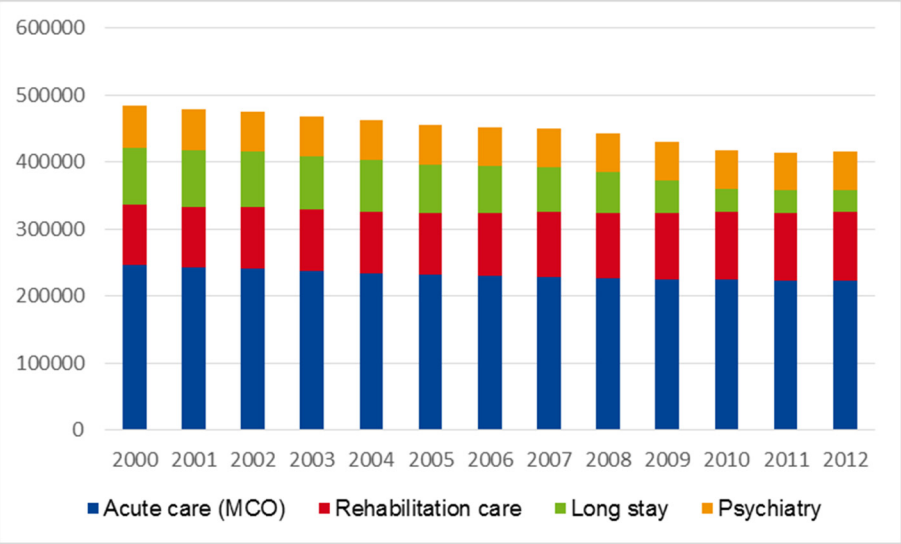
In 2014, there were 3 111 facilities offering inpatient care in France.[329] They comprise four main types of structures:[330]

- 'Medical care, Surgery and Obstetrics' hospitals ('*Medecine, Chirurgie, Obstétrique*', MCO) delivering acute care;
- long stay facilities;
- rehabilitation care facilities; and
- psychiatric hospitals.

Acute (MCO) hospitals cover a large range of activities divided in three categories: medical (resuscitation, intensive care, medical oncology, general paediatrics, geriatrics, etc.); surgery (heart surgery, neurosurgery, paediatric surgery, etc.) and obstetrics (gynaecology, obstetrics, abortion, etc.).[331, 332]

In 2014 there were 411 000 inpatient beds in these facilities which is a substantial decrease compared to 2003 when there were 468 000 inpatient beds. The number of beds in acute and psychiatric structures has steadily decreased during the period, but the most important decline occurred for the long-stay facilities where more than half of the beds were closed (from 80 000 to 32 000). The capacity of rehabilitation care facilities has slightly increased in this period.[329] These evolutions, illustrated in Figure 47, are the result of political willingness to reduce the excess capacity and to reorganise the supply of care towards more alternatives to inpatient stays (day-surgery, hospital at home, etc.).[329]

Figure 47 – Evolution of the number of inpatient beds



Source: Eco-Santé (2016)[333]

Hospital categories: public hospitals, private not-for-profit and for-profit hospitals

According to the 2009 HPST Act, which simplified the classification of acute care hospitals, they are classified in three categories: public hospitals, private not-for-profit hospitals, and for-profit hospitals. Among the 2 086 acute care hospitals in 2011, 835 (40%) were public, 700 (34%) private not-for-profit and 551 (26%) for-profit.[330]

Public hospitals are owned by a local or national administration and are subject to rules and structures defined by the law regarding their governance and administration.[330] They can be classified in three categories:

- Regional and teaching hospitals (‘*centres hospitaliers régionaux*’, ‘*centres hospitaliers universitaires’*, CHR/CHU) which supply specialised care to the regional population as well as less specialised care to the population at a close distance. There were 182 CHR/CHU in 2014, among the 1 416 public hospitals.[329]
- General hospitals (‘*centres hospitaliers*’, CH), which supply most of the acute care as well as inpatient care for the elderly. There were 973 general hospitals in 2014.[329]
- Other public hospitals include psychiatric hospitals (97 in 2014) and long-stay facilities.[329]

Public hospitals hold 75% of acute care capacity and perform 75% of inpatient acute stays.[334]

Private not-for-profit hospitals are owned by a private association, a religious organisation or a foundation.[330] They share the same values and obligations as public hospitals: no limitation to access to care, no additional fees, and continuity of care (24h/day).[335] Among the 1 012 private not-for-profit hospitals in 2014, 21 are cancer treatment centres which have a teaching and research mission similar to the one of public teaching hospitals. It is estimated that 10% of the cancer patients in France are treated in such a centre.[336]

For-profit hospitals, also called private clinics, are owned by private companies with a commercial objective. They tend to be more specialised than public hospitals, delivering only certain types of procedures or treatments.[330] They account for 10% of the inpatient beds.

Table 36 – Number of hospitals and beds by category in 2014

	Number of hospitals	Number of beds
Public hospitals	**1 416**	**256 229**
Regional and teaching hospitals	182	73 585
General hospitals	973	146 403
Psychiatry	97	25 667
Others	164	10 574
Private not-for-profit hospitals	**683**	**57 176**
Cancer centres	21	2 813
Others	662	54 363
Private for-profit hospitals	**1 012**	**97 516**
Rehabilitation care	344	28 157
Acute care or multidisciplinary	514	55 934
Mental care	145	12 947
Long stay	6	303
Others	3	175
Total	**3 111**	**410 921**

Source: Adapted from DREES (2016)[329]

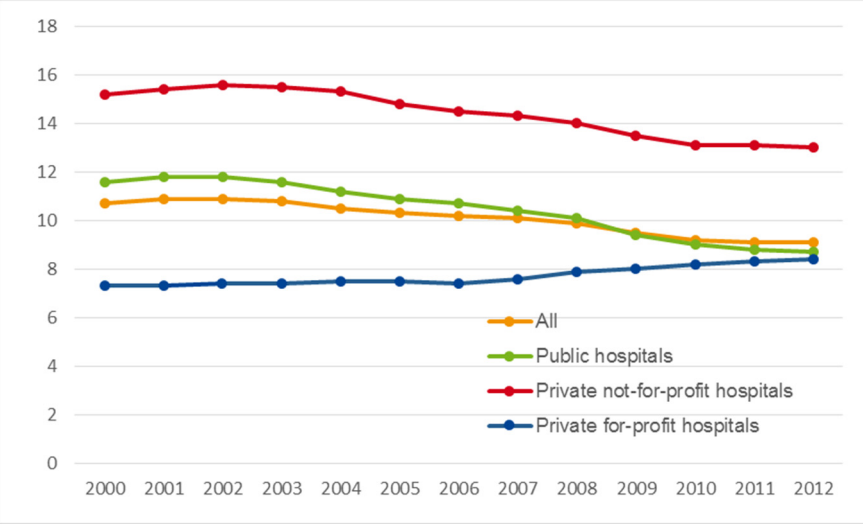
Large variability in hospital capacity between the different regions

It has to be noted that the national numbers do not represent well the regional disparities. In particular, the number of beds per 10000 inhabitants ranges from 15 to 126 depending on the department. However, the variation is smaller when considering only acute care.[329] In a same way, the repartition of beds between the three categories of hospitals varies widely across departments. At the national level, around 60% of the beds are located in public hospitals, 15% in private not-for-profit hospitals and 25% in for-profit hospitals. However, this last category of hospitals is almost absent in some departments but accounts for more than 40% of the beds in others. The share of private not-for-profit hospitals also varies from almost 0% in some departments to more than 30% in others.[329]

Slow decrease in average hospital length of stay

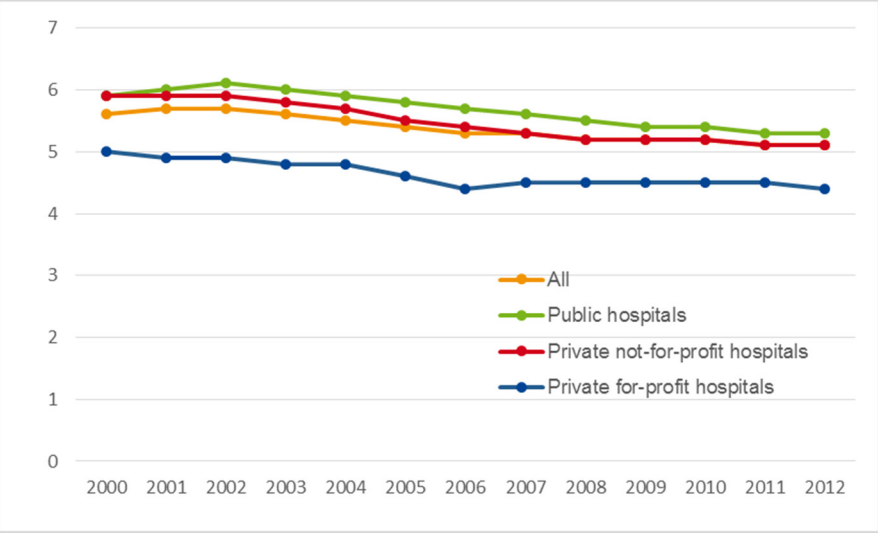
Figure 48 and Figure 49 show the evolution of average length of stay by category of hospital for all types of care and for only acute care, respectively. In general, average length of stay has decreased in French hospitals (from 10.7 days in 2000 to 9.1 days in 2012), mostly driven by a reduction in public and private not-for-profit hospitals. While average length of stay was shorter in for-profit hospitals (7.3 days in 2000), it has increased since then and is now close to the level of public hospitals. Focusing on acute care only, the average length of stay has halved in 30 years (from 10.2 days in 1980 to 5.1 in 2011[337]). Private for-profit hospitals have a shorter average length of stay (4.4 days in 2012), followed by private not-for-profit hospitals (5.1 days) and public hospitals (5.3 days).

Figure 48 – Average length of stay (all types of care)



Source: Eco-Santé (2016)[333]

Figure 49 – Average length of stay (acute care)



Source: Eco-Santé (2016)[333]

4.2 Concentration of complex services

The link between hospital volume and outcomes has been widely used in France to justify the concentration of hospital care.[338] In particular, minimum thresholds for some care activities are to an increasing extent used as a criterion to evaluate and regulate the quality of care. In 2006, a first report[339], commissioned by the Minister of Health, recommended the rapid closure of 113 surgery services with low volume (lower than 2 000 acts per year) as they did not meet criteria of safety, quality and continuity of care. Later, another study[340] confirmed the existence of a volume-outcome link for six interventions (i.e. colon cancer surgery; coronary artery bypass surgery; pancreatic resection; acute myocardial infarction; stroke; and total hip arthroplasty) in France.

Heart surgery

Minimal thresholds have been used for heart surgery since 2006. Indeed, the Decree of 24 January 2006[341] set the minimal activity volume to 400 major interventions (extracorporeal blood circulation or 'beating heart' surgery) per year and per hospital. For paediatric heart surgery, this threshold is 150.

Cancer treatment[q]

In 2002, the National Federation of Cancer Centres, in accordance with all actors involved in cancer treatment in France, published a 'white book' defining the adequate conditions allowing the best practices in cancer surgery.[342] This work included several proposals for public authorities, based on a specific survey within the cancer centres and an analysis of public databases. Several expert groups of surgeons and oncologists discussed and improved the proposals. The proposals covered quality, safety, and the notion of activity thresholds.[343] In preparation of the Cancer Plan 2003-2007, the National Cancer Institute (INCa) has expanded these proposals. In particular, it defined minimum volume thresholds for some activities.

This work has been carried out as follows.[343, 344] In a first step the international literature was analysed. Next, three expert groups, representing expert societies, patients and hospital federations, were organised: for chemotherapy, radiotherapy, and cancer surgery. Proposals for quality criteria made by the expert groups were submitted to a panel of 200 health professionals. The applicability of the criteria was then tested in ten voluntary hospitals. Final proposals were adjusted based on the results from these pilot tests.

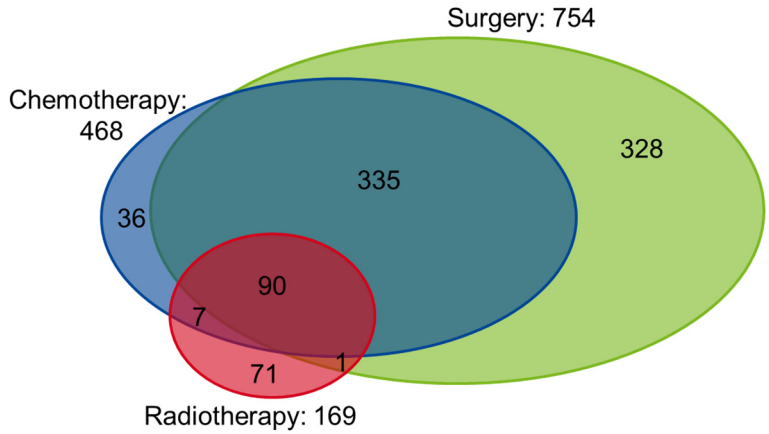
[q] See also Chapter 6.

Since 2007, minimum volume thresholds have to be met in order to obtain the license for such cancer related activities, namely:[345]

- Cancer surgery: breast, digestive, urologic and thoracic cancers: 30 interventions/year; gynaecologic, ENT and maxillofacial cancers : 20 interventions/year;
- External radiotherapy: 600 patients/years;
- Chemotherapy: 80 patients/year with at least 50 in day care.

Before 2011, the license was granted to hospitals reaching 80% of the threshold. Amongst the 1 152 hospitals with an activity in cancer surgery, radiotherapy or chemotherapy in 2008, 24% (284 hospitals) did not receive such a license in 2010.[345] For the 868 other hospitals, at least one license was granted (754 hospitals were licensed for cancer surgery, 468 for chemotherapy and 169 for radiotherapy, see also Figure 50).

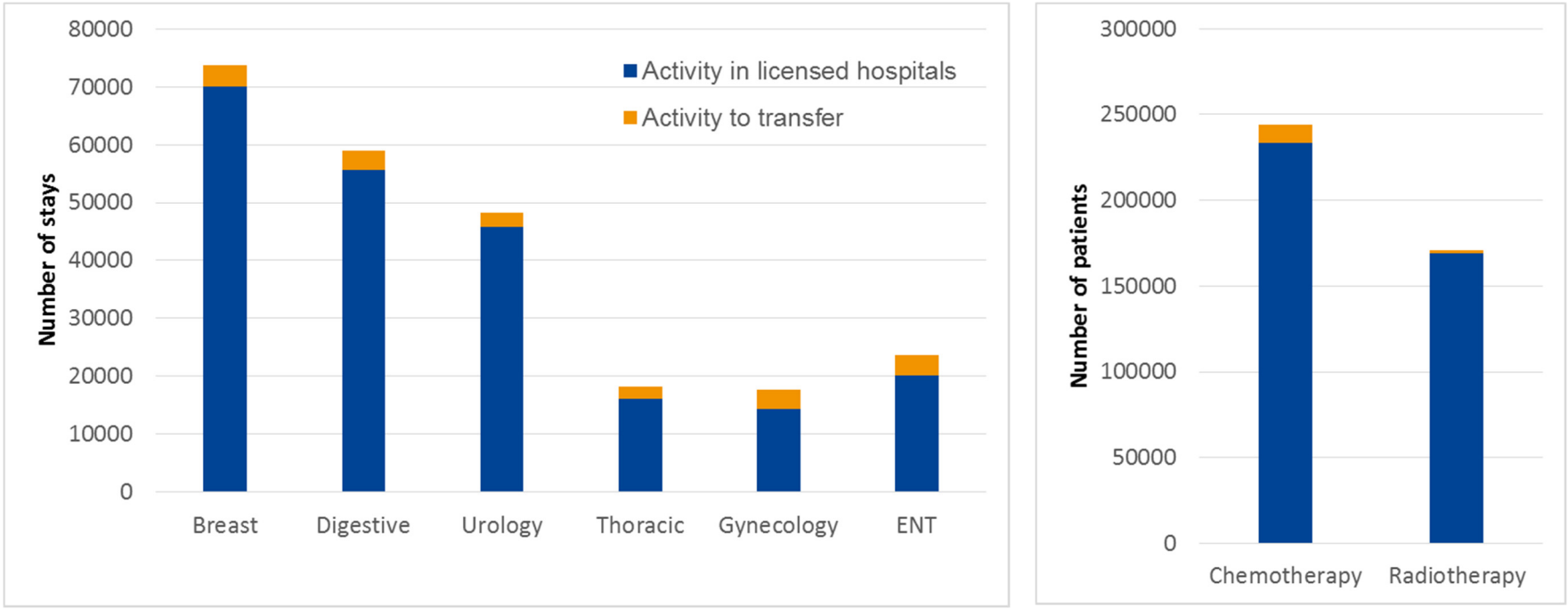
Figure 50 – Licenses for cancer treatment in 2010



Source: INCa (2010)[345]

Care activities previously performed by hospitals that did not receive the license to do so had to be transferred to licensed hospitals. However, this represents only a small share of the total volume: 7.8% of the stays in the concerned cancer surgeries, 4.2% of the patients in chemotherapy and 1.7% of the patients in radiotherapy (see also Figure 51).

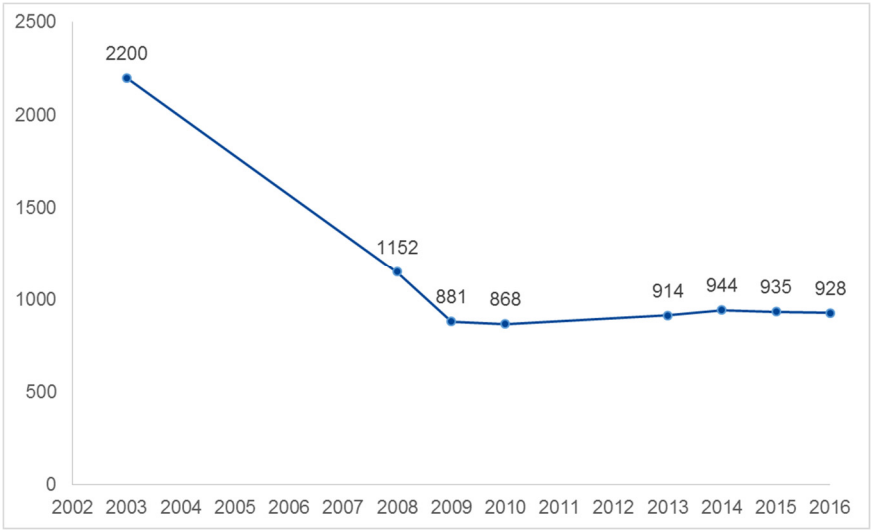
Figure 51 – Volume of care activities to be transferred to licensed hospitals



Source: INCa (2010)[345]

Since 2011, hospitals must reach the defined threshold to obtain the five year license from the ARS. Currently, 928 hospitals are licensed for cancer treatment.[346] Following the implementation of minimum volume threshold requirements, the number of hospitals licensed to treat cancer has decreased by 57% between 2003 and 2013 (with 20% between 2009 and 2015, see also Figure 52).[347]

Figure 52 – Evolution of the number of hospitals licensed to treat cancer (2003-2016)



Source: INCa (2010, 2012, 2013, 2014, 2015, 2016)[345-350]

The definition of minimum volume thresholds is justified by the fact that a sufficient and regular practice by the team is needed to ensure quality of care. Nevertheless, their implementation has been criticised.[351] Firstly, the thresholds are established by hospital and not by surgeon, while the volume-outcome link is expected to occur at the surgeon level. Nevertheless, the volume-outcome effect can also be related to team organisation and equipment. Moreover, a rapid and simple message was necessary and the data are only available at the hospital level. Secondly, quantitative thresholds are perceived as arbitrary. For instance, for breast cancer, the literature suggests a threshold between 25 and 100 acts per year. The threshold of 30 acts is therefore close to the lower bound. However, too strict thresholds would have unbalanced the supply of care (specialised centres being suddenly overwhelmed).

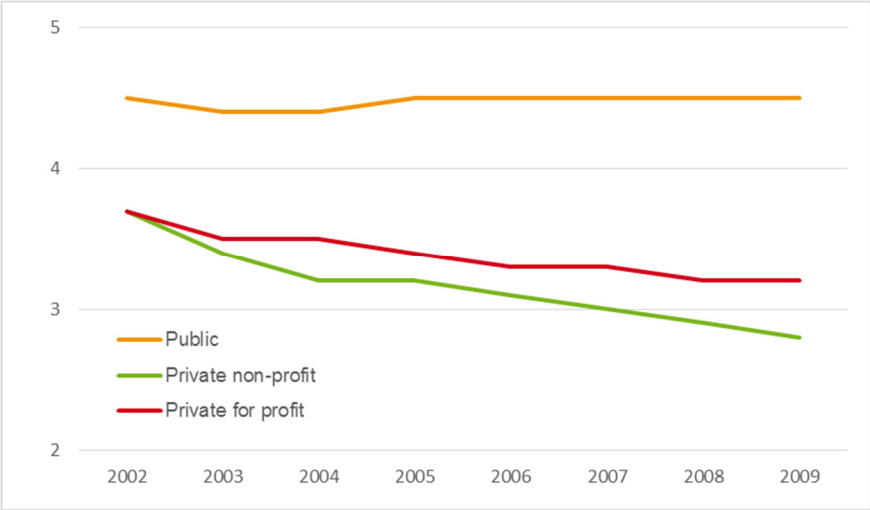
Maternity wards

The organisation of maternity wards in France has followed a long process of concentration, initiated in the seventies. In 1972, the Dienesch Decree[352] stated that a minimum of 15 beds was necessary to run a maternity ward.[329] In 1998, maternity wards have been classified in three categories. Type 1 maternities ensure obstetrics services, type 2 ensure obstetrics and neonatology services and type 3 ensure obstetrics, neonatology and neonatal reanimation services. Type 2 can further be divided between the ones without (type 2A) and with (type 2B) a neonatal intensive care unit.[353] Furthermore, a minimum volume threshold has been established at 300 deliveries per year for maternity units to be licensed to practice obstetrics.[354] These measures led to a reduction of the number of maternities and an increase of their size. More details on this topic can be found in Chapter 8.

4.3 Specialisation

In France, half of the activity in surgery (and two thirds of day surgery) is realised in private for-profit hospitals.[329] Public hospitals tend to mostly perform more complex surgery. Private for-profit hospitals are far more specialised than public hospitals.[355] French nomenclature allows to group hospital stays in 200 ‘products’ (cataract, stroke, etc.) Very specialised private hospitals, that realise 80% of their activity in 5 or less products, have on average 5 000 stays per year.[356] Those who reach 80% of their activity with only one product are specialised in digestive tract diseases, eye diseases, or perform only endoscopies.[356] Figure 53 shows a measure of the specialisation of different hospital categories in France. The entropy index measures the diversity of the hospital case mix.[357] Therefore, a lower index means a higher specialisation. We observe a trend towards more specialisation in private hospitals.

Figure 53 – Average entropy index by type of hospital in France, 2002-2009



Note: the entropy index corresponds to $D^j = \sum_i S_i^j ln \frac{1}{S_i}$ *where* S_i^j *denotes the proportion of the total activity of the hospital j realised in the activity i (i = [358]). If* $D^j=0$*, the hospital is considered as mono-product.[357] Source: Bonastre et al. (2013)[359]*

Significant differences are also observed across regions. For instance, Alsace, Centre, and Languedoc-Roussillon are characterised by a higher proportion of mono- or bi-disciplinary private hospitals, i.e. more specialised structures. Nevertheless, the temporal evolution towards more specialisation is observed overall in all regions of France.[360]

4.4 Proximity services and small hospitals

Distance and accessibility

According to a study of INSEE[361] and DREES[362], half of the patients are hospitalised at less than 20 minutes from their place of residence. Precisely, the median travel time to the hospital is 21 minutes, but it varies from 9 to 42 minutes depending on the health area considered. This difference does not occur across regions but inside each region, that is between health areas of the same region (i.e. intraregional variation is larger than interregional variation).

The time necessary to reach the hospital also varies widely according to the patient's pathology. More frequent pathologies are treated closer to the patient's living place. The 20 pathologies with the lowest median travel time are very frequent and represented 4.2 million of inpatient stays in 2008. Half of these stays take place in a general hospital and 20% in regional or teaching hospitals (CHR/CHU). For instance, the median time to go to the hospital for a vaginal delivery is 17 minutes, for respiratory infections 18 minutes, etc. On the other hand, the 20 pathologies with the highest median travel time have a low frequency. Together, they represented 211 300 stays in 2008. They concern complex care that is usually only available in CHR/CHU (65% of the stays for these pathologies). For instance, the median travel time for vascular surgery is 60 minutes.

Using a different method Coldefy et al. (2011)[363] reached similar results. They measured the travel time to reach the closest hospital, instead of the travel to the hospital effectively chosen by the patient. The closest maternity is located at a median travel time of 13 minutes, while the closest hospital for vascular surgery is at a median travel time of 24 minutes and the one for cardiac surgery at 38 minutes (see Table 37).

Table 37 – Travel time to hospital care (2007)

	Mean	Median
Orthopaedic Surgery	00:13:29	00:12:13
Endoscopy	00:13:49	00:12:26
Maternity (all types)	00:14:46	00:13:29
Hepato-gastroenterology	00:15:02	00:13:29
Medical cardiology	00:15:16	00:14:06
Cancer	00:15:22	00:13:29
Nephrology	00:15:50	00:14:11
Digestive surgery	00:16:14	00:14:07
Pulmonology	00:16:20	00:14:38
Medical neurology	00:17:47	00:15:54
Rheumatology	00:19:14	00:17:03
Urology	00:19:14	00:16:53
Medical endocrinology	00:19:17	00:16:48
Maternity (type 2 or +)	00:19:17	00:16:31
Ophthalmology	00:19:55	00:16:59
Haematology	00:20:25	00:17:54
Medical orthopaedics	00:21:34	00:19:53
Dermatology	00:23:41	00:20:10
ENT	00:25:03	00:22:44
Vascular surgery	00:28:25	00:24:21
Thoracic surgery	00:30:44	00:24:52
Maternity (type 3)	00:38:18	00:29:46
Neurosurgery	00:44:50	00:39:23
Heart surgery	00:46:01	00:37:54
Burn surgery	01:14:49	01:07:20

Source: Coldefy et al. (2011)[363]

Globally, the travel time to most medical care is reasonable. Even for very complex care, emergency transport modes, such as helicopters, can be used to reduce remoteness.[363] Nevertheless, the HPST Act emphasizes the importance of access to care for individuals located beyond reasonable travel time, or with low mobility. Proximity hospitals contribute to response to this issue.

Proximity hospitals

In 2004, there were 362 small public hospitals, called 'local hospitals' ensuring proximity care.[364] Before the HPST Act, there were still 320 such hospitals.[365] They represented a third of the public facilities, but only a minority of the hospital beds (i.e. 13 000 inpatient beds[365] on a total of more than 400000 beds[329]). The average number of acute (medical) beds per proximity hospital was 14, and they ensured 3% of the public care services in medical acute care.[365] In contrast to the other types of hospitals, their financing was not linked to their activity.

In 2009, the HPST Act abolished the notion of local hospitals but they continued to be exempted from the activity-based tariff system, as a temporary measure. The notion of 'proximity hospitals' has been formally defined in May 2016[366], following the government engagement to reinforce the role of such hospitals in support to primary care services[367] and a report from the State Audit Office (*'Cour des Comptes'*)[365] stating the importance of the former local hospitals in areas where the number of general practitioners is declining.

To be considered as a proximity hospital, the facility must fulfil the following requirements:[366, 368]

- The ARS license for medical care is granted to the hospital
- The ARS licenses for surgery and obstetrics are not granted to the hospital
- The medical activity does not exceed a given maximum (5 500 stays)

- The hospital covers a territory[r] that is defined as 'fragile', i.e. at least two of the following criteria are met:
  - The share of the population aged 75 or more is above the national average;
  - The share of the population living below the poverty line (60% of the median income) is above the national average;
  - The population density does not exceed a given maximum (150 inhabitants per km²);
  - The share of general practitioners per 100 000 inhabitants is lower than the national average.

  If the territory cannot be defined as fragile according to these criteria, the hospital can still be defined as a proximity hospital if one of the following criteria is met:

  - The hospital is operating with doctors working also in an ambulatory setting;
  - The hospital covers a territory where it is the only one with an ARS license for medical care.

The first list of 243 proximity hospitals has been established in June 2016. Most of them (64%) are former local hospitals.[368]

The proximity hospitals have a double role. On the one hand, they reinforce the supply of primary care services. In particular, they organise more specialised consultations, by the family doctor, inside the hospital. On the other hand, they develop partnerships with other hospitals in order to orientate the patient in case he/she needs more complex care.

Proximity hospitals are financed through a mixed system: 80% is constituted by a lump-sum payment based on historical resources and the remaining part is activity-based. Indeed, a full activity-based system would be harmful for such small facilities as the payment would vary widely across years. Nevertheless, dynamism is encouraged as a part of the resources is linked to the activity.[368]

[r] The territory is defined by a travel time by road of 20 minutes around the hospital, taking into account peak and non-peak hours.

Box 12 – Hospital payment system in France

In France, activity-based tariffs (called 'tarification à l'activité', T2A) have been introduced for public hospitals in 2004 and for private hospitals in 2005. Since 2008, acute care in all hospitals is funded through this system. As other DRG-like systems, tariffs are based on a payment per stay, which itself is based on the activity actually carried out by the hospital taking into account clinical case-mix, level of severity and length of stay. Nevertheless, national tariffs were adjusted to reflect hospitals' historical cost patterns in order to protect them from excessive budget cuts. Two T2A tariff scales are available, one for public and one for private hospitals. Proximity hospitals are financed through a mixed system that derogates to the T2A.

Sources: Cash et al. (2011)[369], Van de Voorde et al. (2013)[370] and DGOS (2016)[368]

Small hospitals

Although a minimum number of beds is not defined at the national level, some ARSs have made the choice to introduce such minimum threshold for medical care in their regions.[365] For instance, in its Regional Health Project, the ARS Lorraine considered to transform hospitals with less than 30 medical beds into proximity non-hospital structures. The ARS Pays-de-Loire stated that at least 20 beds are necessary to ensure that a medical project can really be set up with a dedicated team.

Regarding surgery, closures of small services are regularly advocated by national authorities, although they face strong opposition from local authorities.[371] The third generation of SROS, implemented in 2006, established a recommended minimum activity threshold in order to reorganise the supply of surgical care. This threshold was set at 1 500 stays in surgery per year or 2 000 acts in an operating room requiring

anaesthesia.[372] Among the 26 SROS, 19 explicitly used the threshold of 2 000 acts as a condition to maintain a surgery service.[373] In 2010, hospitals performing less than 1 500 surgical acts per year were threatened with closure.[374] This concerned 54 small hospitals, although the list has to be interpreted with caution as it has never been confirmed by public authorities.[375] In 2015, the Minister of Health set an indicative threshold to define low-activity hospitals at 2 101 acts per year.[372] It corresponds to the 25th percentile in 2012, i.e. in 2012, one fourth of the hospitals licensed for surgery performed less than 2 101 acts per year.[372] Identifying low activity hospitals has been perceived as a threat of closure for these hospitals.[376-378]. Indeed, the Minister of Health foresees the reorganisation of the hospital system at the horizon 2020, taking into account 'restructuring, notably closure of services with low activity in surgery'.[372]

The same tendency is observed for emergency services, where the announced threshold of 10 000 contacts per year would lead to the closure of 67 out of the 650 current emergency departments.[379-381]

These evolutions follow the trend initiated by maternity services, where the threshold is set at 300 deliveries per year (see Chapter 8).

4.5 Integration of services

Care pathways

Recently, various initiatives have been taken to develop care pathways in France. Such pathways are defined as the '*global trajectory for patients and users within their health area, with a particular emphasis on the individual and his choices'*.[382] They require coordinated action from actors involved in prevention, healthcare, health and social care, and social sectors. The objective is to ensure the individual receives the appropriate care, by the appropriate professionals, at the appropriate place, while reducing costs. While the concept of care pathways is advocated by political authorities in France, it seems that the implementation of such policies is still partial. Lots of coordination initiatives exist, but they fail to transversally integrate clinical, medico-social and social sectors.[383] In addition, the large number of such initiatives reduces efficiency and clarity.[383, 384] Finally, while coordination is still encouraged, the concept of fully integrated care seems to have disappeared from the political debate.[385] In addition, no specific payment system for care pathways has been set up in France (personal communication with Isabelle Hirtzlin, Université Paris 1).

Care for the elderly

The most visible action towards integration of care is certainly the development of care pathways targeted to the elderly. Care for fragile elderly, in particular with declining autonomy, was judged to be too fragmented. It was leading to unjustified hospital admissions and stays (unnecessary stays, avoidable use of emergency services, excessive length of stay, etc.).[386] The cost of avoidable hospitalisations of elderly has been estimated to approximately 2 billion euros per year.[387]

Eleven pilot projects aiming to develop better care pathways for the elderly have been launched in 2012, for a duration of five years. These projects, known as 'article 70 projects', were submitted by actors already implied in coordination networks. The idea was to improve the existing systems with the aim to reproduce them at the national level.[386] The pilots are led by the ARSs, financed by the health insurance funds and evaluated by the High Authority of Health.[388, 389] Some projects focus on pre-hospitalisation, some on post-hospitalisation and some on both. An amount of 50 000 euros has been allocated to each part (pre and/or post hospitalisation) of the projects. The low amount is justified by the fact that the projects are built on existing networks, which are financed by other sources.[386]

The evaluation of the on-going projects led to the following conclusions:[389]

- To avoid unnecessary readmission, the implication of the complete medical team is important regarding three key steps:
  - During hospitalisation, identify as soon as possible the risks of readmission. This should lead to a specific support including health and social evaluation, contacts with the professionals in charge of care at the patient's living place, etc.
  - At the moment of the discharge, the patient should receive a document including information necessary for the continuity of

care. Moreover, to facilitate the quality of care at home, the discharge should take place in the morning.
    - After discharge, the actions initiated at the hospital should be pursued at home. This implies a more or less large implication of the hospital medical team, depending on the local supply of medical care.
- The organisation of primary care in multidisciplinary teams is an important condition for success of the projects.
- The capacity to collect, share and use structured clinical data is another necessary condition for success. Improving information and communication is therefore crucial.

In 2014, new pilot projects have been launched through the programme PAERPA (‘*Personnes Agées En Risque de Perte d’Autonomie’*) with the aim of experimenting new care organisations for the elderly. Fourteen projects in nine regions have been selected, each of them receiving approximately 4 million euros per year over three years.[390]

Several common tools are used by the projects:[390, 391]

- The Personal Health Plan is a shared diagnostic tool, initiated by the family doctor as soon as a risk is identified. It summarizes the health and social situation of the patient and identifies the persons involved in the delivery of care.
- An information-sharing platform is used by professionals and patients to improve the coordination between health professionals. In particular, it supports the follow-up of the Personal Health Plan, offers a phone line for geriatric questions, allows the activation of social financial support, etc.
- A discharge document, written by the hospital medical team, is sent to the family doctor.
- A secure messaging tool will be developed in order to safely share patient’s medical and social information.

In 2016, the PAERPA programme has been extended to cover additional health areas and consolidate the current projects.[392]

Other initiatives

In recent years, several actions have been taken in a large number of fields to improve integration, focussing on target populations such as persons with a handicap, patients with chronic diseases, patients with severe obesity, people in precarious situations, patients with neuro-degenerative diseases (Alzheimer (see Box 13), Parkinson and multiple sclerosis), etc.[393] According to the Ministry of Health, all topics that are considered as national priorities are also the object of studies to define care pathways.[393]

Box 13 – Homes for the Integration and Autonomy for Alzheimer

One of the core measures of the Alzheimer Plan 2008-2012 was the creation of the Homes for the Integration and Autonomy for Alzheimer patients (‘*Maison pour l’Autonomie et l’Intégration des malades Alzheimer*’, MAIAs). They are not a physical structure, but rather a method conceived to improve integration of services (ambulatory, hospital, medico-social, etc.) concerning autonomy. Currently, 98% of the French territory is covered by one of the 352 MAIAs.[394, 395] In 2016, 85% of the territory was covered, by 302 MAIAs.[395, 396]

The MAIAs policy is based on a study, Project and Researches on Integration of Services for the Maintenance of Autonomy in France (PRISMA France), which grew out of a unique and original adaptation of a model from Quebec to the reality of the French system.[385] It is the most complete model of integration of care services in France, going beyond the simple coordination of care. In an integrated system, all actors build the project together and share the actions and responsibilities.[396] However, despite the success of the policy, it seems that integration has disappeared from the political debate.[385]

The MAIAs are based on six mechanisms and tools of integration:[396-398]

- Coordination between institutions, involving all the stakeholders in the medical, psychological, social service and administrative field. The aim is to develop a common project, which addresses the supply for the entire area, corresponding to population needs. Decision makers should be concerned by this entire project and not only the supply of services over which they have authority.

- Single entry point. Each person (patient, family, professional, etc.) receives the same response, no matter which partner is solicited. The patient does not have to know how the system works to obtain information.
- Case management. Long-term follow-up is performed by case managers, who are the contact person for the patient, the general practitioner, etc.
- Standardised multidimensional assessment tools. These assessments are done at the entry-point level and at the case manager level.
- Individualised service plan. This tool defines, plans and ensures consistent and continue follow-up of all the interventions.
- Sharing information system. Clinical data must be shared between health professionals to ensure the continuity of care.

A first evaluation of the system shows positive results: the average number of points of contact before reaching the MAIA fell from 3.2 in 2009 to 1.3 in 2010 and hospitalisation rate decreased.[398]

A set of patient pathways has also been developed by the High Authority of Health (HAS) to improve the quality of care for patients with chronic diseases and to reduce spending. It publishes manuals and tools for several diseases. Currently, the following topics are covered:[399]

- Stroke;
- Chronic obstructive pulmonary disease (COPD);
- Broncho-pulmonary cancer and malignant pleural mesothelioma cancer;
- Chronic heart failure;
- Hodgkin's Lymphoma;
- Parkinson's disease;
- Chronic renal failure;
- Type 2 diabetes;
- Palliative care.

4.6 Collaboration forms between hospitals

France has experienced a trend towards more collaboration between hospitals. For simplicity, we distinguish two collaboration forms. On the one hand, a hospital group includes two or more hospitals owned, leased, sponsored, or contract managed by a central organisation. The creation of such groups is motivated by economic considerations rather than by an objective of coordinating healthcare supply in an area. On the other hand, a network is composed of independent hospitals and other care providers who work together to coordinate and deliver services.

4.6.1 Hospitals groups

Hospital groups can be categorised in two main types: public hospital groups, which are led by teaching hospitals (CHU), and private for-profit groups, also known as hospital chains, which have a commercial purpose. In 2013, there were 32 public hospital groups, representing 200 hospitals, about 90 000 beds and around one third of hospital activity in the country. The biggest public hospital group, *Assistance Publique – Hopitaux de Paris* (AP-HP) provides on its own 10% of the hospital care in France.[330] Regarding private hospitals, about 60% of them belong to a group. Most of the groups operate in a single region but some of them, such as *Générale de Santé* (GdS) or *Elsan*, operate across the country.

Table 38 – Key indicators for major hospital groups in France (2015)

	AP-HP (Paris) (1st public group)	Hospices civils de Lyon (2nd public group)	Ramsay-GdS (1st private group)	Elsan (2nd private group)
Number of hospitals (all categories)	39	14	124	80
Number of hospitals (acute only)			62	65
Number of beds (all categories, inpatient and day care)	22 720	5 250		10 900
Number of births in maternity units (per year)	40000	10 500	35 000	33 000
Number of emergencies (per year)	1340 000	280 000	500 000	310 000
Number of staff	100000	23 000	22 000	14 000
Market share	10% of hospital care in France		17% of private hospital care in France	12% of private hospital care in France

Sources: AP-HP (2015)[400], Hospices Civils de Lyon (2016)[401], Ramsay-GdS (2016)[402] and Elsan (2016)[403]

4.6.2 Networks

The first type of collaboration forms between hospitals have been introduced in France in 1970.[404] Since then, several tools in favour of collaboration have been created in the French law. The 2009 HPST Act[314] and the law of modernisation of the health system of January 2016[405] have 'cleaned' the system of tools for cooperation that can be used by hospitals. They have re-introduced the '*groupements de cooperation sanitaire*' (GCS) created in 1996 and have established the '*communautés hospitalières de territoire*' (CHT) that have recently been transformed into '*groupements hospitaliers de territoire*' (GHT). The first is a tool for collaboration between private and public facilities while the second is dedicated to public hospitals.[406]

Groupements de Cooperation Sanitaire (GCS)

The GCSs were created in 1996 as a tool for collaboration between public and private hospitals. Their role has recently been redefined by the law of modernisation of the health system of January 2016.[405] Two categories of GCS can be distinguished:[329]

- GCS of resources. Such a network can be constituted in order to pool any type of resources:[407] administrative, logistic, technical, medico-technical, teaching or research activities, human resources, equipment, real estate, information, etc. Medical staff of one member of the GCS can provide care to a patient of another member. Such a GCS can also receive a license from the ARS for major medical equipment and can use a license for an activity of care granted by the ARS to one of its members.[329] Collaboration is possible between various kinds of healthcare professionals, private or public, the only restriction being that at least one hospital has to be member of the GCS. The GCS of resources is a legal entity, hence can be an employer.[329]

- GCS-ES (*'GCS-Établissement de santé'*). GCSs of resources can further move to a GCS-ES, a more complete form of collaboration. In that case, the GSC itself is considered as a hospital. It can be licensed by the ARS for one or several care activities. However, the cumbersome management of such GSC-ES has been criticised by the concerned actors.[408] This tool is therefore rarely used.

Communautés Hospitalières de Territoire (CHT)

The CHT is a conventional form of collaboration, in the sense that it is based on an agreement signed between hospitals.[406, 409] The CHT is not a legal entity in itself since each hospital in the CHT keeps its legal personality. Therefore the CHTs do not imply merging of hospitals. Each hospital keeps its independence and autonomy. Financial resources cannot be pooled at the CHT level. In the same way, a CHT cannot be considered as an employer.[410]

According to the 2009 HPST Act, public hospitals can conclude a CHT convention with the double objective of pursuing a common medical strategy and commonly manage some functions and activities. Hence CHTs are constituted on a voluntary basis, but they can also be encouraged by the ARS. Only public hospitals are allowed to sign a CHT convention and each hospital can only be part of one CHT.[406]

The CHT is supposed to add value in terms of:[411, 412]

- Quality of care:
  - Facilitating patients' care pathway
  - Improving access and continuity of care in the area
- Sustainability and optimisation of the supply of care:
  - Strengthening hospital teams (more specialties, etc.)
  - Strengthening attractiveness for some areas
- Cost:
  - Optimising real estate and human resources
  - Pooling support functions
  - Optimising technical platforms

There exist many forms of CHTs, but each of them is based on a 'common medical project' which harmonises hospital projects in order to satisfy healthcare needs of the population in the area.[410] This document is at the core of the CHT. It defines the organisation of the CHT and the division of activities across facilities. The project must be approved by the ARS. Each hospital has therefore to establish its own project in accordance with the common medical project.[404]

Box 14 – Example: CHT Villefranche - Tarare – Alix

In January 2011, the public hospitals of Villefranche-sur-Soane (600 beds) and Tarare (300 beds) established the first CHT of the Region of Rhône-Alpes. Population surrounding the hospital of Tarare has suffered from the textile industry restructuring and is therefore quite poor (55% of the households live below the poverty line, the rate of unemployment is 15.3%, etc.). The hospital of Tarare and its patients benefit from the CHT, notably:

- Medical teams of Villefranche can now operate in Tarare in various fields such as paediatrics, gynaecology, cardiology, etc.
- Post-surgery stays are now offered in Tarare: patients have to travel to Villefranche for the surgery, but consultations, pre-op check-up and post-op follow-ups take place in Tarare.

The hospital of Villefranche also benefits from the collaboration. Indeed, patients who cannot be treated in Tarare are in priority referred to Villefranche. This strengthens the modern technical platform (new imagery unit, new day-surgery unit, new obstetrics room and new reanimation unit) installed in Villefranche.

Finally, IT tools, including teleconference and telemedicine, are used to allow easy contacts and exchange of information between medical teams.

Source: ARS Rhône-Alpes (2011)[411]

Groupements Hospitaliers de Territoire (GHT)

While networks such as CHTs are necessary to satisfy the political willingness to transform the healthcare system towards an increased use of care pathways, their development has been judged insufficient. Indeed, there were only 39 CHTs in France in 2013[413] and 45 in 2014[408]. There were only 22 GCS-ES in 2014 and none of them was exclusively constituted of public hospitals.[408] On the other hand, collaboration tools concerning narrowly defined activities have been widely used. The number of GCS of resources has increased from 191 in 2008 to 621 in 2014 but most of them (326) have only been created with the aim of pooling IT, logistics or administrative functions.[408]

The law of modernisation of the health system of January 2016[405], in particular its article 107, transformed the CHTs into GHTs, which became mandatory. Their aim is to ensure better access to care by strengthening the collaboration between public hospitals. They are organised around a 'shared medical project' that responds to the population's medical needs. The GHTs are therefore characterised by five key elements:[329, 413]

- The participation is mandatory. Each public hospital must be part of a GHT. Derogations may be granted by the ARS if the size, the location or the specialisation of the hospital makes the collaboration irrelevant.
- The GHT is based on a 'shared medical project' that describes the supply chain inside the GHT.
- Some functions (information, purchases, coordination of training) are pooled and transferred to the designated 'support hospital'.
- The organisation of medico-technical activities (imaging, clinical biology, etc.) is defined in common. The technical platform does not have to be unique, but the organisation should be.
- The GHT has no legal personality by itself. It functions through the 'support hospital'.

The list of 135 GHTs has been established in July 2016 by the ARSs, following consultations with public hospital representatives.[414] It has been recommended that the maximum travel time between two hospitals of a same GHT does not exceed one hour.[408] This recommendation is not translated in the law, but some ARSs have explicitly taken distance into account in the definition of the GHTs (for instance, Auvergne-Rhônes-Alpes[415]).

These 135 GHTs are very heterogeneous, in terms of size, population covered and number of hospital members (see also Table 39).[416] Some only have two members, while others count 15 members, and the population covered ranges from 50 000 to more than 2 000 000 inhabitants.[417] There is also little consistency between regions regarding the geographical choices made to define the GHTs.[418] About a year after their creation, the degree of maturity of the GHTs is also variable.[416] However, each GHT should have established its common medical project before July 2017.

Table 39 – GHTs per region in France, 2016

Region	Number of GHTs	Population (2016)
Auvergne-Rhône-Alpes	15	7 940 652
Bourgogne-Franche-Comté	12	2 820 150
Bretagne	8	3 310 341
Centre-Val-de-Loire	6	2 587 004
Corse	2	330 354
Grand Est	11	5 558 304
Hauts-de-France	14	6 030 309
Île-de-France	15	12 142 802
Normandie	11	3 343 247
Nouvelle Aquitaine	12	5 943 096
Occitanie	14	5 830 166
Pays de la Loire	5	3 743 982
Provence-Alpes-Côte d'Azur	6	5 024 192

Note: there are 4 additional GHTs in overseas regions; Population: estimation at 1 January 2016.
Sources: Ministère des Affaires sociales et de la Santé (2016)[419] and INSEE (2017)[420]

Up to now, the objectives of the GHTs are a common organisation of care as well as a rationalisation by the pooling of support functions. They do not explicitly imply concentration of care. However, concerns have been raised, notably by labour unions, that this new organisation is a step towards merging and concentration of care.[421-425] In particular, it is expected that financial solidarity will be organised between the members of each GHT in order to establish a group strategy.[408, 426] With such a common budget for the group, the financial viability of each hospital will no longer be linked to the activity realised in that particular hospital. Therefore, individual hospitals will no longer have incentives to supply the same care activities as their neighbours. Rather than competing with each other, they will develop a group strategy, based on the complementary between hospitals.

4.7 Vision on the future

In recent years, alternatives to hospitalisation have been developed and are increasingly encouraged by the public authorities. The law of modernisation of the health system of January 2016.[405] puts an emphasis on proximity and the development of 'shift towards ambulatory care' ('*virage ambulatoire*'). At the same time, the Plan for Health System Efficiency and Performance has the ambition to organise the hospital of the future by optimising care organisations and changing practices. It aims to improve care coverage and quality of care, without degrading the financial equilibrium of healthcare facilities and, as a result, to achieve savings (€ 10 billion in savings expected by 2017).[427] This plan promotes alternatives to hospitalisation (day surgery, reduction of length of stay, hospitalisation at home, ambulatory medical care, etc.).

Hospitalisation at home[s]

Hospitalisation at home ('*hospitalisation à domicile*', HAD) is a form of full-time hospitalisation where care is provided at the person's place of residence. According to the decree of 2 October 1992, 'the structures of hospitalisation at home make it possible to provide continuous and necessarily coordinated medical and paramedical care at the patient's home, for a limited period that can be revised according to the evolution of his health status. HAD care differs from care usually provided at home by the complexity and frequency of acts'.[429] The circular of 30 May 2000 states: 'HAD applies to patients, regardless of their age, who have heavy acute or chronic, progressive and/or unstable pathologies and who, in the absence of such a service, would be hospitalised'.[430]

As other hospitals, HAD structures are subject to a licensing procedure. From about 60 licensed structures at the end of the nineties, the number has evolved to 298 in 2009 and to 311 in 2015, covering now the entire country.[431-433] Between 2005 and 2015, the number of patients in HAD has increased by 200% and the number of days realised in HAD by 190%.[431]

Despite this spectacular development, HAD still represents a very small part of classical hospitalisation (0.6% of the number of inpatient stays).[434] Public authorities committed to promote the development of HAD, as a substitute for hospitalisation. A target for 2018 was set to 30-35 patients per day per 100 000 inhabitants (this threshold was 18.5 patients per day in 2014), which corresponds to doubling the overall activity compared to 2011.[433]

A day in HAD is estimated to cost, on average, 198 euros, compared with 703 euros per day in a hospital.[435] Based on these numbers, and the assumption that 10% of short stays and 5% of medium stays could be substituted by HAD over three years for some pathologies, it has been estimated that 35 billion euros could be saved.[436]

[s] The interested reader can find more information about hospitalisation at home in Farfan-Portet et al. (2015).[428]

Day surgery[t]

For the last 10 years, French authorities have encouraged through various actions the development of day surgery, which is defined as hospital stays of maximum 12 hours without overnight stay. Since 2010, the development of day surgery is considered as national priority and a target of 54.7% of interventions realised in day care was set for 2016.[372] Although the share of day surgery has increased from 43.3% in 2010 to 51.9% in 2015, the set target was not met.[71] Moreover, the development of day surgery has been heterogeneous between regions as well as between public and private hospitals, the latter showing higher day-surgery rates. In 2015, a new national target, for 2020, has been set at 66.2%.[372]

t The interested reader can find more information about day surgery in Leroy et al. (2017).[71]

5 THE NETHERLANDS

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5.1 Introduction

The Dutch hospital sector depended for many decades on self-governance by private non-profit providers (e.g. regarding quality-of-care, and all strategic decisions). The scale and scope of Dutch hospitals was comparatively large. Specialists were mainly self-employed and rarely worked outside the hospital premises, for example in their own offices or in private clinics. The government increased its involvement with the sector mainly for reasons of fiscal sustainability; in 1971 local certificate-of-need regulations were centralized, followed by the introduction of a system of global budgets in the early 1980s and special funding regimes for university clinics and certain high-tech procedures and equipment. The late 1990s saw a major crisis in the sector as a result of lacking hospital productivity and increasing waiting lists. This created political momentum which became one of the drivers for the Dutch market reforms in 2006.[437]

These market reforms gradually altered the incentive structures of the hospital sector as well as its organizational characteristics. Only the rates of the more complex (30%) hospital cases were set, while the remaining parts were freely negotiable between providers and insurance companies. Hospitals witnessed increased merger activity and hospitals started to build outpatient clinics.

This chapter consists of an analytical review of the contemporary hospital landscape in the Netherlands. We examine and describe how the sector is organised (section 5.2). We then focus on the institutions that steer specialised and highly specialised services (section 5.3). We give special attention to the issues of smaller hospitals and the distribution of hospital services (section 5.4), and integrated care (section 5.5). Finally we present our conclusions (section 5.6).

5.2 Hospitals in the Netherlands

5.2.1 The Dutch healthcare system

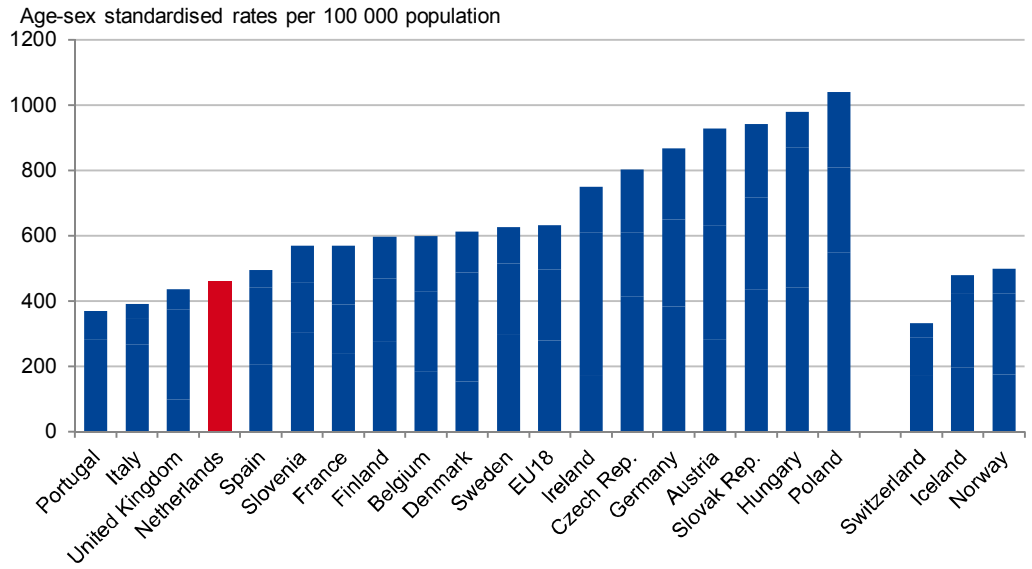
In this section we will give an overview of healthcare spending and healthcare quality in the Netherlands in comparison with other countries. The Netherlands ranks 7th of the OECD countries in terms of healthcare expenditure as a share of GDP in 2015. Total healthcare expenditure accounts for 10.8% of GDP.[438] The Netherlands takes up the 4th place, behind Germany, Sweden and France.[439] The above average position is mainly due to comparatively high long-term care expenditures. Primary care, hospital care and pharmaceutical expenditure is on or below average. If current policies remain unchanged, the Dutch central planning office expects curative care to grow by around 5.0% per year.[440] This will likely add fiscal pressure to the system over the medium term.

Although the Dutch healthcare system is expensive, it shows notable strengths in return. One of them is a strong gatekeeper system. In 2009-2010, the Primary Health care Activity Monitor assessed 77 indicators in various European countries (covering governance, workforce development, accessibility, continuity, coordination, and comprehensiveness) and characterised the Dutch system as 'strong'.[441]

That the primary care system is quite effective as gatekeeper to hospital care is further reflected in the comparatively low number of avoidable hospital admissions (Figure 54), and the low numbers of hospital discharges (Figure 55). This suggests good levels of efficiency, but also suggests a high inpatient case-mix among Dutch hospitals. The median length of stay (LOS) was 130 minutes in the Dutch Emergency Departments, which is relatively short compared to other Western countries, which generally have a LOS of 176 to 480 min.[442] Furthermore, the Dutch hospital sector has an average length of stay in 2014 of 6.4 days compared to the EU28 average of 8.0 days (note that the Netherlands only accounts for curative acute care, which could result in an under-estimation).[439]

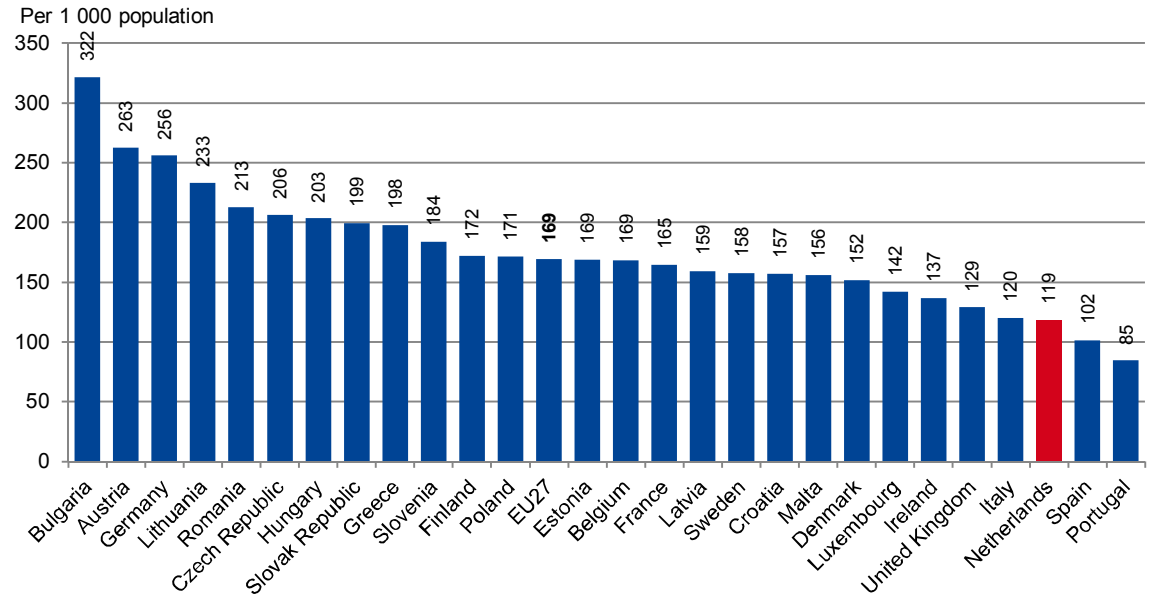
Hospital quality is good, as reflected in a comparatively low amenable mortality rate of 85 in 100 000 people (see Figure 56), substantial improvement of 5 year survival rates for cancer[443], as well as good 30 day fatality (stroke-AMI) values compared to the OECD average[444].

Figure 54 – Avoidable admissions for chronic ambulatory care sensitive conditions, 2013 (or nearest year)



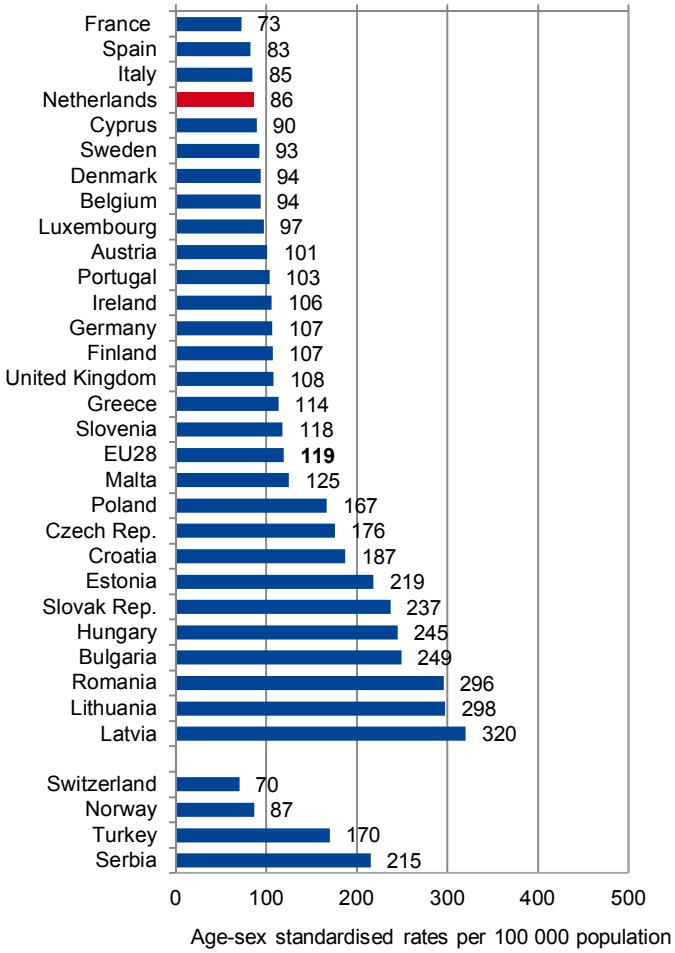
Source: OECD Health Statistics (2016)[445]

Figure 55 – Hospital discharges per 1 000 population, 2014 (or nearest year)



Source: OECD Health Statistics (2016)[445]

Figure 56 – Amenable mortality rates, 2013

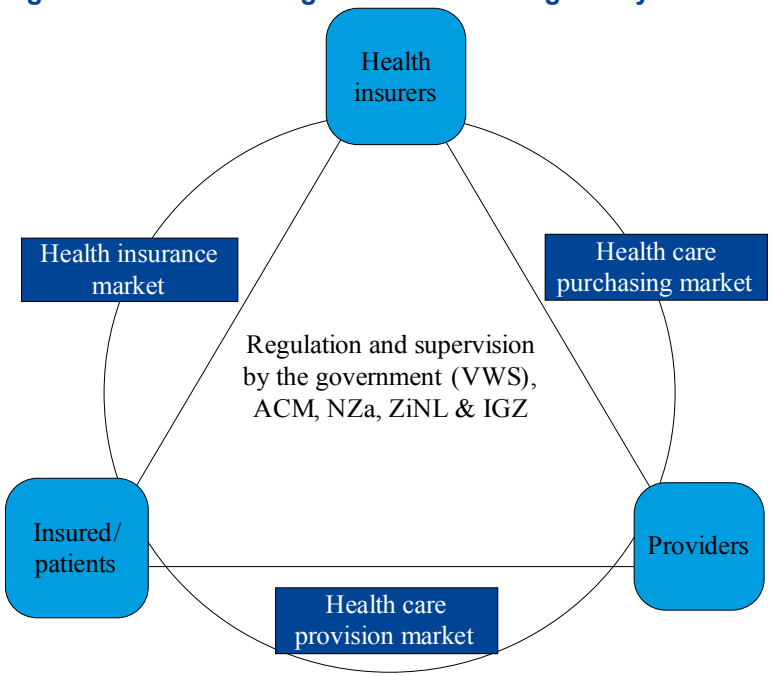


Source: Eurostat (2016)[446]

5.2.2 Market reform' of the healthcare sector

In 2006, a substantial reform of the healthcare sector introduced a single universal mandatory health insurance scheme carried out by private health insurers (Health Insurance Act – Zvw). This reform abolished the split between the public (about two thirds of the population) and private health insurance market, and 'introduced' managed competition as the underlying principle of the entire healthcare system. The government loosened command and control of the system and focused on monitoring and setting the regulatory framework. As a consequence, the Netherlands has placed health insurers in the driver's seat for many decisions related to the financing and contracting of care, while safeguarding important policy goals regarding access, quality and affordability. For example, health insurers have to accept all applicants and enrolees have the right to switch insurer each year. Generally three markets are defined in the healthcare landscape; 1) the health insurance market, 2) the healthcare purchasing market, and 3) the health provision market.[447] There are agencies and monitoring bodies to guarantee certain public values – quality, affordability and accessibility – and for safeguarding fair competition in these markets: the Authority for Consumers and Markets (Dutch abbreviation ACM), Dutch Health care Authority (Dutch abbreviation NZa), National Health Care Institute (Dutch abbreviation ZiNL) and the Health Care Inspectorate (Dutch abbreviation IGZ).

Figure 57 – Three managed markets and regulatory/monitoring bodies



The ACM acts as the national competition authority of the Netherlands, including the healthcare markets. The ACM's role is to ensure fair competition and protects the rights of healthcare consumers. It is responsible for checking and approving mergers and various forms of cooperation between healthcare providers above a certain threshold. All hospitals that seek to merge need approval of the ACM.

The NZa, as a healthcare specific authority, sets the conditions for a fair market and regulates remunerations where market imperfections prevail. Thus when needed, it interferes with rate setting, and monitors whether health insurers and providers act according to the market rules. In addition, the ACM asks for the expert opinion of the NZa when they have to assess a proposed merger. The NZa, in turn, requests expertise from the Health Care Inspectorate (IGZ) to advise on the possible effects of the mergers on the quality of care. Since the ACM and NZA have a joint responsibility for health markets and competences may overlap, although this has become more strictly separated, the NZa will first exert sector-specific authority.[447]

The National Health Care Institute (ZiNL) manages the basic healthcare package through the provision of advice on cost-effectiveness of interventions. ZiNL sets, encourages and supports the healthcare parties responsible for drawing up quality standards and relevant measuring instruments, and also collects and provides data on quality of care.

The 2006 health insurance reform installed premium-based competition between health insurers and a complex market with more consumer choice has emerged. First, citizens are required to purchase and select from 58 different insurance policies with different premium levels.[448] Second, the level of a possible voluntary deductible up to 500 euro can be selected in return for a premium rebate (and in addition to a compulsory deductible of 385 euro in 2017). Third, citizens can choose between a policy which warrants all benefits in-kind within a (generally broad, yet occasionally limited) provider network ('*naturapolis'*), a reimbursement policy ('*restitutiepolis'*) or a combination of the two ('*combinatiepolis'*).

In theory, the insured will only be fully reimbursed if they seek care by a contracted provider, whereas the (usually slightly more expensive) reimbursement policy does not restrict provider choice but might set limits to the level of reimbursement. If the insured individual visits a provider without a contract the insured will only be reimbursed up to 80% of the tariff. Nonetheless, there is a criterion monitored by the NZa that sets boundaries to this, also referred to as the '*hinderpaal-criterium*'. This means that health insurers cannot reimburse at a level that would prevent the patient from seeking care with a specific hospital service provider. Since insurers generally contract all hospitals, this '*hinderpaal-criterium*' has not been challenged in court.

The Dutch health insurer market has four large insurance companies, which together cover 88.5% of the market. This gives the insurance companies strong bargaining power in some – but not all – healthcare sectors. Since 2006, no new entrants came into the health insurance market. The health insurers are historically concentrated within certain regions and enjoy a higher market share in 'their' own region. However, the levels of geographical concentration has been decreasing slightly over the years.[449]

In 2005, the Netherlands introduced a reimbursement scheme similar to Diagnosis Related Groups (DRGs – referred to as DBCs in Dutch terms), including outpatient treatments. In 2005, 10% of the tariffs of these DBCs were freely negotiable, referred to as the B-segment, between the health insurer and the healthcare providers. This proportion has increased over the years, and in 2012 around 70% of the DBCs were part of the B-segment. More information on the DBC system in the Netherlands can be found in a KCE report on hospital payment systems[370] and in the report of the European Observatory on Health Systems and Policies Series, Diagnosis related Groups in Europe[450].

In 2012, most of the remaining safety nets for hospitals were largely abolished (ex post risk equalization). However, at the same time a collective agreement on national level between providers, health insurers and unions was made to implement a 'global budget' in the Dutch health care sector ('*hoofdlijnenakkoord*'). The 'global budget' restricted the annual net growth of hospital expenditures to 2.5 % plus inflation between 2012 and 2014. From 2015-2017 this ceiling has been lowered to a 1% plus inflation annual net growth of hospital expenditures. In practice these agreements to a large extent set the fiscal framework for the local negotiations between insurers and providers.

5.2.3 Hospital classification, levels and types

Defining hospital services

Medical specialised care can be defined as the diagnostics, treatments and therapies provided by trained medical specialists. In order to access reimbursable curative care by a medical specialist, patients need a referral from their GP, or can access it through emergency care.[451] Emergency care is provided by GPs, emergency wards and trauma centres.[447] In 2015, the Netherlands counted 102 hospitals (general, tertiary and academic), 120 hospital locations and 111 ambulatory care centres.[452]

The organisations that provide medical specialist care can facilitate self-employed medical specialists or have them on their payroll ('salaried'). Around 42% of the active medical specialists in the Netherlands are currently independent professionals, 43% are salaried professionals of the hospital, the remaining 15% combines working as salaried professional and independent professional.[453] The number of salaried professionals has increased by almost 5% in 2016 as compared to 2010.[453]

All providers of hospital care need formal entrance approval under the Health Care Institutions Admission Act (*Wet Toelating Zorginstellingen*, WTZi). This act sets a regulatory framework that among others outlines rules on good governance within an organisation and the prohibition to allocate profit to third parties. Yet, hospitals are free to decide on all of their investments since capital planning has been abolished.

Three levels of health care

The Dutch acute healthcare system is generally divided into three levels: primary, secondary and tertiary care. Primary care plays an important role in the Netherlands. In 2015, there were 9 418 GPs working in primary care.[454] Most citizens are registered with a GP, although this is not formally required. Switching between GPs can be done without formal restriction.[455] GPs provide for a broad scope of services, increasingly substituting hospital care; 165 per 1 000 patients seen by a GP were referred to secondary care in 2010.[456] However, there is a large referral variation between GPs: between 94 to 254 new referrals per 1 000 patients, controlled for relevant patient characteristics.[456]

Part of the collective agreement, to curb healthcare expenditure, was to incentivize and mandate GPs to substitute parts of secondary care. However, the reduction due to the substitution of care, was marginal and ultimately did not seem to have a financial impact on health care as a whole.[457]

Tertiary care is highly specialisd care (although not always exactly defined), which is provided in the academic hospitals, designated tertiary care hospitals and a few specialised clinics. Table 40 provides a general overview of the type of hospital service providers active in the Netherlands. The table also provides an illustration of what kind of care is provided.

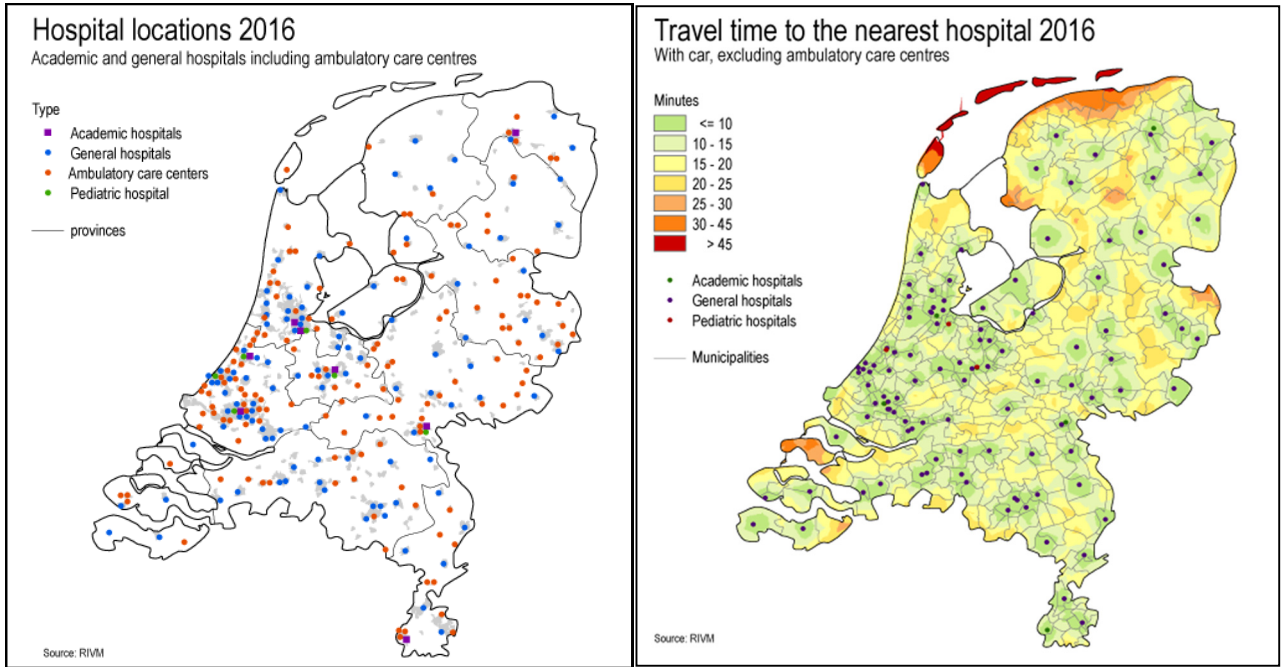
Table 40 – Overview type of healthcare providers and type of care offered

Type	#	Basic/standardized/ elective care	Complex care	Specialisation in one type of treatment or disease	Reimbursable care	Non -reimbursable care
Academic hospitals	8[a]	X	X		X	
General hospitals, (including teaching hospitals and rehabilitation hospitals)	70[a]	X			X	
Tertiary hospitals	24[a]		X	X	X	
Independent treatment centres (ZBCs)	320 [b]	X		X	X	X

Sources: [a] Data 2015[452]; [b] Data 2015[458]

The general and academic hospitals are relatively evenly spread over the Netherlands. There exists a slight clustering of hospitals in the Western region of the Netherlands, but this part is also the more urbanized part. Hospital care is accessible within 30 minutes for 99% of the people. The only exceptions are the islands (*Waddeneilanden*) and some regions in the North and South-West of the Netherlands (Figure 58). According to the National Institute for Public Health and the Environment (RIVM), 99.8% of the Dutch population can be transported within 45 minutes to an emergency department or acute obstetric care setting which is open 24/7.[459]

Figure 58 – Location of hospitals 2016 & travel time closest hospital in minutes by car excluding ambulatory care centres 2016



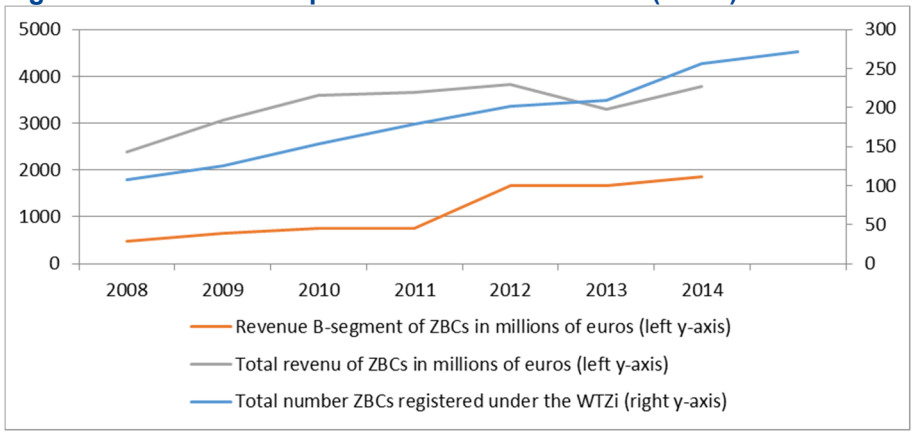
Source: Volksgezondheidenzorg.info (2016)[460, 461]

Whereas the number of hospitals in the Netherlands has remained relatively stable, the number of independent treatment centres (ZBCs) has grown over the years (Figure 59), especially in the more densely populated areas. Independent treatment centres can be seen as a certain form of focused factories, providing specialist standardized treatments. These providers most often cover parts of the following specializations: dermatology, general surgery, plastic surgery, ophthalmology and orthopaedics.[462] The prices of ZBCs are generally 15-20% lower than the prices negotiated with hospitals.[463]

In 1998, a regulation for ZBCs was introduced ('*Regeling zelfstandige behandelcentra*') that allowed ZBCs to provide hospital care services under specific conditions such as the obligation to have a contract with a general hospital in case of emergency complications and rules on governance and quality measurement. In 2003, the added value in terms of quality, efficiency (costs, logistics) and patient experience of ZBCs became more recognized and the conditions to provide hospital services became less strict, which made it easier for new entrees. For instance, the condition that ZBCs could only provide care that had a waiting time was lifted.

Since the introduction of the WTZi, the strict separation between ZBCs and hospitals became more blurred. Both are now defined the same, as organisations providing medical specialist care, although only hospitals can operate inpatient departments.[462] Moreover, in a significant number of cases, hospitals own all or part of the shares of a ZBC.

Figure 59 – Growth independent treatment centres (ZBCs)



Source: DigiMv dataset. Note that the jump in B-segment revenue in 2012 is due to an increase of more healthcare products falling under this segment.

Dutch hospitals need to comply with a maximum acceptable waiting time for patients in need of non-acute and elective care. This norm is referred to as the '*Treeknorm*'. There has been a decline in the percentage of departments and independent treatment centres having waiting times above the *Treeknorm* between 2010 and 2013. However, recently the number of departments and ZBCs, providing outpatient treatments or diagnostic services, exceeding the *Treeknorm,* increased a bit. This trend is possibly due to the containment of financial resources.[464]

Mergers and joint ventures

Over the years, the number of independent hospitals (including rehabilitation hospitals) decreased from 143 in 1997 to 102 in 2015, but the number of locations remained relatively stable: the decrease was chiefly due to mergers and joint ventures.

Arguments for mergers and joint ventures are that scaling up will optimize their health care portfolio and increase the quality of health care delivery. However, in one recent study no clear relationship between quality improvement after mergers could be found.[465, 466] Another reason is that hospitals are incentivized/forced to merge due to a weak financial position. One example is the acquisition by a private investor, MC group, of the Slotervaart hospital. MC group also took over other healthcare organisations, usually finding themselves in a critical financial condition. The MC group reorganized them to make these organisations profitable again.

Box 15 – The different forms of mergers and joint ventures in the hospital sector

Legal merger: the separate legal entities merge into one legal entity.

Administrative merger: the organisations keep their legal entity separate but their administration of the two hospitals merge. Hence the two organisations are governed by one board.

Joint venture: hereby the hospitals remain separate but set up a different entity to share capital and risk for a common project. The separate hospitals distribute the shares among themselves.

Legal mergers are most common in the hospital sector, followed by administrative mergers. Joint ventures rarely happen.[467u] Most hospitals that went through an administrative merger, went through a legal merger soon after. This is a shift compared to a couple of years ago because previously hospitals usually waited several years before they pursued a legal merger after an administrative one. At the moment, the number of mergers seems to have reached its peak. The number of mergers halved in 2016 compared to 2015.[467]

In 2015, the NZA expressed in a position paper their concern that there was potentially too much market concentration. The NZa is concerned that due to the mergers, some type of care facilities are less accessible. Some people have to travel longer because specific types of treatment are, after the merger, only available in one location. Due to the fact that often closely located hospitals merge with one another, the NZa warns for too much regional market power. This concentration is likely to have a negative impact on the choice of patients and may increase price and not necessarily quality.[468] In addition, concern has been expressed by experts that there seems to be no-point of return after a merger, and that it is practically impossible to split up the hospitals after a failed merger.[469]

Collaboration

Collaborations between hospitals emerge through bottom-up initiatives and are mostly case specific. Since the hospital sector has to comply with the rules of the regulated market, and collaboration forms could challenge certain market mechanisms, the Authority for Consumers and Markets (ACM) assesses the various collaboration forms. ACM argues that there exists space to collaborate but it has to be in the interest of the consumer, for both the patients as well as the insured. Recently the ACM for example approved that hospitals are allowed to combine forces to jointly purchase pharmaceuticals. The ACM argues that this initiative could result in lower prices and is thus in the general interest. Before this formal ruling, hospitals were not allowed to collaborate if their joint purchasing was more than 35% of the market.[470]

5.2.4 *Hospital capacity: centralised planning and decentralised influences*

This section discusses how planning of hospital capacity has changed and is organised currently. Hospital planning is the result of the interplay between the supervisory role of the government and the market authorities, market forces (including commercial lending) and the norms set by the health care professionals and IGZ.

Government

In 2008, the WTZi-regulation to determine capital costs for construction and maintenance was reformed. The reimbursements of capital costs were no longer separately determined by technical rules and subsequent calculations, but became an integrative part of the rates for inpatient care. This meant that hospitals enjoyed more freedom and less administrative burden, but on the other hand became more exposed to investment risks.[471] Hospitals are currently responsible for their own investment choices, and they have to take into account whether there will be enough demand by patients, whether or not they will be contracted by insurers, and if banks will grant them loans. Most loans are underwritten by the Healthcare Guarantee Fund (WFZ) (a non-profit foundation for credit enhancement). Equity capital still plays a limited role due to the government-imposed ban on allocating profit to third parties. The solvency of especially the hospital sector has gradually increased from 14.1% in 2010 towards 21.6% in 2015.[452] Thus although for-profit ownership is forbidden, the hospital sector seems now

u Based upon a questionnaire and open publications, 29% of the hospitals indicated to have been part of a legal merger and 20% of an administrative merger, and only 5% to have been involved with a joint venture.[467]

quite well capitalized although with substantial and increasing variety between different providers.

Some specific norms are also set in the Health Care Market Regulation Act (WMG), for instance, emergency care has to be accessible within 45 minutes.[472] The WMG only sets out a couple of specific requirements, and leaves the rest to the market and the regulatory bodies (ACM and NZa). Other than a few exceptions, such as emergency care and Exceptional Medical Procedures, there is no government planning or central policy to distribute facilities across the country.

Contracting

The health insurers and hospital providers negotiate and may settle for an annual contract. Selective contracting is an instrument for health insurers to differentiate themselves from one another. Although both health insurers and hospitals have an interest to reach an agreement, health insurers and the healthcare providers experience contrasting objectives. The healthcare providers seek to increase their turnover, while the health insurers aim to control volume and curb the providers' market power.

One new recent initiative emerged in response to overcome this conflict: multiple-year contracts between healthcare providers and health insurers. Herein providers and insurers mutually agree to a gradual reduction of the growth of turnover in return for guaranteed revenue. The Dutch Health, Welfare and Sport Minister expressed support for these innovative contracts.[473] One of the pioneers is hospital Bernhoven in Uden, a general hospital, which realised a reduction in volume of 8% in 2015. One of their volume reduction experiments involved staffing the emergency room/first aid (SEH), with internists, cardiologists and surgeons. This led to a reduction of the number of hospitalizations and length of stay.[474]

Health insurers

Health insurers are legally obliged to guarantee healthcare provision for the insured with an in-kind policy; this concerns quality, timeliness and accessibility of care (duty of care – '*zorgplicht*'). This means that the insurers have to contract sufficient healthcare provider capacity to ensure accessibility. The health insurers have discretionary authority to ensure this duty within a regulatory framework monitored by the NZa.[475] In general terms, the health insurers are obliged to organise healthcare within a 'reasonable' distance from the insured. What is reasonable depends on the healthcare specific requirements. The NZa tests this obligation in relation to the opportunities to contract healthcare providers, geographic distance and time needed to travel.[475] Furthermore, a distinction is made between different types of care: acute, elective and chronic care. When there is too little capacity and waiting times increase, the health insurer has to contract more care the next year in order to fulfil the duty of care. When there is excess capacity, and hospitals only get reimbursed for their actual production, they have an incentive to bring their capacity in line with demand for hospital services.

There exists no obligation for health insurers to contract all hospitals or any other providers. As a result, insurers have the ability to steer hospital care to a certain extent through practices off selective contracting. Also hospitals themselves may make strategic choices on the types of medical specialist procedures they would like to deliver, and make investment choices in order to maintain or increase their market share.

Usually, health insurers contract virtually all hospitals, but not necessarily on all the conditions and procedures that the hospitals are offering. For instance, specific selective contracting takes place for breast cancer and hernia operations.[476] Recently, a group of teaching hospitals (Santeon) and one of the larger insurance companies (CZ), independently from each other suggested to concentrate all surgery for prostate cancer in two hospitals, following the example of Martini Klinik in Hamburg.

Selective purchasing is more common with regard to independent treatment centres (ZBCs)[462], but insurers are obliged to at least reimburse 80% of the care cost, also for patients outside their network. This regulation, article 13 of the Health Insurance Act (Zvw), was and is subject of discussion, especially because health insurers argue that this limits their ability to organise care for their patients and compete on quality of care. For example, ZBCs might treat low-risks patients that still generate profits, even at 80% of the average reimbursement rates.

Medical specialist/professionals

Part of the independent medical specialists are organised in group practices (‘*maatschappen*’). These medical specialists can act as a countervailing power towards the hospital board. A couple of important developments could influence and shift the balance within the relationship between the hospital administration and the (self-employed) physician staff:[477]

- Since 2015, integrated tariffs were introduced (‘*integrale tarieven’*). This means that the reimbursement of healthcare delivery no longer separately accounts for the costs of the medical specialist (honorarium), but that self-employed doctors now negotiate their reimbursement with the hospital board.
- Regional formation of independent partnerships of group practices could lead to more negotiation power for independent medical specialists vis-à-vis hospitals, which could stifle competition; it also facilitates concentration of patient streams (see section 5.3).
- A small share of specialists became a shareholder in the hospital (doctor-run hospitals).
- More medical specialists move from an independent status to becoming salaried staff of the hospitals.

In the last three decades quality of care has received a great deal of attention, with medical specialists taking a leading position. In 1989 the first so-called Leidschendam-conference was organized by the Royal Dutch Medical Association and other stakeholders. This resulted in the Care Providers Quality Act (1996) in which a legal framework was set to deliver responsible care that meets the quality standards to have proper systems for quality management and complaints procedures. This helped the process of developing guidelines and standards of healthcare delivery. Quality of care needs to be of a certain minimum level. IGZ enforces these legislative requirements. Health insurers may or may not contract some medical specialist treatments depending on the outcome of some quality measures.

Market authorities

The NZa and the ACM regulate and monitor the healthcare market. The ACM assesses concentration and mergers in order to prevent anti-competitive practices that tend to lead to a dominant position. So far, the NZa and ACM have rarely blocked collaborations and mergers of hospitals.

Since 2004, the ACM assessed 30 hospital mergers. Most of them were approved immediately, 4 mergers had to conform to certain rules set out by the ACM, and only one was blocked. The ACM generally supports collaboration if in their view the organisations can be expected to operate more effectively and provide better healthcare once merged.[478] However, in a recent high profile ruling, the ACM decided that it was not in the public interest that insurance companies collaborated for joint procurement on proton beamers (see section 5.3).

In 2013 the activities on quality improvement were bundled within the National Health Care Institute (ZiNL) with the explicit goal to improve the quality of care. It may use administrative decision power (‘*doorzettingsmacht’*) to make healthcare providers and the professionals comply with certain quality instruments (guidelines, volume norms etc.). However, ZiNL first ‘asks’ the professionals to define the exact specificities of such instruments. Thus the scientific medical associations (‘*beroepsgroepen’*) hold significant influence on hospital treatment profiles, but the ZiNL has the final decision power. For example, the scientific medical associations set quality and volume norms for some treatments of complex diseases (i.e. breast cancer, bladder cancer and prostate cancer) which resulted from an initiative by the IGZ and the scientific professional associations.[479] Such norms are now often also set in the contracts between

providers and health insurers.[480] Every year, a large number of quality indicators is collected under coordination of ZiNL to improve transparency of healthcare inputs, processes and outcomes. ZiNL may use its decision power to impose a standard, when professions do not agree upon a set of necessary guidelines.

5.3 Concentration of specialised and highly specialised services

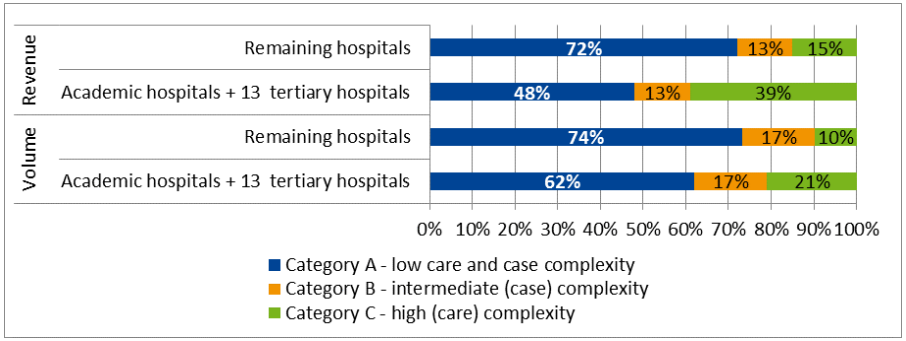
5.3.1 Introduction

The government's role is on the one hand quite limited, as health insurers are generally the organisations who contract all (highly) specialised services. At the same time, there are several specific procedures for which government planning and regulation exists. Scientific professional associations do design their own frameworks that influence the concentration of specialised services.

5.3.2 Organisation: dispersion and concentration

In order to better understand the concentration and dispersion of the different types of care, a categorization of complexity of care is needed. Since the definition of complexity of care is not clear-cut, a categorization has been made based upon a quantitative and qualitative analysis of various elements, such as case complexity, care complexity, travel time, low versus high volume.[481] One third of the 4 250 defined DRGs can be categorized as complex care services (Category C); this resembles around ten percent of total volume and twenty percent of total revenue.[481] Figure 60 illustrates that academic and 13 tertiary hospitals provide more complex care than the other hospitals, both in volume and revenue.

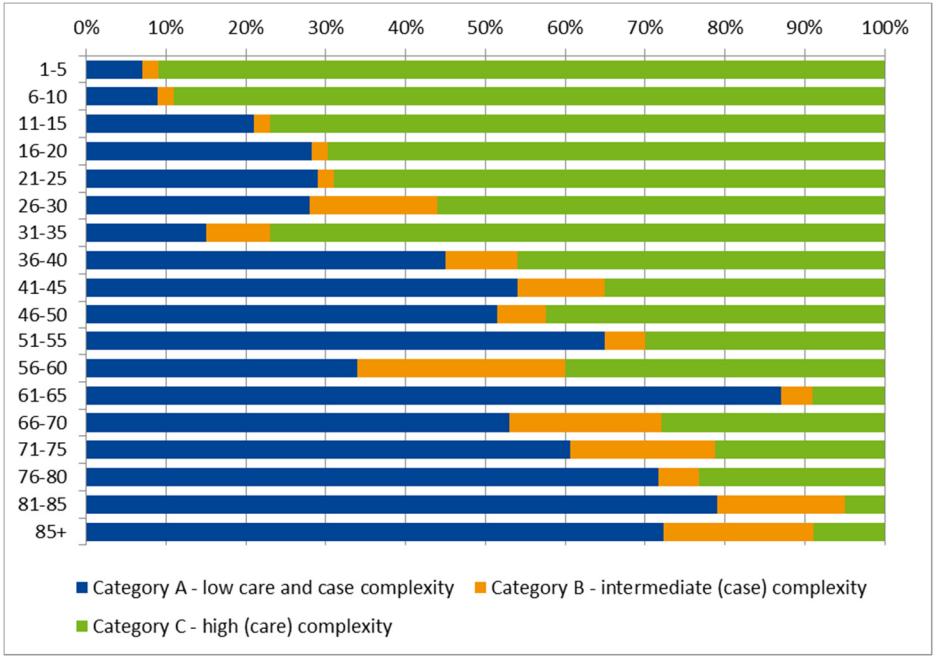
Figure 60 – Share of complex care in academic and tertiary hospitals, weighted percentages volume and revenue



Source: Heida et al. (2016)[481]

In line with reasoning, Figure 61 categorizes the DBCs based upon the number or providers that offer them. To illustrate, of the DBCs that are provided by only 1 to 5 providers (y-axis) over 90% are complex care services. In general, complex care services (Category C) are mostly concentrated among 1 to 35 hospitals, while less complex care services are provided by the majority of providers (Category A and B).

Figure 61 – Number of hospital providers offering certain DBCs (weighted volume of DBC products), per complexity category in percentage



Source: Heida et al. (2016)[481]

5.3.3 Planning of specific procedures

Regulation and funding of certain specific procedures

Some medical procedures are perceived to be 'special' in such a way that only appointed hospitals are allowed to carry them out. This applies for example to heart surgery and organ transplantations. This is regulated under the Special Medical Procedures Act (Wbmv). The minister of Health, Welfare and Sport decides under which conditions hospitals or clinics receive a certificate for special medical procedures. Hospitals that provide such procedures are also entitled to adequate reimbursement, which are set by the Dutch health care authority. It is important to note that the Wbmv (1995) and its predecessor article 18 of the care provision law (Wzv) are governed under the assumptions of central planning and regulation; later efforts to concentrate complex care saw different governance approaches (see underneath).

Currently the following procedures are included:[482]

- Organ transplantation of heart, kidney, pancreas, lungs, lever or small intestine;
- Implantation of artificial organ that replace the (part) of the function of the heart, kidney, pancreas, lungs, lever or small intestine;
- Transplantation of stem cells from bone marrow, blood or the funicular;
- Procedures on the heart;
- Specific forms of neurosurgery;
- Proton therapy;
- Treatment of haemophilia;
- Treatments for people with HIV;
- Clinic genetic research;
- Fertilization in vitro, fertilization of the embryo outside of the human body;

- Neonatal intensive care (with exception of neonatal surgical care).

Recently a discussion emerged whether procedures for haemophilia and HIV should be dismissed from the Wmbv regulation. After advice of the Health Council[483], and discussion with other important stakeholders, it was decided in 2016 that these treatments will retain the Wmbv status.

Box 16 – Centre for proton therapy

In 2009 the Health Council concluded that a substantial number of patients could benefit from proton therapy. The Health Care Institute decided upon a list of diagnoses for which proton therapy was considered appropriate care. However, as long as the Netherlands does not have a centre for proton therapy, patients are required to travel to Germany.

In 2013 the Ministry of Welfare, Health and Sport (VWS) decided to provide for a maximum of 4 licences for delivering proton therapy in specific centres. Proton therapy would be part of the Special Medical Procedures Act.

It took some time before these centre(s) had their business cases calculated and construction work could begin. A relevant struggle was the hesitation of health insurers to guarantee contracts for all centres. Health insurers were of the opinion that one centre might be enough to start with, so they asked permission for collective bargaining. ACM decided that health insurers were not allowed to do so.

Currently two centres are almost operational and aim to start treating patients in the second part of 2017; a third centre aims to open by the end of 2018. The NZa decided that hospitals could only ask for reimbursement of production with proton therapy, if they could prove that patients were treated according to the guidelines.[484, 485, 486]

The tariffs of Wbmv-procedures are regulated according to the WMG. Since these procedures are considered to be complex, the Health care authority sets a maximum price.

Funding of specific functions

For some types of care it is not possible, or at least not completely, to administer separate volume variables to specific patients or individual health insurers. Working with an increase of tariffs (surcharge) for such functions that bear high fixed costs might lead to market failures. Since 2012, the NZa sets an 'availability contribution' ('*beschikbaarheidsbijdrage*') for certain services.[487] Examples are the hospital-based follow-up medical training for nurses and medical support staff, as well as other functions or characteristics of care – such as availability, specific knowledge or specific facilities/infrastructure – are subsidized through this contribution. Examples of other functions are trauma helicopters, academic care, emergency care in certain rural areas, and burn centres/units.

Recently, the compensation for burn centres was changed. Due to the diversity of patients, costs of the delivery of appropriate care are highly unpredictable, with large variations in costs between different patients. Also, the three burn centres in the Netherlands have different characteristics and populations. A one-size-fits-all availability contribution was therefore changed into a model where centres are reimbursed for their actual costs (direct delivery of healthcare), with a set of rules how to compensate for indirect and fixed costs.

5.3.4 Contracting specialised services

Health insurers can differentiate their purchasing on the type of medical specialist treatments/care. Basic care embodies high volumes in combination with low complexity. Specialised care has the characteristics of low volumes in combination with high complexity. In general, hospitals and health insurers make all-inclusive contracts which contain all types of care services combined.

For a number of diseases, people seem willing to travel further than the nearest hospital, for example to the Alexander Monro Breast cancer hospital and the Antoni van Leeuwenhoek hospital (specialist in cancer treatments).

Another avenue for payers' contracting policies, is that these normally need to comply with different quality standards that include minimum volume thresholds on certain procedures or other quality driven standards and guidelines.

The National Heath Care Institute (ZiNL) provides a platform for stakeholders (scientific professional associations, patient associations, and the association of the insurance companies) to negotiate information standards, medical guidelines and performance indicators. These guidelines and indicators can also be used for purchasing healthcare services. Establishing such performance indicators is perceived as a cumbersome process. Besides, certain physician association groups initiated more ambitious clinical registries, for instance the Dutch Institute for Clinical Auditing (DICA) and the foundation that aspires to improve the quality assessment of heart treatments ('*Meetbaar beter voor de hartzorg*'). Other factors might have influenced the enforcement of quality standards. For instance, there is attention of the media, and there is continuous improvement of medical and organisational knowledge. Also the role of IGZ who safeguards the minimum quality norms, seems to be a positive driver.

Provider and insurer associations have facilitated processes to concentrate care, if required by standards on the quality of care. The association of academic hospitals (NFU) stipulates which of its members have the necessary expertise over certain rare diseases or very specific patient groups. For instance, the AMC and Erasmus MC are designated as expert centres for sickle cell and related diseases. Furthermore, the Dutch hospital association (NVZ) and insurance association (ZN) facilitate a website, that for each hospital stipulates its profile for complex patient care, including volume thresholds and quality norms (i.e. minimumkwaliteitsnormen.nl). For instance, the site provides information about which 20 hospital locations fulfil the quality norms for bariatric procedures. Note that these norms are formulated by the professionals and are not specifically stipulated within the Wbmv.

Academic hospitals hold a strong negotiating position compared to the smaller hospitals and independent treatment centres. At the same time, academic hospitals have a 'last resort' function. Thus the general hospital has an incentive to guide its complex patients towards the academic centres. This for example might be the case if a general hospital threatens to overspend on its expensive pharmaceuticals that are financially ring fenced; referral of such patients to tertiary care hospitals or university clinics eases its budgetary pressure. Patient referrals due to such financial reasons might further concentrate the level of complex care.

Since 2011 the government negotiated the annual collective agreement with the entire hospital sector (*'hoofdlijnenakkoord'*). Within these agreements, it was agreed to concentrate (highly) complex care and to disperse chronic, acute and elective care. The latter is to insure that elective and acute care will be accessible 'closer' to the patient. Acute care is provided in 97 emergency departments and 11 specialised trauma centres. These trauma centres are designed for patients with severe injuries, and treated by 24-hours standby multi-disciplinary teams specialized in trauma injuries.

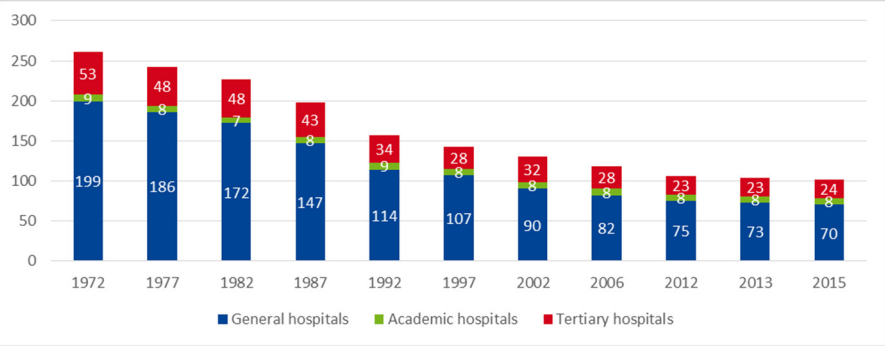
5.4 Distribution of services

5.4.1 Shifts in provision

The hospital sector experienced a shift of inpatient hospitalization towards day surgery and a shift from day surgery to ambulatory care. The share of day treatments has grown from 22% to 56% between 1992 and 2012. In 2012, this trend seemed to stop.[452]

In 1972 there were 261 hospitals (199 general, 9 academic and 53 tertiary). Since then, the number of hospitals has dropped from 157 hospitals in 1992 (114 general, 9 academic and 34 tertiary, including rehabilitation hospitals) to 102 hospitals in 2015 (70 general, 8 academic and 24 tertiary) (Figure 62).

Figure 62 – Trend in number of hospitals (1972 -2015)

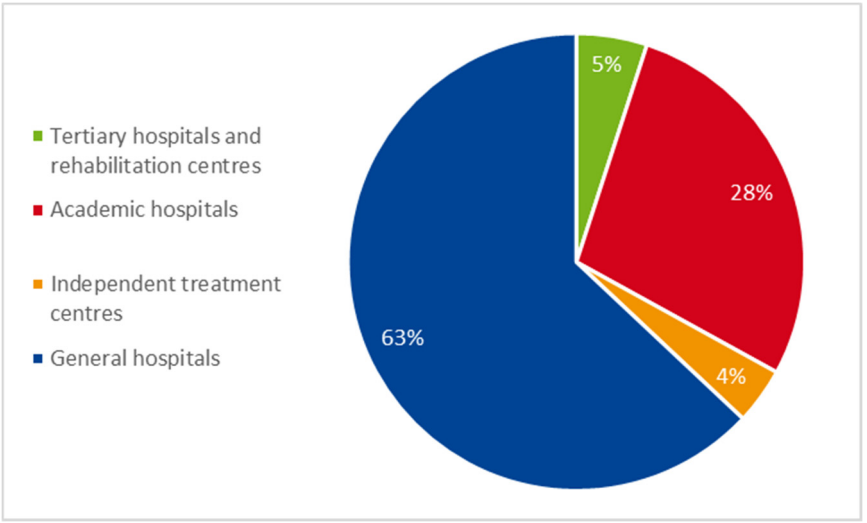


Source: NVZ (2016)[452]

The number of hospital locations is much higher than the number of hospitals. In 2014 there were in total 76 general hospitals, accounting for 120 hospital locations and 111 ambulatory care centres. The number of locations has remained relatively stable since 2009, while the number of ambulatory care centres almost doubled, up from 60 ambulatory care centres in 2009. A large number of hospitals opened an ambulatory care centre at the edge of their 'care region' ('*verzorgingsgebied*') to be able to compete with surrounding hospitals.

Figure 63 illustrates that general hospitals provide 63% of total specialist care (measured in euros); academic hospitals are responsible for 28%; and the tertiary hospitals for 5% of care, while independent treatment centres provide the final 4% of hospital care. Between 2009 and 2014, the share in total revenue of general hospitals show a minor decline from 63.3% in 2009 to 62.7% in 2014. Academic hospitals expanded their share from 31.4% to 31.8%.[452]

Figure 63 – Share of hospitals within hospital care services (2015)



Source: NVZ (2016)[452]

5.5 Efforts to integrate care

Changes in the demand for care (e.g. through increasing numbers of people living with multi-morbidity) necessitate a revision of current models of care. Intensifying and enhancing integrated care is seen as an important part of this revision. In the Netherlands, cross-organisational integrated care due to new organizational arrangements is still a scarce phenomenon. Formal collaborations between hospitals and between hospitals and other providers seem relatively scarce although registrations are lacking and a lot of (in)formal collaborations exist under the radar. Shared Service Centres (SSC) is a common way for hospitals to collaborate. A SSC means that certain activities of multiple organisations are put in one legal entity. These services can entail supporting functions (e.g. ICT services) or supporting clinical activities such as laboratories and pharmacies.

Since 1994, various collaborations forms between primary care and secondary/tertiary care developed, referred to as transmural care (*co-operation and co-ordination between general and specialised caregivers with shared overall responsibility and the specification of delegated responsibilities*).[488] Transmural care is provided through local networks of organisations that go beyond the hospital sector alone. The idea was that transmural care would cultivate itself through a bottom-up approach, i.e. initiated by the health care organisations themselves. Although transmural care spread, it was also in need of top-down measures to insure broader implementation.[488]

Hospitals are often at the centre of new initiatives that seek to integrate care. One showcase is ParkinsonNet. ParkinsonNet is a professional regional network within the catchment area of hospitals that aspires to improve healthcare in Parkinson's disease. It provides trainings to improve PD-specific expertise among allied health personnel, tries to enhance the accuracy of referrals by neurologists, and stimulates preferred referral to ParkinsonNet therapists. Lastly it stimulates collaboration between therapists, neurologists, and patients.[489]

Although primary care generally lacks the organizational resources of hospitals, integration of care carries on much more forcefully in that sector, although with few spin offs to specialist care. Changes in the payment structure built important preconditions. In 2010, a nationwide bundled payment to integrate chronic care (for diabetes, COPD, and cardiovascular diseases) was introduced. This financing scheme facilitates a payment structure whereby insurers pay for a bundle of all care. With this bundled payment, the principal entity has to cover a full range of services for a fixed period.[455] *The bundled-payment approach supersedes traditional health care purchasing for the condition and divides the market into two segments - one in which health insurers contract care from care groups, the other in which care groups contract services from individual providers, each with freely negotiable fees.*[455] Bundled payments for type 2 diabetes decreased patient mortality rates and costs, but challenges remain (e.g. model is still limited to primary care).[490] Recently bundled payments to integrate birth care were introduced (see Box 17).

Box 17 – Integrated birth care

Since 2015, the NZa allows midwifes and maternity assistants/nurses to organise themselves in one birth centre and bundle their services for the health insurer. Before, the health insurers had to purchase birth care separately from the different healthcare providers/professionals, which hampered collaborations between primary and secondary care. The bundled payment scheme aims to bridge the two levels and foster collaboration. Currently 85 obstetric collaborations (VSVs) are active. 22 VSVs were contracted by a health insurer.[486]

5.6 Conclusions and future challenges

5.6.1 Conclusions

The 2006 market reforms greatly changed the dynamics among all actors in the Dutch health system, including the hospital sector. The number of hospital organisations continues to decline, although the number of locations remained more or less stable over the past ten years. This does not mean that the scope of the services in these locations stays the same. Typically, merged hospitals tend to concentrate their tertiary care services at one 'main' location also to comply with expanding amounts of volume thresholds and quality guidelines; the other locations generally remain open, but focus more on outpatient care or elective surgery although many also operate an emergency room. As of today, hospital systems that operate more than five facilities do not exist in the Netherlands. So far the countries' eight academic hospitals have not merged[v], although its association took some initiatives to concentrate high complex treatments most notably rare and genetic diseases. The most high-profile and disputed concentration among

[v] However, the two university clinics in the capital city of Amsterdam now seek for a merger.

academic tertiary care is the creation of a new specialty hospital for children's oncology in Utrecht, because it also foresees a smaller role in this area for the other academic hospitals (e.g. for follow-ups). IGZ stated for this case, that health insurers should stay attentive to the accessibility of care for children from different socio-economic backgrounds and locations in the Netherlands.[491]

The concentration of most tertiary care into approximately 32 hospitals (university clinics, tertiary care hospitals and some specialty clinics) has seen important progress due to new and post healthcare reform standards by the medical professions for predominantly complex surgeries and cancer treatments. In case the professions do not agree upon a set of necessary guidelines, the National Health Care Institute may use its decision power to impose a standard.

In a less direct way, concentration of (complex) care is also facilitated by mergers of local hospitals (and the creation of some regional physician partnerships) that may lower the barriers for shifting patients towards one designated infrastructure.

Before these bottom-up governance initiatives to concentrate complex care emerged, certificate-of-need regulations had already concentrated new technologies that appeared in the 1970s and 1980s, such as heart surgery, transplantations, dialysis, and IVF in certain hospitals.

Concentration of complex care also has had ramifications for competition. The new large hospital combinations hold substantial leverage over health insurers due to their dominant market position. In contrast, the decreasing numbers of smaller community hospitals as well as the increasing numbers of independent treatment centres (ZBCs) increasingly face tougher negotiations with health insurers. However, while community clinics struggle with high fixed costs and in some cases slightly declining rural populations, a share of ZBCs seem to survive quite well. The latter is due to the fact that the freedom-of-choice under the Zvw warrants minimal payments of some 80% of the contracted rates for persons with a benefits-in-kind policy, while those with a reimbursement policy are compensated for 100% of costs. For many of these 'focused factories' this guarantees a sound business model.

Another recent trend is to negotiate multi-year contracts under a shared savings model. This means that savings resulting from specific projects aiming to spur efficiency are shared between the insurer and provider. Hospitals see their approved budget decline as time and the number of successful project implementations continue. The flagship case of this trend is the community hospital of Bernhoven in the Eastern part of the country.

5.6.2 Future challenges

The hospital sector has seen substantial diversification and consolidation over the past decade. Although hospitals continue to have strong constituencies, both for medical and non-medical reasons (e.g. city profiling and local employment), this does not necessarily make providers fit for the future and important challenges remain. For example, excess capacity has increased due to lower average lengths of stay and the supply of many new centres for both outpatient care and elective surgeries. Also the historic Dutch 'narrative' that all specialist outpatient care, elective treatments, and chronic disease management needs hospital involvement seems no longer adequate. Furthermore, new technologies will increasingly enable minimal invasive surgeries that keep on shortening average lengths-of-stay and improve the effectiveness of virtual connections and care networks (health records, e-Health etc.).

Population ageing and the increasing numbers of individuals living with multiple chronic diseases (multi-morbidity) will necessitate a response from the hospital sector. One approach is to shift the locus to a patient centred system, instead of a disease oriented system.[492] Furthermore, a transition towards strengthening community-based centres could advance the future hospital sector.[493]

If the historic expansion of the hospital far beyond its core of an operating theatre with inpatient wards continues, so might pressures to fundamentally alter these conglomerates. As in the recent past, the large facilities that focus on complex care might be shielded a bit longer from such questions of change – but not indiscriminately.

PART IV: HOSPITAL CAPACITY PLANNING FOR SELECTED CARE ASSIGNMENTS

COMPLEX SURGERY FOR CANCER OF THE PANCREAS, OESOPHAGUS AND LUNG, RADIOTHERAPY AND MATERNITY SERVICES

6 COMPLEX SURGERY FOR CANCER OF THE PANCREAS, OESOPHAGUS AND LUNG

6.1 Introduction

6.1.1 Background

Concentration of care for rare or complex conditions has become a widespread policy in many western countries with quality of care as the most important argument. The idea is that for patients suffering from rare conditions or requiring complex treatments the concentration of care is required to assure that specialist multidisciplinary teams see a sufficient number of patients to be able to develop and maintain expertise and to deliver best outcomes.[270, 285, 286] Typical examples in which concentration of care has proven to be succesful are stroke care services (hyper-acute stroke units)[270] and complex cancer surgery.[287] Yet, the number of specialised services for which concentration takes place is much larger. Some specialised services cover the majority of care for patients with these conditions while for most conditions the specialised services only concern a part of the entire care pathway.

The subject of this section is the concentration of complex surgical treatment of cancers for which a high level of expertise is required. There is a sound evidence base that endorses the need to concentrate complex surgical procedures in reference centres. Indeed, volume-outcome relationships have been demonstrated for numerous types of complex surgical procedures for cancers such as oesophageal or pancreatic cancer resections. Both cancers are not so infrequent (around 1 500 new oesophageal and 1 800 new pancreatic cancer cases per year), but only about one quarter of those patients will undergo a surgery. Therefore, oesophagectomy and pancreatectomy can be considered as rare surgical interventions in addition to being complex interventions.

Providing highly specialised and complex healthcare of quality is a challenge which requires careful resource planning. Especially in the case of rare and/or complex cancers, there is a compelling pressure, both from the side of patient organisations and from European authorities to concentrate their management in reference centres, embedded in a 'shared care' network model.[494] Stakeholders admit that the well-documented extremely low caseloads for many specialised services in Belgium put too many patients at risk of not getting access to high-quality state-of-the-art care.[20] Whenever it has been studied in Belgium, the relationship between volume and outcomes has been confirmed.[495-497] Concentration is, however, not only a means to get skilled and experienced physicians but it is also required to get expertise and specialist input from the entire multidisciplinary team throughout the whole care continuum.[20] Reforms aiming at concentration are based on the 'practice makes perfect' principle: physicians and multidisciplinary teams with more of these patients develop greater skills which contributes to better outcomes.

In consultation with the minister of Social Affairs and Public Health who commissioned this study, the focus of this chapter is on the concentration of surgery for three cancers for which evidence-based information on the need for concentration is available in previous KCE reports: pancreatic[497], oesophageal[498], and lung[499] cancers. The broader description of the organisation of care, of which surgery is one part, is largely based on a previous KCE report on the 'organisation of care for adults with rare and complex cancers' (KCE Report 219)[494] for pancreatic and oesophageal cancer and on KCE Report 266 (Quality indicators on the management of lung cancer) for lung cancer[499].

In the reform plans of the minister (see Short Report), it is mentioned that care assignments that are not provided in each loco-regional network will be provided at the superregional level by 'reference points'. To be in line with the international literature, we would rather use the terms 'reference centres' or 'specialised services/functions' instead of reference points throughout this chapter, as these terms are more commonly used at the international level.

6.1.2 *Organisation of care for adults with rare and complex cancers in reference centres*

Centralising care in reference centres is an internationally accepted best practice

There is international consensus that it is not practicable, efficient nor ethical that every hospital continues to offer care for every rare or complex cancer surgery. In order to improve the quality of cancer care, the only option is to concentrate expertise and sophisticated infrastructure in reference centres, which have to comply with strict criteria to be certified as such. Such a concentration is supported by the European Union (EU) that urges its Member States to identify reference centres and to create networks with other reference centres throughout Europe.[500]

Several EU countries have already set up reference centres for rare and complex cancers. KCE report 219 described the organisation of reference centres for rare and complex cancers in adults more in detail for four countries: England, France, the Netherlands, and Denmark.[494]

More details on the different initiatives taken at the European level to manage patients with a rare disease can also be found in KCE report 219. It should also be noted that since the beginning of 2017, the first European Reference Networks (ERNs) were approved by the European Commission, allowing to create a clear governance structure for knowledge sharing and care coordination across the European Union.[501]

Necessary preparatory work for Belgium is available

Preparatory work to enable the implementation of reference centres in Belgium was done in KCE report 219.[494] For fourteen different groups of rare and/or complex cancers, multidisciplinary working groups convened to specify and detail the preferred model of reference centre for their discipline. They could opt for:

- Model 1: Reference centres from diagnosis to follow-up.
- Model 2: Shared care between reference centres and local hospitals. For example, a contact is taken with a reference centre for diagnostic step and multidisciplinary teams meetings and the patient is then referred back to the local hospital (for treatment, palliative care, and follow-up).
- Model 3: An alternative model proposed by the working group.

The working groups detailed the list of specific criteria (in addition to those required by the oncology care programme, see section 6.2.2) that have to be fulfilled by a hospital that would like to become a reference centre, including human resources and team requirements, multidisciplinary management, required facilities and equipment, patient centred care, minimal volume of patients, quality assurance research and other scientific activities, teaching and dissemination.

6.1.3 Rare and complex cancers: definition and incidence in Belgium

Rare cancer

In this report, the definition elaborated by the RARECARE network is used, i.e. a rare cancer is a cancer that affects less than 6 new patients per 100 000 inhabitants per year.[502]

According to the RARECARE report, there are about 14 000 new cases of rare cancers per year in Belgium, which represent 23% of the total cancer diagnoses.[503]

The three most common families of rare cancers, representing approximately 24%, 16% and 14% of all rare cancers are, respectively haematological malignancies, digestive cancers and head and neck cancers.[503]

Complex cancer

For some cancers that are not labelled as rare cancers, it is equally important to obtain a critical caseload per centre to maintain sufficient expertise. Therefore, KCE Report 219 expanded its scope by also including complex cancers, defined as:

- 'A cancer on a very specific and extremely difficult to reach anatomic localisation (for instance a brain tumour or an ocular tumour);
- A cancer occurring during a specific condition (for instance a cancer occurring during pregnancy);
- A cancer requiring a high level of expertise, because of its diagnosis and/or treatment (for instance soft tissue sarcoma, oesophageal cancer);
- A cancer requiring very high-tech or costly technical infrastructure (for instance HIPEC treatment for tumours of the peritoneum).'[494]

6.1.4 Study objectives and research questions

The objective of this chapter is to **formulate recommendations on the required number of reference centres for complex surgery for pancreas, oesophageal and lung cancer on the basis of volume thresholds**, now and in the future (horizon 2025).

To address the research objective, the following sub-questions should be answered:

- What is the current incidence in Belgium for pancreas, oesophageal and lung cancer?
- What are for these three cancers the current practice and standards in Belgium:
  - number of surgical procedures per centre (volume thresholds)?
  - specific requirements?
- What are the international standards for these three cancers?

- What is the expected evolution of patients to be treated in reference centres in Belgium for the three selected cancers (horizon 2025)?
- What is the required number of reference centres for the three selected cancers?

6.1.5 Data sources and methods

6.1.5.1 Data sources

Various KCE reports have already investigated several aspects which are required for our analysis. Given the short timeframe of this study and with an aim of efficiency, this work has been used as much as possible. We regrouped, updated and synthesized the available evidence. This chapter is therefore mainly based on the following sources of information:

- Data and analyses from the Belgian Cancer Registry (BCR)
- Data from the Intermutualistic Agency (IMA – AIM)
- Previous KCE reports on:
  - Volume-outcome for surgical interventions (KCE Report 113)[497]
  - Guidelines on upper gastrointestinal cancer (KCE Report 179)[504]
  - Quality indicators on the management of upper gastrointestinal cancer (KCE Report 200)[498]
  - Guidelines on lung cancer (KCE Report 206)[505]
  - Organisation of care for adults with a rare or complex cancer (KCE Report 219)[494]
  - Quality indicators on the management of lung cancer (KCE Report 266)[499]
  - Guidelines on pancreatic cancer (KCE Report 286)[506]

6.1.5.2 Analysis of the international practice

For the analysis of the international practice, a grey literature search was performed by looking at official / national websites of the selected countries (i.e. France, England, the Netherlands and Denmark) in order to update KCE Report 219.[494] The international analysis is focused on the key elements used to identify 'reference' or 'specialised' centres for the three selected cancers as well as on the number of reference centres they currently have. More details on the care organisation in these countries can be found in KCE report 219.[494]

6.1.5.3 Analysis of Belgian data

Incidence data

Incidence is reported at the national level per sex and is available from the Belgian Cancer Registry (BCR) for the period 2005-2014. Data in this chapter are reported in terms of absolute numbers (N, number of new cancer diagnoses) and age-standardised rates according to the world population (WSR, N/100 000 person-years). Incidences are reported for all patients with a known incidence date and having a Belgian residence at time of diagnosis.

Patient selection

To select the cancer patients from the BCR database, the following inclusion criteria were applied:

- Known incidence date;
- Patients having a residence in Belgium at the time of diagnosis;
- NSSN (National Social Security Number) available;
- Patients who could be linked to the administrative reimbursement databases of the health insurance companies, provided by the Intermutualistic Agency (IMA – AIM);
- ICD-10 definition for (peri-)pancreatic cancer (C25 + C17.0 + C24.0 + C24.1), oesophageal cancer (C15 + C16.0), and lung cancer (C34);

- Within a given tumour type, only the first primary tumour diagnosed during the period 2005-2013 (2014 for pancreas) was kept for analysis. We made no assumption regarding the patient's cancer history, i.e. whether he/she had another tumour type diagnosed before or after the selected tumour.

It should be noted that for pancreas, other tumour sites around the pancreas (i.e. C25) were also taken into account to describe 'peri-pancreatic cancer' (i.e. C17.0: Malignant neoplasm of duodenum; C24.0: Malignant neoplasm of extrahepatic bile duct; C24.1: Malignant neoplasm of ampulla of Vater) because if resection is considered, similar surgical intervention techniques as for pancreatic tumours are used. We labelled all these cancers together as 'peri-pancreatic cancers'.

For oesophageal cancer, the gastro-oesophageal junction (C16.0) was also taken into account for similar reasons.

Linkage of cancer registry data with health insurance data

The number of patients undergoing a pancreatic-related resection, an oesophageal resection, or a lung resection by year of activity is available in the IMA – AIM database (for all causes, without making a distinction between oncologic or non-oncologic indications for these surgical procedures; latest year available: 2015). This database contains the reimbursed therapeutic procedures, gathered from all seven Belgian health insurance companies. The list of RIZIV – INAMI nomenclature codes selected for the surgical procedures considered is described in Table 41.

In order to assess the number of cancer patients undergoing a surgery by year of activity, the standard cancer registration database from the BCR was linked to administrative data from the IMA – AIM. For each cancer patient registered in the BCR, IMA – AIM data are theoretically available from 1 year before the year of incidence until 5 years after. Given an administrative delay, data available for these analyses on cancer patients were limited to the end of 2013 (2014 for the cancer of the pancreas). For each patient in this linked database, we then investigated whether he/she underwent a (reimbursed) surgery according to the list of RIZIV – INAMI nomenclature codes described in Table 41.

Table 41 – List of RIZIV – INAMI nomenclature codes for selected surgical procedures

Procedure	RIZIV – INAMI codes
Pancreatic-related resections	241415, 241426, 241430, 241441, 242012, 242023, 242034, 242045, 242056, 242060
Whipple only	242012, 242023
Oesophageal resections	228012, 228023, 228233, 228244, 228174, 228185, 228255, 228266
Lung resections	227216, 227220, 227231, 227242, 227253, 227264, 227275, 227286

As the IMA – AIM data do not contain any information regarding cancer diagnosis, we defined a timeframe around the incidence date (one month before till nine months after incidence date) to restrict the possibility of including medical acts that were carried out for other purposes than the ones of interest. Only surgeries performed within this time window were considered for the analyses.

All surgical procedures fulfilling the above mentioned criteria were selected, but the selection was restricted to surgeries performed within 2010-2013/2014 (based on the year of activity).

For the description of the number of surgeries by centre, the centre that carried out the surgery according to the IMA – AIM data was retained. Some hospitals underwent a merger during the study period. In agreement with previous quality of care research projects,[498, 499] the numbers of surgeries by hospital are based on the hospitals that were active at the end of the observation period, in this case 2013 (2014 for pancreatic cancer).

6.2 Brief view on the organisation of oncological care in Belgium and in a selection of countries

6.2.1 Introduction

The aim of this section is to introduce the main general processes concerning the identification of reference centres or specialised care services for cancer in Belgium, France, England, the Netherlands and Denmark. A more detailed analysis of criteria used abroad to identify reference centres or specialised care services for the three selected cancers as well as their current number of reference centres can be found in sections 6.3.4 for pancreatic cancers, 6.4.4 for oesophageal cancers, and 6.5.4 for lung cancers.

As described in the method section, it should also be noted that more details on the care organisation in these countries can be found in KCE report 219 on rare and complex cancers.[494]

6.2.2 Belgium

The Belgian legislator provided a law regulating care for oncology patients via 'the care programme for oncology care'. Hospitals can be licensed as having a:

- '**Care programme for basic oncology care**' that focuses mainly on diagnosis and less complex treatment. In January 2017, 83 out of 204 acute hospital sites had a care programme for basic oncology care (42 in Flanders, 10 in Brussels, and 31 in Wallonia; source: FOD Volksgezondheid - SPF Santé publique);
- '**Oncology care programme**' that has to offer more advanced diagnostic options as well as various therapeutic possibilities. The number of care programmes that can be installed at that organisational level is not limited. In January 2017, 76 out of 204 acute hospital sites had an oncology care programme (49 in Flanders, 9 in Brussels, and 18 in Wallonia; source: FOD Volksgezondheid - SPF Santé publique). It should also be noted that no hospital site had both an oncology care programme and a care programme for basic oncology care.
- In addition, the law allows the development of '**specialised care programmes**' for patients with cancers that need a complex multidisciplinary approach and/or extremely specialised expertise and/or that are very rare. It also states that specific care programmes should be developed for children younger than 16 years old with an oncological illness that requires specific modalities from a diagnostic and/or therapeutic perspective. The breast cancer clinics are the only example of such a specialised care programme for adult cancer patients. One of the licensing norms that breast cancer clinics should meet is a norm on the minimal annual volume. There is a clear guidance at the EU level that there should be at least 150 women with breast cancer treated per centre and at least 50 operations per surgeon. The Belgian legislator adopted this threshold but allowed a transition period with a lower threshold. At present it is not known what the annual volume of the breast cancer clinics 'in transition' is, and more importantly, it is not known how many breast cancer patients are still being treated outside the licensed centres.

6.2.3 France

Since 2009, health institutions managing patients with cancer must have an authorization issued by their regional health agency ('*Agences Régionales de Santé*', ARS) for the following procedures: cancer surgery; external radiotherapy; chemotherapy and medical treatment of cancer. Currently, 928 health institutions and radiotherapy centres have obtained such an authorization. The licensing system is based on three pillars:[346]

- **General quality criteria** regardless of the type of care and treatment, aiming at promoting good clinical practice and providing adequate information, listening and support to the patient; access to innovative treatments through clinical trials; and coordinated care and multidisciplinary consultations around a care plan;
- **Specific criteria** defined by the French National Cancer Institute ('*Institut National du Cancer*', INCa) **for the major therapeutic disciplines of cancer**, i.e. cancer surgery (see Box 18), external radiotherapy and chemotherapy. In addition, the National Cancer

Institute has established accreditation criteria for the care of children and adolescents with cancer;

- **A minimum activity threshold per year** for certain treatments and types of cancer:
  - 30 interventions per year and per centre for the surgery of breast, digestive, urological and thoracic cancers;
  - 20 interventions per year and per centre for the surgery of gynaecological, ENT and maxillofacial cancers;

  There is no minimum threshold for surgery of other types of cancer.

To improve care coordination in oncology, all regions of France are covered by a regional network of oncology. These networks are in charge of the coordination of cancer activities and of the improvement of oncology practices in their region (one network per region). Each health institution that received an authorization for cancer surgery, external radiotherapy, chemotherapy, or medical treatment of cancer must be member of their regional cancer network.[346]

Moreover, specific networks have been created for rare cancers. INCa approved 14 clinical networks (+ 8 in process of being licensed) and 4 pathological networks as 'national reference networks for rare adult cancers' in order to better guarantee the quality and safety of the management of patients with these cancers and structure the patient pathway for patients with these rare malignant tumours. Each of these networks for the different rare cancer groups is composed of a national reference centre (different sites are possible but only one is the national coordinating centre). Six to 34 regional or interregional expert centres cover the whole territory, including the overseas territories (see Box 19 for the description of their respective responsibilities; and Table 42 for the number of expert centres per network). The aim is to combine expertise and proximity. As shown in Table 42, the average number of estimated new annual cases per regional clinical expert centre (estimated annual incidence / number of regional centres in the network) varies strongly according to the network, with a range of 5 to 154 cases per centre.

Box 18 – Specific criteria for cancer surgery in France

- Surgeons must be qualified and must demonstrate a regular activity in this area;
- At least one of the surgeons must attend, either physically or by videoconference, the multidisciplinary consultation;
- The patient's file must contain the minutes of the multidisciplinary consultation, as well as an anatomopathological and an operative report that includes at least the elements defined by the INCa;
- Extemporaneous histological examinations and access to a tumour bank (if necessary) should be possible, either on the site or by the mean of convention;
- The 'continuous education programme' of the institution should include specific trainings on the surgical management of patients with cancer for the health care workers concerned;
- A quality approach must be implemented;
- A self-evaluation of the surgical practice for patients with cancer must be carried out annually by means of indicators defined by the INCa, relating in particular to the activity per surgeon. These data, which are anonymized, are submitted to the INCa and synthetized at the national level;
- Additional criteria have also be defined for mammary, digestive, urologic, thoracic, gynaecological, ENT, Maxillofacial and cervico-facial cancer surgery.

Source: INCa (2016)[346]

Box 19 – Responsibilities of national and regional clinical expert centres for rare cancers in France

- The national clinical expert centre is responsible for: structuring the network and selecting the regional clinical expert centres, organising double reading of tumour specimens, organising multidisciplinary consultative meetings (if needed at the national level), contributing to clinical research on these rare cancers, enabling drafting of recommendations for good practice and their dissemination throughout the network, establishing a national database to contribute to the observation of these cancers, organising training for all health professionals involved, working in collaboration with the patient associations, and providing relevant information to patients and their relatives.[507]
- The regional clinical expert centre is responsible for: 'adapting these roles at regional level, including organising a regional referral multidisciplinary consultative meeting, enrolling patients in clinical trials, training health professionals at regional level, and developing coordination with health facilities authorised to treat cancer in order to optimise the patient pathway'.[507]

Table 42 – Rare cancer clinical networks, national expert centres and regional expert centres in France

Rare cancer groups NETWORK ACRONYM	Rare cancers	Number of national expert centres**	Number of regional centres	Number of new patients in 2013	Estimated annual incidence	Annual incidence/ number of regional centres
Soft tissue and visceral sarcomas - Clinical **NETSARC**	• Gastrointestinal stromal tumours (GIST) • Liposarcomas • Leiomyosarcomas • Other differentiated sarcomas • Poorly differentiated sarcomas • Unclassified sarcomas • Pulmonary, cardiac and other visceral sarcomas • Desmoid tumours	3	26	3 526	4 000 cases / year	154
Rare sporadic and hereditary malignant neuroendocrine tumours - Clinical **RENATEN**	• Digestive tract and pancreatic endocrine tumour (ET) • Typical and atypical bronchial carcinoid type ET • Large cell neuroendocrine carcinomas • Thymic endocrine carcinomas • Other endocrine tumours (bladder, kidney, skin, etc.) • Medullary thyroid carcinomas • Sporadic malignant nonadrenal paragangliomas and familial paragangliomas	1	15	1 592	1 200 cases / year	80
Rare ovarian cancers **TMRO**	• Mucinous adenocarcinoma • Malignant sex cord stromal tumours • Malignant germinal tumours • Clear-cell adenocarcinoma • Small cell cancers with hypercalcaemia • Endocrine tumours ostruma ovaria	3	20	951	500 cases / year	25
Cutaneous lymphomas **GFELC**	• Cutaneous T cell lymphomas • Cutaneous B cell lymphomas	1	10	919	700 cases / year	70
Osteosarcomas **RESOS***	-	1	13	521	630 cases / year	48

Rare cancer groups NETWORK ACRONYM	Rare cancers	Number of national expert centres**	Number of regional centres	Number of new patients in 2013	Estimated annual incidence	Annual incidence/ number of regional centres
Rare ENT cancers **REFCOR**	• Malignant tumours of the facial bones • Malignant tumours of the salivary glands • Malignant tumours of the ear • Head and neck sarcomas • Others	2	25	486	900 cases / year	36
Uveal melanomas **MELACHONAT***	-	1	7	380	600 cases / year	86
Primary ocular and brain lymphomas LOC	• Primitive lymphomas of the brain, spinal cord, meninges and eye • Isolated primitive intraocular lymphomas	2	20	287	350 cases / year	18
High-grade oligodendrogliomas **POLA**	• Anaplastic oligodendrogliomas • Anaplastic oligoastrocytomas • Glioblastomas with aoligodendroglial component	2	30	285	600 cases / year	20
Adrenal cancer **COMETE-Cancer**	• Adrenocortical carcinomas • Malignant phaeochromocytomas • Malignant paragangliomas	2	9	284	125 cases / year	14
Malignant pleural mesotheliomas **MESOCLIN***	-	3	13	267	900 cases / year	69
Refractory thyroid cancer **TUTHYREF**	• Iodine 131 refractory papillary and follicular cancers • Metastatic medullary cancers • Anaplastic cancers	2	29	255	400 cases / year	14
Rare brain tumours **TUCERA***	-	1	29	202	1 800 cases / year	62

Rare cancer groups NETWORK ACRONYM	Rare cancers	Number of national expert centres**	Number of regional centres	Number of new patients in 2013	Estimated annual incidence	Annual incidence/ number of regional centres
Rare skin cancers (other than cutaneous sarcomas) **CARADERM***	-	1	19	131	950 cases / year	50
Von Hippel-Lindau disease and other hereditary predispositions to renal cancer **PREDIR**	• VHL disease • Type 1 hereditary papillary carcinoma • Birt-Hogg-Dubé syndromes • Hereditary leiomyomatosis with papillary renal carcinoma • Clear cell renal carcinomas associated with translocations • Familial forms of clear cell renal carcinomas not associated with the VHL gene • Bourneville's tuberous sclerosis and renal cancer • MODY 5 diabetes and renal carcinoma	1	6	120	200 cases / year	33
Gestational trophoblastic tumours **MTG**	• Invasive moles • Choriocarcinomas • Tumours at the placental implantation site • Epithelioid trophoblastic tumours	1	27	118	180 cases / year	7
Thymomas and thymic carcinomas **RYTHMIC**	• Malignant thymomas • Thymic carcinomas	2	12	113	250 cases / year	21
Gestational cancers **CALG**	• Breast cancers • Malignant haemopathies • Cervical cancers • Ovarian cancers • Digestive tract cancers • Others	1	-	99	500 cases / year	-

Rare cancer groups NETWORK ACRONYM	Rare cancers	Number of national expert centres**	Number of regional centres	Number of new patients in 2013	Estimated annual incidence	Annual incidence/ number of regional centres
Rare peritoneal tumours RENAPE	• Pseudomyxomas • Peritoneal mesotheliomas • Primitive peritoneal serous carcinomas • Peritoneal desmoplastic tumours • Peritoneal psammocarcinomas	1	9	74	150 cases / year	17
Lymphomas associated with coeliac disease CELAC	• Low-grade T-cell lymphomas (clonal refractory sprue) • High-grade T-cell lymphomas • High-grade B-cell lymphomas	2	21	52	350 cases / year	17
Rare renal cancer CARARE*	-	1	17	31	1 000 cases / year	59
Virally induced cancers in transplant recipients (TR) K-VIROGREF*	• Lymphoproliferative disorders in TR • Kaposi's sarcomas in TR • Anogenital cancers in TR • Merkel cell tumours in TR	3	24	31	110 cases / year	5
Cancer in HIV+ subjects CANCERVIH*	-	3	34	0	700 cases / year	21

*Sources: INCa 2015[507]; Orphanet 2016[508] ; * More recently structured but not yet labelled; ** Different sites are possible but only one is the national coordinating centre; - No more precision found.*

6.2.4 England

Concerning cancer services in England, a distinction is made between common cancer services commissioned by the Clinical Commissioning Groups (CCGs) (except radiotherapy, chemotherapy and specialist interventions) and specialised cancer services commissioned by NHS England (see Box 20 and Box 21 and section 3.3 in Chapter 3 for more details).[289, 509]

Specialised services, including specialised cancer services, were created for patients who have rare conditions or who need a specialised team working together at a centre. There are currently 149 specialised services covering a diverse range of conditions including rare and complex cancers.[289] These specialised services have now been grouped into six National Programmes of Care: internal medicine; cancer; mental health; trauma; females and children; and blood and infection. Each programme has a board which coordinates and prioritizes work across the services in that programme of care. They also have several Clinical Reference Groups to provide clinical advices on the best ways that specialised services should be provided.[509]

The National Programme of Care for cancer is composed of a board and five clinical reference groups:[509]

- Radiotherapy;
- Chemotherapy;
- Specialised Cancer Surgery;
- Specialised Cancer Diagnostics;
- Children and Young Adult Cancer Services.

The clinical reference group on specialised cancer surgery has defined standards of care for the following cancer surgery:[509]

- Malignant Mesothelioma cancer (Adult);
- Oesophageal and Gastric cancer (Adult);
- Primary Malignant Bone Tumours Service (Adults and Adolescents);
- Soft Tissue Sarcoma cancer(Adult);
- Brain and Central Nervous System cancer (Adult);
- Specialised Kidney Bladder and Prostate cancer (Adult);
- Penile cancer (Adult);
- Testicular cancer (Adult);
- Ex-vivo partial nephrectomy service (Adult);
- Head and Neck cancer (Adult);
- Stereotactic Radiosurgery and Stereotactic Radiotherapy (Intracranial) (All Ages);
- Complex Gynaecology -Specialist Gynaecological Cancers.

It should also be noted that the National Programme of Care for internal medicine has a Clinical Reference Group (CRG) that covers specialised hepatobiliary and pancreas services, including services for pancreatic cancer.[509]

England has also established Strategic Clinical Networks that focus on defined priority service areas to bring about improvement in the quality and equity of care as well as in outcomes for complex patient pathways using an integrated, whole system approach (see also Chapter 3).

The priority services area are:[510]

- Cardiovascular services, including cardiac, stroke, renal and diabetes;
- Maternity, Children and Young People;
- Mental Health, Dementia and Neurological Conditions; and
- Cancer.

These networks will exist for up to five years and will be managed by 12 locally based support teams funded by the NHS Commissioning Board. These teams will build and oversee effective network arrangements for their area and help networks to develop an annual programme of quality improvement in local services.[510]

Box 20 – Specialist cancer services commissioned by the NHS England

'A. All care provided by Specialist Cancer Centres for rare cancers:

- Anal cancers
- Brain/central nervous system cancers for all low and high grade tumours (linking with Specialist Neurosciences centres)
- Endocrine cancers
- Germ cell cancers (except initial diagnosis and treatment)
- Gynaecological cancers (except early stage cervical and endometrial cancers and initial assessment of all gynaecological cancers)
- Head and neck cancers
- Mesothelioma
- Pituitary cancers (linking with Specialist Neurosciences Centres)
- Sarcoma (except soft tissue sarcoma identified for local surgery)
- Skin cancers (patients with invasive skin cancer with a greater risk or rarity and patients with cutaneous skin lymphomas)
- Upper gastro intestinal cancers
- Urological cancers (testicular, penile)

B. All care provided to Teenagers and Young Adults by defined Specialist Teenage and Young Adult Cancer Centres

C. Certain complex surgery for specified common cancers provided by specified Specialist Cancer Centres (including assessment if performed at the Specialist Centre):

- Germ cell cancers (for example, gynaecological and testicular except initial diagnosis and non-complex surgery)
- Gynaecological cancers (except early stage cervical and endometrial cancers and initial assessment of all gynaecological cancers)
- Urological cancers (specialist surgery only for bladder, kidney and prostate cancers)

D. Certain specified interventions provided by defined Specialist Cancer Centres (including assessment if performed at the Specialist Centre) for more common cancers:

- Gastrointestinal cancer interventions:
  - laparoscopic liver resection
  - thoracoscopically assisted oesophagectomy
  - preoperative high dose rate brachytherapy for rectal cancer
  - microwave ablation for hepatocellular carcinoma
  - laparoscopic gastrectomy for cancer
- Gynaecological cancer interventions:
  - exenterative surgery for gynaecological cancer
  - high dose rate brachytherapy for carcinoma of the cervix
- Lung cancer interventions:
- continuous hyperfractionated accelerated radiotherapy (CHART)) for non-small cell lung cancer
  - thoracic surgery for lung cancer
  - cryotherapy for malignant endobronchial obstruction

- Skin cancer interventions:
  - Mohs surgery
  - total skin electron beam radiotherapy (TSEB)
  - photopheresis for cutaneous (skin) T-cell lymphoma
  - immunocompromised patients at increased risk of developing skin cancers, for example, transplant patients

E. Chemotherapy: the procurement and delivery of chemotherapy including drug costs and molecular diagnostic testing for targeted medicine (noting all molecular diagnostic testing is considered to be in tariff unless otherwise specified).

F. Blood and bone marrow transplantation for haematological cancers and lymphomas'

Source: NHS England 2016[289]

Box 21 – Cancer services commissioned by the Clinical Commissioning Groups

'CCGs commission services for patients with the following specified common cancers with the exception of radiotherapy, chemotherapy and the specialist interventions listed above:

- Adjuvant drug treatments, for example, hormone therapies not excluded from tariff, drugs affecting bone metabolism
- Bladder and kidney cancer (except specialist surgery)
- Breast cancer
- Germ cell cancer (initial diagnosis and treatment)
- Gynaecological cancers (Initial assessment of all cancers; treatment of early stage cervical and endometrial cancers)
- Haematological cancers and associated haemato-oncological pathology
- Lower gastrointestinal cancer
- Lung cancer
- Prostate cancer (except specialist surgery)
- Sarcoma (soft tissue where local surgery is appropriate)
- Skin cancer (except for patients with invasive skin cancer and those with cutaneous skin lymphomas)
- Specified interventions that are commissioned by NHS England for the treatment of cancers where the indication is not cancer-related, for example, Moh's surgery for the treatment of non-cancerous indications'

Source: NHS England 2016[289]

6.2.5 The Netherlands

The cancer care landscape has been undergoing several changes in the Netherlands these last years, with a concentration of some cancer care when necessary and a spread out of care close to the patient when possible. The underlying dynamics of these changes is to concentrate highly complex care and to localize chronic, acute and elective care. Nearly all hospitals in the Netherlands provide some type of cancer care but rare and very specific conditions are no longer treated by each hospital (see also Chapter 5).

The concentration of cancer care in the Netherlands is the result of standards that have been developed by scientific associations. The Dutch Society for Surgery ('*Nederlandse Vereniging voor Heelkunde',* NVvH) has taken a pioneering role with the determination of minimum quality standards for a large number of surgical interventions and tumour types.[511] This includes the surgical treatment of gastric cancer, pancreatic cancer, bladder cancer and soft tissue sarcomas. End 2012, the Foundation of Oncological Collaboration ('*Stichting Oncologische Samenwerking*', SONCOS, www.soncos.org), a cooperation of three scientific associations in oncology ('*Nederlandse Vereniging voor Chirurgische Oncologie',* NVCO; '*Nederlandse Vereniging voor Medische Oncologie*', NVMO; '*Nederlandse*

Vereniging voor Radiotherapie en Oncologie', NVRO) published a quality standard for cancer care in the Netherlands. This report was a first step towards multidisciplinary tumour-specific standards, resulting in a further concentration of care. These standards specify volume requirements but also requirements in terms of infrastructure, specialisms that should be available, participation in data registration projects and maximum waiting times. This report is updated on a yearly basis and results in revised standards if necessary. The 2017 report describes standards for the management of 26 types of cancer (see Box 22).[511, 512]

The objective is that if a hospital does not comply with these standards, the healthcare insurer will no longer purchase this cancer treatment. The SONCOS first standard was published in 2012 but the Health Inspectorate ('*Inspectie voor de Gezondheidszorg'*, IGZ) and the Netherlands Health Insurers ('*Zorgverzekeraars Nederland*', ZN) gave hospitals time to meet these standards. In their healthcare procurement for 2014, ZN specified that they would not reject hospitals not meeting all SONCOS standards for this 2014 procurement but that they will began negotiations with these hospitals to ensure they will meet them in the future.[513]

Box 22 – Types of cancer for which SONCOS standards have be defined (2017 standards)

- Malignant bone tumour
- Soft tissue tumours
- Melanoma
- Neuroendocrine tumours
- Thyroid carcinoma
- Other endocrine tumours
- Oesophagus and stomach carcinoma
- Pancreas / distal bile duct carcinoma
- Liver / proximal bile duct carcinoma
- Colorectal carcinoma
- Peritoneal metastases
- Cervical cancer
- Endometrial cancer
- Ovarian Cancer
- Vulva Carcinoma
- Gliomas
- Head and neck cancer
- Lung carcinoma
- Breast tumours
- Retinoblastoma
- Uveal melanoma
- Bladder cancer
- Kidney cancer
- Penile cancer
- Prostate cancer
- Testicular cancer

Source: SONCOS (2017)[512]

It should also be noted that for the so-called 'last resort' patients or patients in need of a tertiary referral ('*topreferentie patiënten*'), top referral care services ('*topreferente zorg*') provided by university medical centres ('*Universitaire Medische Centra*', UMCs) have been developed. There are 8 UMCs in the Netherlands. For each top referral care, one or more reference centres is licensed among these 8 UMCs ('*Expertisecentrum voor een topreferente zorgfunctie*'). The Dutch Federation of UMCs has developed a web site to help patients and providers to identify the appropriate reference centre for their disease (http://www.nfu.nl/trf/).

Moreover, besides the 8 UMCs, there are also 26 Collaborating Specialised Clinical Care Training Hospitals ('*Samenwerkende Topklinische opleidingsZiekenhuizen*', STZ) providing highly specialised and complex care for one or more specific care areas.[514]

6.2.6 Denmark

To improve cancer care in Denmark, integrated cancer pathways have been developed, defining the organisational and clinical standards for the diagnostics and treatment of 34 cancer types (see Box 23). They cover the full care continuum (suspicion of cancer, diagnosis, treatment, and follow-up). The aim is to provide patient centred care, reduce the process duration (e.g. with reduced referral time or faster diagnosis and treatment) and ensure the follow-up of national clinical guidelines. These pathways were developed by 14 working groups supervised by the National Board of Health, each including representatives from the five regions, the medical specialities relevant to the specific cancer, the general practitioners, the Nursing Society and, when relevant, pathologists, radiologists etc.[515, 516]

Box 23 – Integrated cancer pathways in Denmark

Denmark has developped integrated cancer pathways for the following cancers:

- Acute leukemia and advanced myelodysplastic syndrome
- Anal cancer
- Bile duct cancer
- Bladder and kidney cancer
- Brain cancer
- Breast cancer
- Cancer in children: Brain and spinal cord tumors
- Cancer in children: Children with retinoblastoma
- Cancer in children: Leukemia
- Cancer in children: Lymphoma (Neck)
- Cancer in children: thoracic, abdominal, bone and soft tissue cancers
- Cancer of the esophagus, stomach, and mouth
- Cancer of the eye: Melanoma of the uvea
- Cancer of the eye: Orbital tumors
- Cervical cancer
- Chronic myeloid disorders
- Colorectal cancer
- Head and neck cancer
- Lung cancer
- Lymphoma and chronic lymphocytic leukemia
- Melanoma

- Mesothelioma
- Metastases without organ specific cancer type
- Multiple myeloma
- Ovarian cancer
- Pancreatic cancer
- Patients with nonspecific symptoms of serious illness that could be cancer
- Penile cancer
- Primary liver cancer
- Prostate cancer
- Sarcomas
- Testicular cancer
- Uterine cancer
- Valvular cancer

Source: Danish Health Authority[515, 516]

Hospital services have been divided in two categories, i.e. the basic hospitals services (representing around 90% of all hospital services) and the specialised hospital services (representing around 10% of all hospital services).

The identification of specialised services is based on criteria such as the size of the patient group, the complexity of the service or the resource consumption. Specialised hospital services are then divided into:

- Regional specialised hospital services: Regional specialised hospital services are services with (i) some complexity and for which the disease is relatively rare, or (ii) services that are rarely required or for which the resource consumption warrants some concentration of services. A regional service is typically established in 1 to 3 hospital sites in each of the 5 regions, depending on the patient population and local conditions of the region. If regional specialised hospital services are allocated to several hospitals in the same region, it is assumed that the hospitals performing the particular services enter into binding collaboration on, for instance, referral and guidelines for treatment.[517] and
- Highly specialised hospital services: i.e. services with a considerable complexity and that depend on the existence of many interdisciplinary services/partners, services for very rare disease, or services that are very rarely required and thus that require a concentrated knowledge, experience and expertise, and/or services with a significant resource consumption. Collaboration at the national level between hospitals approved to perform the same highly specialised hospital services is a prerequisite. Typically, a highly specialised hospital service is established in 1 to 3 hospital sites in Denmark.[517]

To assign the level of specialisation of the service (basis, regional specialised or highly specialised hospital services), three criteria are used:

- The complexity of the service and the need for collaboration with other services or specialties;
- The occurrence of the service (number of new cases or number of diagnostic / therapeutic procedures); and
- The resource consumption.

The Danish Health and Medicines Authority (DHMA) is responsible for the definition and allocation of specialised hospital services for all publicly funded health services in hospitals (public and private). The DHMA maintains and updates a guidance for 36 specialties (35 medical and 1 odontological), defining for each specialty the relevant specialised hospital service within that specialty and listing the hospitals approved for each specialised service.[517]

6.2.7 *A focus on implementation modalities of reference centres or specialised services*

In France

In France, they must have an authorization issued by their regional health agency (ARS). To obtain this authorization, they had to show prospectively that they respected the norms. The same procedure was also followed for the implementation of the networks for rare adult cancer. A call for applications was launched by the INCa and hospitals must showed that they respected the criteria defined by the INCa. These criteria are based on three pillars: general quality criteria, criteria specific to surgery and a minimum activity threshold per year (see section 6.2.3).[346] The proposals received were subject to a double expert assessment, involving international experts. Only teaching hospitals that were authorized for the treatment of cancer were eligible as national centres of expertise.

In England

Specialised cancer services are commissioned by the NHS England via contracts defining a series of requirements that must be respected, including among other the catchment area. These services are only commissioned if the hospital is already compliant with these requirements or if they have demonstrable plans to be compliant within agreed timeframes. Commissioned services then commit themselves with the continuous respect of the requirements.

The specialist pancreatic cancer service for example is required to agree the following areas with their local cancer network:

- Service configuration and population coverage;
- Referral criteria, clinical protocols, network policies and treatment pathways;
- Engagement with the local networks groups and national cancer peer review for pancreatic tumours.

The definition of the minimum population that must be covered is based a.o. on estimations such as the cancer incidence, the percentage of patients eligible for surgery and recommendations on the minimum volume thresholds for surgery. The specialist pancreatic cancer service should for example serve a population of 2 million people or more, agreed and signed off by commissioners. They estimated that centres covering populations lower than 2 million will not gain sufficient experience for members of the team.[518]

In the Netherlands

In the Netherlands, cancer treatments are purchased by the healthcare insurers. A retrospective process is applied, i.e. healthcare insurers let time to hospitals to respect the standards. The first SONCOS standard were published in 2012 and the Netherlands Health Insurer (ZN) specified in their healthcare procurement for 2014 that hospitals not respecting all SONCOS standards for this 2014 procurement will not be rejected this year but that they will negotiate with them to ensure they will meet the standards in the future.[513]

In Denmark

According to the DHMA, the planning of specialised hospital services is as much as possible evidence-based, e.g. using documentation on the relationship between volume and quality. However, they stated that evidence of specific organisational solutions is less well established and thus that planning of specialised hospital services was to a large extend based on the knowledge and experience of health professionals.[517]

Candidate hospitals must applicate to the DHMA and have to prove they respect (or that they will respect) the requirements defined by the DHMA (criteria defined in the speciality guidance, general requirements related to e.g. the capacity, the volume, or the qualifications, experience, education and training required, and other specific applications criteria).

The approval is then valid for a three-year period. During this period, approved hospitals must continue to comply with the DHMA requirements and specialty guidances. If they do not fulfil these requirements, the approval can be withdrawn by the DHMA (for example if the hospital is unable to maintain the volume anticipated in its original application).[517]

Table 43 – Reference centres' implementation modalities

	Requirements on volume	Selection of hospital services
France	• Directly used as selection criteria. • Other quality criteria are also used.	• Authorization issued by the regional health agency. Hospitals that apply must show they are currently respecting the criteria.
England	• Indirectly used as selection criteria: used to define the minimum population to be covered. • Other quality criteria are also defined.	• Commissioned by NHS England. Hospital services that apply must shown they are currently respecting the criteria or must prove they will respect them within an agreed timeframe. Commissioned services must then commit themselves with the respect of the criteria.
The Netherlands	• Criteria included in the quality standards that must be respected. • Other quality criteria are also defined.	• Hospitals had time to respect the standards and to look e.g. for referral agreements.
Denmark	• Can be used for the selection of centres but not as a main and systematic criterion. • Other quality criteria are also used.	• Planned by the Danish Health and Medicines Authority (DHMA). Hospitals services that applied must show they are currently respecting the criteria or that they will respect them. Approved services must then continue to respect the criteria (approval can be withdrawn by the DHMA).

6.3 Cancer of the pancreas

6.3.1 Description of the pathology

According to the project Surveillance of Rare Cancers in Europe (RARECARE), pancreatic cancers can be defined as being either the common adenocarcinoma with variants of pancreas (almost all diagnoses, i.e. 95%) or one of the seven rare entities (squamous cell carcinoma with variants of pancreas, acinar cell carcinoma of pancreas, mucinous cystadenocarcinoma of the pancreas, invasive intraductal papillary mucinous carcinoma of pancreas, solid pseudopapillary carcinoma of pancreas, serous cystadeocarcinoma of pancreas, and carcinoma with osteoclast-like giant cells of pancreas; see Table 44).[519]

Table 44 – Pancreatic cancer by sub-entity, for 2009-2013

Sub-entities	N	CR
Adenocarcinoma with variants of pancreas	5 865	10.73
Squamous cell carcinoma with variants of pancreas	12	0.02
Acinar cell carcinoma of pancreas	35	0.06
Mucinous cystadenocarcinoma of the pancreas	21	0.04
Invasive intraductal papillary mucinous carcinoma of pancreas	52	0.10
Solid pseudopapillary carcinoma of pancreas	10	0.02
Serous cystadeocarcinoma of pancreas	-	-
Carcinoma with osteoclast-like giant cells of pancreas	7	0.01

Source: Belgian Cancer Registry[520]
N: Absolute numbers - number of new cancer diagnoses registered between 2009-2013, CR: Crude (all ages) Rate (N/100 000 person-years)

Because of an aggressive biology, poor response to therapy, late diagnosis and no efficient screening programmes, pancreatic cancer has a very poor prognosis.[494]

A distinction is made between resectable pancreatic cancer, borderline resectable pancreatic cancer, and non-resectable pancreatic cancer. There are nevertheless no universally accepted resectability criteria for patients with pancreatic cancer. One of the most cited guidelines,[521] i.e. guidelines of the National Comprehensive Cancer Network (NCCN), provide criteria according to the degree of arterial and venous tumour contact.[522]

Resectable pancreatic cancer usually concerns lesions that are confined to the pancreas or have spread just outside the pancreas without invading major blood vessels, nerves or lymph nodes and the surgeon considers that it can be removed entirely. Non-resectable pancreatic cancer concerns patients with metastases and locally advanced pancreatic cancer (LAPC).[494] LAPC could be defined as 'a tumour locoregionally confined with some degree of involvement of the nearby major vascular structures, but without any evidence of metastases'.[523] According to experts, a clear definition of LAPC is nevertheless lacking and in practice, some attempts are made to offer the best chances for resection to an individual patient (e.g. through induction therapy). For borderline resectable pancreatic cancer, the surgeon will consider the possible resectability.[506]

6.3.2 *Burden of pancreatic cancer in Belgium*

For the 2009-2014 period, pancreatic cancer (ICD-10 code C25) was newly diagnosed in 9 389 new patients. The age standardised rate, using the World Standard Population (WSR) per 100 000 person-years was higher in males than in females and a rise in incidence for both genders can be noted, i.e. from 7.36 in 2009 to 8.14 in 2014 for males and 5.43 in 2009 to 6.41 in 2014 for females (see Table 45 and Table 46).[524]

Table 47 and Table 48 present the same data for (peri-)pancreatic cancer: ICD-10 codes C25 + C17.0 (Malignant neoplasm of duodenum) + C24.0 (Malignant neoplasm of extrahepatic bile duct) + C24.1 (Malignant neoplasm of ampulla of Vater). The increase in incidence must nevertheless be interpreted with caution because special efforts have been done recently to optimize the completeness of pancreatic cancer registration.[520]

Mortality rates were more stable and the five-year survival rate for the 2009-2013 cohort was estimated at 11.3% for males and 11.0% for females.[520]

If we look at the absolute number of new diagnoses per age group of 5 years in 2013, pancreatic cancer (C25) was most frequently diagnosed in the age group of 65-69 years old in males and in the age group of 75-79 years old in females (see Figure 64).[525] The average age at diagnosis was 68.9 years for males and 70.9 years for females.[526]

Among patients for which a stage could be determined, halve of patients were diagnosed in stage IV in 2013 (see Table 49).[526]

Table 45 – Pancreatic cancer (C25): absolute numbers per gender (N), 2009-2014

	2009	2010	2011	2012	2013	2014
Males	710	790	782	810	861	871
Females	663	738	759	747	814	844

N: Absolute numbers - number of new cancer diagnoses registered in the period. Source: Belgian Cancer Registry[524]

Table 46 – Pancreatic cancer (C25): Age-Standardised Rate, using the World Standard Population (WSR), 2009-2014

	2009	2010	2011	2012	2013	2014
Males	7.36	7.89	7.74	7.99	8.14	8.14
Females	5.43	5.88	5.88	5.76	6.22	6.41

WSR: Age-Standardised Rate, using the World Standard Population (N/100,000 person-years). Source: Belgian Cancer Registry[524]

Table 47 – (Peri-)pancreatic cancer (C25 + C17.0 + C24.0 + C24.1): absolute numbers per gender (N), 2009-2014

	2009	2010	2011	2012	2013	2014
Males	880	975	976	1 008	1 042	1 095
Females	826	891	918	880	973	1 010

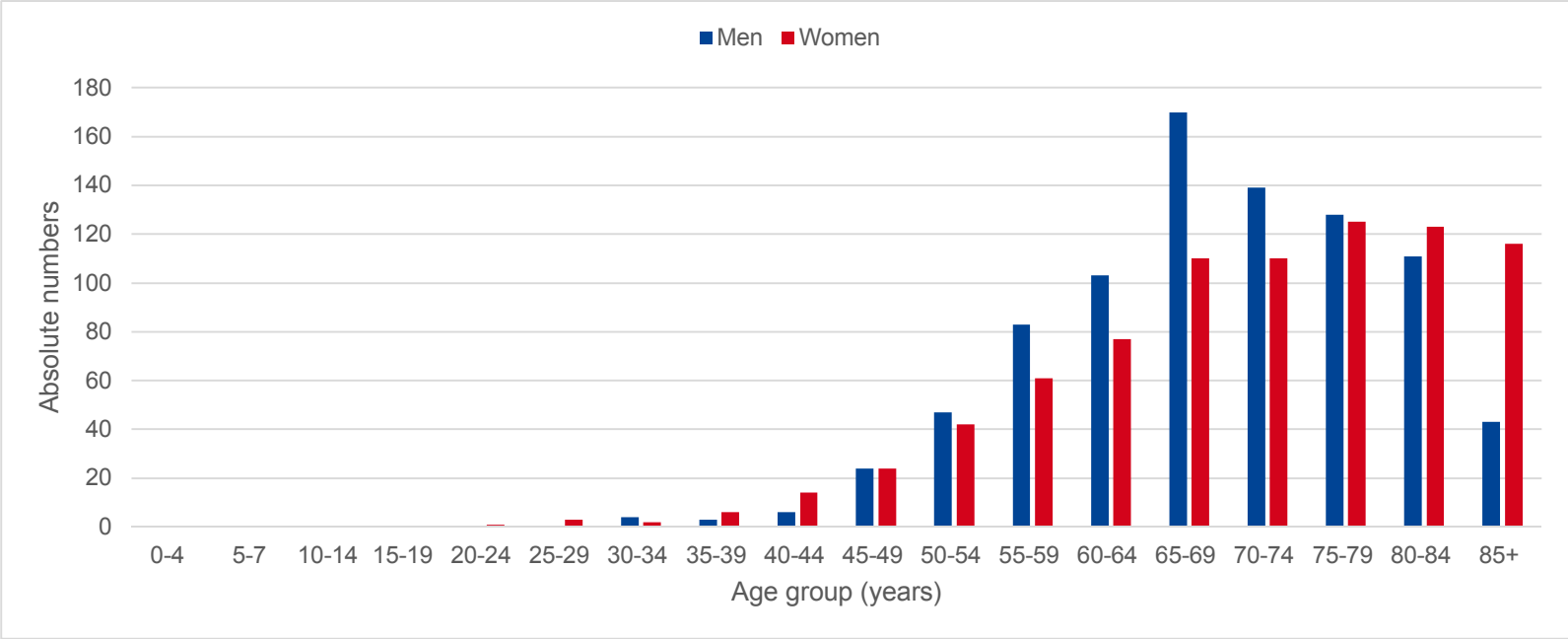
N: Absolute numbers - number of new cancer diagnoses registered in the period. Source: Belgian Cancer Registry[524]

Table 48 – (Peri-)pancreatic cancer (C25 + C17.0 + C24.0 + C24.1): Age-Standardised Rate, using the World Standard Population (WSR), 2009-2014

	2009	2010	2011	2012	2013	2014
Males	9.05	9.71	9.63	9.83	9.82	10.14
Females	6.63	7.03	7.03	6.7	7.44	7.65

WSR: Age-Standardised Rate, using the World Standard Population (N/100 000 person-years). Source: Belgian Cancer Registry[524]

Figure 64 – Pancreatic cancer (C25): Absolute number of new diagnoses in 2013, gender distribution by age group



Source: Belgian Cancer Registry[525]

Table 49 – Pancreatic cancer (C25): Distribution by disease stage, 2013

	Stage* I	Stage II	Stage III	Stage IV	Stage X	Stage NA
Females, N (%)	94 (11.5)	171 (20.9)	61 (7.5)	341 (41.7)	150 (18.3)	1 (0.1)
Males, N (%)	59 (6.9)	194 (22.6)	62 (7.2)	366 (42.7)	173 (20.2)	4 (0.5)
Total	153 (9.1)	365 (21.8)	123 (7.3)	707 (42.2)	323 (19.3)	5 (0.3)

Source: Belgian Cancer Registry[526]*; * Staging of pancreatic cancer is based on the tumour-node-metastasis (TNM) classification system 7th edition proposed by the International Union Against Cancer (UICC).*[527] *T describes the size of the original (primary) tumour and whether it has invaded nearby tissue, N describes nearby (regional) lymph nodes that are involved, M describes distant metastasis (spread of cancer from one part of the body to another); Stage X = diagnoses with an unknown stage; Stage NA: diagnoses with a histological diagnosis where no stage can be evaluated (Not Applicable)*

6.3.3 Current practice in Belgium

6.3.3.1 Number of surgical procedures per centre (all causes)

Table 50 presents the number of pancreatic resections for all causes for the years 2009-2015. The average number of interventions per hospital slightly increased across the years and ranged from 8.5 to 10.9 (with the highest average in 2015). The increase can be explained by the higher number of interventions in 2014-2015 as well as by the steadily decreasing number of hospitals performing this type of surgery. The median number of interventions ranged from 4 to 5 (see Table 50).[528]

In 2015, a total of 870 interventions were performed in 80 hospitals, with an average of 10.9 and a median number of 5 interventions per hospital (see Table 50 and Figure 65). Half of the number of interventions was carried out by 10 hospitals.[528]

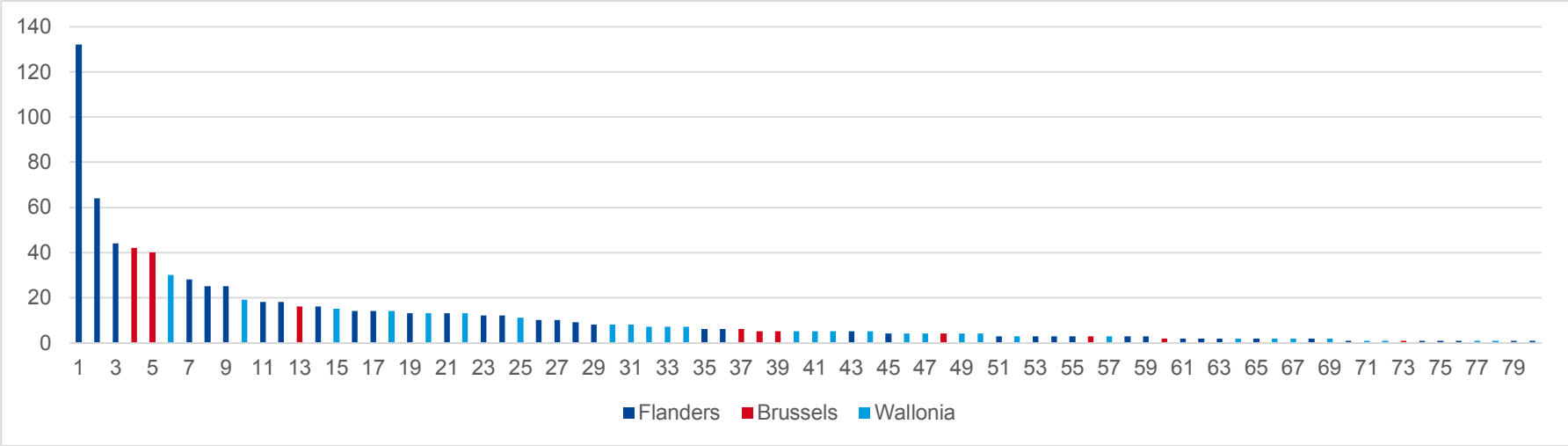
For the 2009-2014 period (to match the period for which data from the Belgian Cancer Registry are available), a total number of 4 714 pancreatic resections have been performed, i.e. an average of 785.7 interventions per year. A total of 104 hospitals performed at least one pancreatic resection during this period.

Table 50 – Overview of pancreatic resections (all causes) per hospital in the 2009-2015 period (latest year available)

	2009	2010	2011	2012	2013	2014	2015
Number of interventions	769	745	810	756	793	841	870
Number of hospitals*	90	89	88	86	85	81	80
Average per hospital	8.5	8.4	9.2	8.8	9.3	10.4	10.9
Median	5	4	4	4.5	5	4	5

*Source: Atlas IMA – AIM[528]; *Some hospitals underwent a merger during the study period. The number of hospitals per year is based on the hospitals that were active at the end of the observation period, i.e. in 2015.*

Figure 65 – Number of pancreatic resections (all causes) per hospital and per region in 2015



*Source: Atlas IMA – AIM[528]; *Some hospitals underwent a merger during the study period. The number of hospitals per year is based on the hospitals that were active at the end of the observation period, i.e. in 2015.*

6.3.3.2 Number of surgical procedures for (peri-)pancreatic cancer per centre

Table 51 presents the number of surgical procedures for (peri-)pancreatic cancer for the years 2009-2014. During this period, a total number of 2 769 pancreatic resections have been performed for a cancer, i.e. an average of 461.5 interventions per year. A total of 94 hospitals performed at least one pancreatic resection for cancer during this period.

As above, the average number of interventions per hospital slightly increased across the years and ranged from 5.8 to 7.2 (with the highest average in 2014).

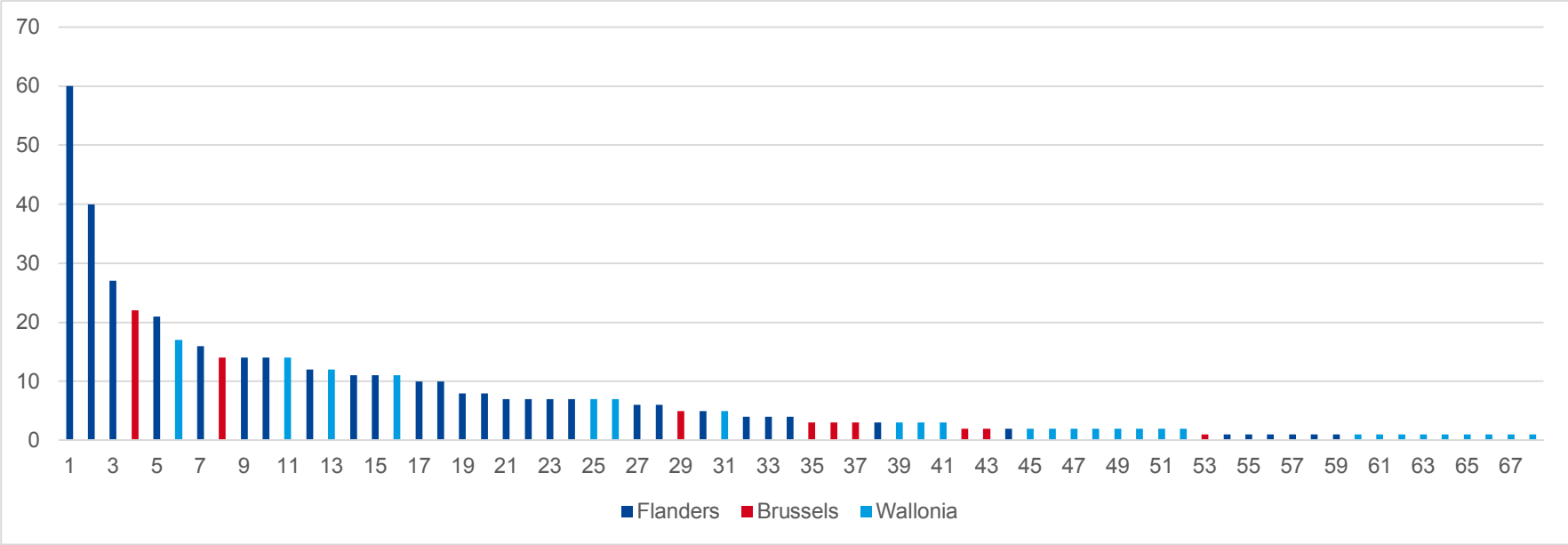
In 2014, a total of 492 interventions for cancer were performed in 68 hospitals, with an average of 7.24 and a median number of 3.5 interventions per hospital (see Table 51 and Figure 66). Half of the number of interventions was carried out by 11 hospitals.[524]

Table 51 – Overview of pancreatic resections for (peri-)pancreatic cancer per hospital in the 2009-2014 period (latest year available)

	2009	2010	2011	2012	2013	2014
Number of interventions	447	416	506	453	455	492
Number of hospitals	77	73	78	74	72	68
Average per hospital	5.81	5.70	6.49	6.12	6.32	7.24
Median	4	3	3	3.5	4	3.5

Source: Belgian Cancer Registry[524]

Figure 66 – Number of pancreatic resections for cancer, per hospital and per region in 2014



6.3.3.3 Specific requirements per phase of the clinical pathway

Recommendations of the working group on pancreatic cancer in KCE Report 219 are summarized in Table 52, in Table 53, and in Box 24.[494]

Level 3 refers to a 'high reference centre':

- Pathology to be treated at this level: all pancreatic tumours with vascular reconstruction (portal vein, superior mesenteric vein, inferior vena cava, all surgery in patients ASA ≥3 (American Society of Anesthesiologists)).
- Minimal requirements: single balloon ERCP and interventional ERCP (Endoscopic retrograde cholangio-pancreatography), expertise in vascular reconstruction techniques + minimal requirements of Level 2.

Level 2 refers to a 'reference centre':

- Pathology to be treated at this level: surgery in ASA 2 patients, with no vascular involvement and no risk for organ failure.
- Minimal requirements: availability and knowledge of per-operative ultrasound, of ERCP (Endoscopic retrograde cholangio-pancreatography) and endoscopic ultrasound, interventional imaging (CT-guided punctures and angiography on 24/7 base), and being part of a team comprising two surgeons performing a minimum of 10 pancreas resections for cancer per year at one hospital site, as well as experienced astrointestinal-oncologists, radiation oncologists, pathologists and radiologists.

Table 52 – Phase(s) of the clinical pathway for which reference centres are required for patients with pancreatic cancer

Phase of the Clinical Pathway	Reference centre (level 2 and 3)*	Peripheral centre (level 1)	Details
1. Multidisciplinary team meeting	For non-metastatic cancer	For metastatic cancer, based on current systemic treatments; subject to change with advances in treatment	
2. Diagnostic confirmation	Molecular diagnosis	X	**Pre-operative diagnosis:** Can be done in all centres (also peripheral centre) if pathologists have developed in their laboratory a method for collection of suitable material for ancillary immunocytochemical stains (e.g. preparation of cell blocks). If pathologists feel uncertain about their diagnosis, the material can be sent to a pathologist with special experience in this topic for second opinion. **Evaluation after resection:** Possible in each laboratory but for some rare cancers, a second opinion from a high reference centre is required (level 3, see Table 53 below). **Therapeutic strategy:** has to be planned in a reference centre for resectable and borderline resectable tumours. **For cancer detection and staging**: Multi-detector Computed Tomography (MD-CT) and/or Magnetic Resonance (MR) with Magnetic Resonance CholangioPancreatography (MRCP) are required. These cross-section imaging modalities should be performed before any endoscopic procedures to avoid the lack of useful diagnostic imaging features and also eventual post-procedural pancreatitis that may limit the ability to visualise the tumour and the interface between the tumour and the vessels.
3. Comprehensive anatomopathology diagnosis	X	X	The cell or tissue sampling and the interpretation of the results should be performed in a reference centre. The rest can be performed in a peripheral centre.
4. Therapeutic modalities:			
Interventional therapies (radiology, gastroenterology; Endoscopic retrograde cholangiopancreatography	X		

(ERCP); Endoscopic Ultrasound (EUS), etc.)			
Surgery	• Reference centre (Level 2): surgery in ASA 2 patients, with no vascular involvement and no risk for organ failure • High reference centre (Level 3): all pancreatic tumours with vascular reconstruction (portal vein, superior mesenteric vein, inferior vena cava), all surgery in patients ASA ≥3		Surgery (combined with chemotherapy) is only possible in 10-15% of patients. For the locally advanced (35%) and metastatic (50%) patients, chemotherapy is the only efficient therapy.
5. Follow-up		X	

Source: Addendum to KCE Report 219[494], concrete proposal for cancers of the pancreas; ASA = American Society of Anaesthesiologists

Table 53 – Pathology sub-entities for which a second opinion from a reference centre is required (Level 2 or 3)

Sub-entities	Need for a second opinion from a reference centre?
Adenocarcinoma with variants of pancreas	Not required
Squamous cell carcinoma with variants of pancreas	Not required
Carcinoma with osteoclast-like giant cells of pancreas	Not required
Acinar cell carcinoma of pancreas and solid pseudopapillary carcinoma of pancreas	The distinction between acinar cell carcinomas, solid pseudopapillary tumours and neuroendocrine tumours cannot be made without ancillary immunohistochemical stains. There are however some pitfalls in interpretation of these immunohistochemical stains. It thus seems appropriate that they are analysed in a high reference centre (Level 3) or by an expert panel.
Mucinous cystadenocarcinoma of the pancreas	Not required. Tumours with similar characteristics occur in the ovary and are well known by pathologists, as they are less rare.
Intraductal papillary mucinous carcinoma invasive of pancreas	Not required. In case the pathologist is not familiar with this type of tumour s/he can send it to a pathologist with more experience in this type of pathology for second opinion, especially in case there is doubt about the fact that there is invasion.
Serous cystadeocarcinoma of pancreas	Not required. In case the pathologist is not familiar with this type of tumour s/he can send it to a pathologist with more experience in this type of pathology for second opinion.

Source: Addendum to KCE Report 219[494], concrete proposal for cancers of the pancreas

Box 24 – General and specific criteria (in addition to those required by the oncology care programme) to be fulfilled by a hospital that would like to become a reference centre (Level 2+3) for pancreatic cancer

'Human Resources and dedicated team

Specialized staff (number, qualification, experience…):

- Surgeon: Part of a team of 2 surgeons performing a minimum of 10 pancreas resections for cancer per year on one hospital site.
- Radiologist: At least two radiologists with main activity (> 50% of work time) in abdominal imaging (CT/MR) and in particular with dedicated interest in pancreatic diseases, including cancer.
- Gastroenterologist with endoscopic expertise: Part of a team of 2 gastroenterologists performing ≥100 ERCP/year and ≥ 50 EUS/year, on one hospital site.
- One interventional radiologist, for the treatment of surgical complications (bleeding, collections)
- Pathologist
- GI oncologist: Part of a team of 2 GI oncologists seeing a minimum of 40 patients with pancreatic cancer/year on one hospital site.
- Radiotherapist: Level 2+3 centres should have easy access to or collaborate with a team of at least 3 radiation oncologists, of which 1 radiation oncologist with experience in the treatment of digestive cancer, including concomitant chemotherapy, on one hospital site.
- One nutritionist - dietician on-site.
- At least one psychologist on-site specifically dedicated to the support of pancreas cancer patients and their families.
- Clinical nurse specialist (Onco-coach/ CSO) specifically dedicated to pancreas cancer patients.
- Nursing staff with specific expertise in the management of pancreas cancer patients (management of postoperative course after major pancreatic surgical procedures, management of complications…).

Multidisciplinary management:

- Specialists required for a reference (Level 2+3) MOC: pathologist, gastroenterologist, GI-oncologist, radiologist with specific expertise in pancreas liver MRI/CT, nuclear medicine specialist, general surgeon with interest in HPB surgery, radiotherapist. Among the members, 3 specialists with proven experience based upon publications or study involvement or lectures during symposia and knowledge of guidelines.

Required facilities and equipment

- Surgery: See proposed model; i.e. Level 2+3:
  - Expertise how to perform vascular reconstructions in HPB surgery: Level 3 only
  - Minimal invasive surgery: Level 2+3
- Radiotherapy: Intensity modulated radiotherapy and/or intensity modulated arc therapy should be available; also the possibility to fuse planning images with FDG-PET images is recommended: Level 2+3
- Interventional imaging: CT-guided punctures and angiography on 24/7 base, Level 2+3
- Collaboration with a reference laboratory for molecular diagnosis

Patient-centred care

- Waiting and throughput times: Maximum 1 week to first visit
- Continuity of care (care covered 7 days a week by specialised staff, agreements concerning the continuity of care...)
- Support services for the patient (care coordinator: nurse coordinator in oncology / Onco-coach dedicated to pancreas cancer patients, Psychologist…)

- National and international networking with other reference centres (appropriate arrangements for referrals within Belgium and from/to other EU countries if applicable)
- Shared care: formal links with other hospitals, specialists and general practitioners (Consideration of E-Health solutions; e.g. shared case management systems, expert systems for tele-expertise and shared repository of cases).

Minimal volume of patients

- 40 patients/centre/year for onco-surgical approach (including metastatic), Level 2+3
- At least 10 pancreatic resections for cancer per year for a team of 2 surgeons at 1 hospital site, Level 2+3

Quality Assurance

- Capacity to propose quality indicators (structure, process, outcomes)
- Exhaustive and reliable information sent to Cancer Registry
- Compliance with existing guidelines and documentation of deviations from guidelines (e.g. NCCN guidelines, KCE guidelines)
- Involvement in quality initiatives (e.g. benchmarking)
- MOC Annual activity report ensuring transparency: advised but not required.

Research and other scientific activities

- Involvement in clinical studies (RCTs, cohort studies, translational studies), participation rate in clinical trials
- Publications in peer-reviewed journals
- Link with a tumour bank
- Development of clinical practice guidelines for diagnosis and care (e.g. Manual in oncology)

Educational activities: Teaching and dissemination

- Involvement in training and continuous education programs (annual or multi-annual training / educational programme for physicians, nurses, supportive disciplines)
- Organisation / communication in scientific congresses

Additional comments

- Funding for second opinion in expert pathology and radiology is mandatory.'

Source: Addendum to KCE Report 219[494], concrete proposal for cancers of the pancreas; CT = Computed Tomography; ERCP = Endoscopic Retrograde Cholangiopancreatography; EUS = Endoscopic ultrasound; FDP-PET = Fluorodeoxyglucose - Positron Emission Tomography; GI = Gastrointestinal; HBP = Hepato-Pancreato-Biliary; KCE = Belgian Healthcare Knowledge Centre; MOC = Multidisciplinary Oncological Consultations; MR(I) = Magnetic Resonance (Imagine); NCCN = National Comprehensive Cancer Network; RCT = Randomized Clinical Trials

6.3.4 International standards for pancreatic resections

6.3.4.1 France

In France, pancreatic resections for cancer must be performed in hospitals that obtained the authorization to perform digestive surgery for cancer (with a minimal threshold of 30 digestive surgery interventions per centre per year). Digestive surgery encompasses surgery in the following sites: stomach, oesophagus, liver, pancreas, and colorectal surgery. In 2015, 631 hospitals obtained such an authorization for a population of 66 415 161.[529, 530] Moreover, for patients with an endocrine pancreatic cancer (around 5% of pancreatic cancers), there is one national expert centre and 15 regional centres.[507, 508]

It should also be noted that besides the specific criteria that have been defined for all cancer surgery (see Box 18 of section 6.2.3), additional criteria have been defined for pancreatic cancer surgery, i.e.:

- the patient's file must be discussed in the multidisciplinary consultation meeting;
- the indication for surgery must be validated during this meeting;
- the adequacy of the technical platform to the planned intervention and the continuity of post-operative care must be assessed during this meeting;
- the surgeon who will operate the patient must participate to this meeting; and
- an access, on the spot or by convention, to operative endoscopy and radiology intervention should be available.[346]

6.3.4.2 *England*

Each person diagnosed with a pancreatic cancer in England should be reviewed by a specialised cancer centre. Tests, chemotherapy and radiotherapy treatments can be done at local hospitals, with a review from a specialist centre. Surgery (curative or palliative) should only be done in a specialist centre.[531]

Moreover, according to the contracts of the NHS England, specialist pancreatic cancer services should serve a population of at least 2 million people or more and there should be at least four to six pancreatic or hepatobiliary surgeons within the team.[518] It should also be noted that at the request of the Department of Health in England (to define the minimum population that should be covered), the association of upper gastrointestinal surgeons of Great Britain and Ireland (AUGIS) made recommendations on a minimum surgeon volume for pancreatic surgery, i.e. at least 80-100 pancreatic resections per centre annually. For a team of 6 surgeons, this mean that they should carry out 12-16 pancreatic resections per year per surgeon.[500]

To avoid too long waiting times for cancer care, it is also stated that pancreatic cancer services must achieve:[518]

- a two week wait for all patients with a suspected pancreatic cancer;
- 31 day wait from diagnosis to first treatment;
- 31 day wait to subsequent treatment;
- 62 day wait from urgent GP referral or screening referral or consultant upgrade to first treatment.

During the second quarter of 2016, 98% of patients with lower gastrointestinal cancers received their first treatment within the 31 days from diagnosis.[532]

If we look at current practice in England, there were 24 specialised services in 2014 for a total number of 8 080 new diagnoses of pancreatic cancer (for a total population of 54 316 600[533] i.e. an average population of 2 263 192 per centre).[534, 535] Applying these figures (8 080/24) to the Belgian context, with 1 715 new diagnoses in 2014 (C25 only)[524], gives 5 centres. Based on the total population, with a population of 11 311 117 in Belgium on January 2016,[530] also corresponds to 5 centres.

6.3.4.3 *The Netherlands*

According to the 2017 SONCOS standards, pancreatic cancer surgery should be performed by at least two certified surgeons with demonstrable specific expertise in pancreatic cancer surgery. Moreover, at least 20 pancreatoduodectomy procedures (classic Whipple or pylorus preserving pancreatoduodectomy) should be performed per centre annually. Additional requirements defined in the SONCOS reports are:[512]

- Adequate endoscopy service allowing endoscopic retrograde cholangiopancreatography (ERCP) and with a recovery area for monitoring after diagnostic or therapeutic procedure;
- Availability of oral endoscopic ultrasound (EUS), for both diagnostic and therapeutic procedures;
- At least two registered gastroenterologists experienced in endoscopy procedures (ERCP, dilatations, stent placement, oral endoscopic ultrasound);
- For surgery (as described above):

  - at least two certified surgeons with proven expertise in pancreatic cancer surgery;
  - for anaesthesiology and interventional radiology: at least two specialists with proven expertise in the care of patients having undergone pancreatic surgery;
- Access to an intensive care unit with personnel skilled in the care of patients after major gastrointestinal and oncological surgery.
- At least 20 pancreatoduodectomy procedures per year and per centre;
- Weekly multidisciplinary consultations with specified specialists[w];
- Specific, rare interventions (e.g. those involving hilus tumours) should be concentrated in few centres in the Netherlands and patients should be referred there;
- Participation in the Dutch Pancreatic Cancer Audit (DPCA).

According to the Health Inspectorate (IGZ), 19 hospitals performed pancreatoduodenectomy procedures in 2014 (for a total population of 16 829 289, i.e. an average population of 885 752 per hospital). A total of 728 pancreatoduodectomy procedures were performed in these 19 hospitals, with an average of 38 patients per hospital (range 19-85).[458] Applying these figures (19/728) to the Belgian context (with 492 pancreatoduodectomy procedures in 2015),[524] this corresponds to 13 centres. Based on the total population, with a population of 11 311 117 in Belgium on January 2016,[530] this also corresponds to 13 centres.

Of the 19 reference centres in the Netherlands, only one hospital did not reach the threshold of 20 interventions. This hospital was asked to seek for further collaborations.[536] It should also be noted that 67 hospitals referred patients to other hospitals for pancreatic resection, with an average of 11 patients per hospital and a maximum of 28. For 9 hospitals, it was not known how many patients they referred.[458]

The Dutch Pancreatic Cancer Audit (DPCA) also highlighted that the majority (59%) of the pancreatic resections (not only pancreatoduodectomy) have a different diagnosis than pancreatic cancer.[537]

It should also be noted that all 8 university hospitals (UMCs) are reference centres for surgery of pancreatic tumours (see section 6.2.5 for details about reference centre in the Netherlands).[538]

6.3.4.4 Denmark

In Denmark, pancreatic resections for benign and malignant pancreatic tumours (including ampullary and duodenal cancers) must be performed in highly specialised services. In the new 2017 plan, 4 hospitals obtained such an authorization for a population of 5 707 251 people (January 2016), i.e. an average population of 1 426 813 per service.[539, 540] In 2014, there were 973 new diagnosis of pancreatic cancer (C25 only). Applying these figures (4/973) to the Belgian context, with 1 715 new diagnosis of pancreatic cancers (C25 only), gives 7 centres in Belgium.[524, 541] Basing the extrapolation on the total population in both countries (i.e. 5 707 251 versus 11 311 117 on January 2016),[530] results in 8 centres.

6.3.4.5 Summary of international standards

Table 54 summarizes the standards for pancreatic resections applied in France, England, the Netherlands and Denmark. Extrapolations to Belgium must nevertheless be used with caution because different definitions are applied: e.g. concerning the threshold for surgery, we focus on surgery for (peri-)pancreatic cancer while France takes into account all digestive surgery (stomach, oesophagus, liver, pancreas, and colorectal) for cancer, the Netherlands focuses on Whipple procedures (not only for cancer), England focuses on surgery for pancreatic cancer (C25) and Denmark on pancreatic resections for benign and malignant pancreatic tumours (including ampullary and duodenal cancers).

[w] 'Surgeon, gastroenterologist, medical oncologist, radiologist, radiation oncologist, pathologist, case manager and/or oncology nurse and/or a nurse specialist in oncology and other nurses if necessary. There must be an option to consult a representative from the reference centre in this weekly meeting.'

Extrapolations to Belgium described in Table 54 are based on the number of new diagnoses of pancreatic cancer (C25) in all countries except for the Netherlands where it is based on the number of pancreatoduodenectomy procedures (Whipple procedures, all causes).

Table 54 – Volume thresholds and number of centres for pancreatic cancer surgery in France, England, the Netherlands, and Denmark

	Minimum population	Minimum threshold per centre per year	Number of centres	Extrapolated to Belgium (based on the number of new diagnoses)*
France				
• **Digestive surgery**	-	30	631	-
England				
• **Pancreatic cancer surgery**	2 000 000	80-100 (12-16 per surgeon)	24	5
The Netherlands				
• **Pancreatoduodectomy (Whipple)**	-	20	19	13
Denmark	-	-	4	7

**Except in the Netherlands (number of pancreatoduodenectomy procedures)*

6.3.5 *What is the required number of reference centres in Belgium in 2017?*

6.3.5.1 *Scenarios for the number of patients undergoing pancreatic resection surgery and for the period taken into account*

Scenarios are based on the number of patients and on the period taken into account. For the selection of patients, a distinction is made between resections for patients with a (peri-)pancreatic cancer (BCR data) and for all patients (=all causes, IMA – AIM data). Experts consider the Whipple procedure to be the most complex procedure (in the Netherlands only Whipple procedures are taken into account to define minimum thresholds). Therefore, additional scenarios were developed taking only account of Whipple procedures.

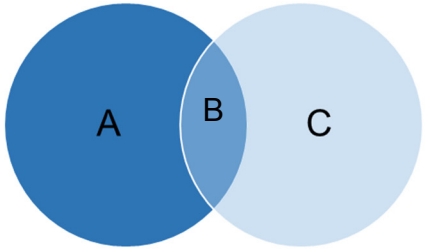
Different scenarios were developed for the period in which procedures were performed: the minimum volume was to be achieved in the most recent year for which data are available (to capture the increasing trend in cancer incidence) or on average for the last three years (to select centres that have a more stable caseload).

Table 55 illustrates the number of patients taken into account according to the scenario.

It should be noted that not all patients with a (peri-)pancreatic cancer are eligible for surgery. In 2014, a resection was performed in about 24% of patients diagnosed with a (peri-)pancreatic cancer.[524] Moreover, not all pancreatic resections concern patients with a cancer. In the Netherlands for example, it has been shown that the majority (59%) of the pancreatic resections have another diagnosis than pancreatic cancer.[537] The same

percentage was observed in Belgian data for the 2012-2014 period (see Figure 67).

Figure 67 – Relation between cancer incidence and pancreatectomies



A: Patients diagnosed with a (peri-)pancreatic cancer; B: Pancreatectomies for patients with a cancer; C: Pancreatectomies for other causes.

Table 55 – Number of patients undergoing pancreatic resection surgery according to the scenario

	2012-2014	2013-2015	2014	2015
Number of new diagnoses of (peri-) pancreatic cancer	6 008 (yearly average: 2 003)	-	2 105	-
Number of pancreatic resections (all patients)	2 390 (yearly average: 797)	2 504 (yearly average: 835) **(Scenario 2)**	841	870 **(Scenario 6)**
Number of pancreatic resections for patients with a cancer	1 400 (yearly average: 467) **(Scenario 1)**	-	492 **(Scenario 5)**	-
Number of Whipple procedures for patients with a cancer	1 072 (yearly average: 357) **(Scenario 3)**	-	388 **(Scenario 7)**	-
Number of Whipple procedures, all patients	1 401 (yearly average: 467)	1 443 (yearly average: 481) **(Scenario 4)**	513	492 **(Scenario 8)**

(-) = not available. Source: BCR data[524] and Atlas IMA – AIM[528].

6.3.5.2 *Minimum volume thresholds*

As described in section 6.3.3.3, the minimum volume thresholds recommended by the working group on pancreatic cancer in KCE report on rare and complex cancers were:[494]

- 40 patients/centre/year for the whole onco-surgical approach (including metastatic patients);
- At least 10 pancreatic resections for cancer per year for a team of 2 surgeons at 1 hospital site.

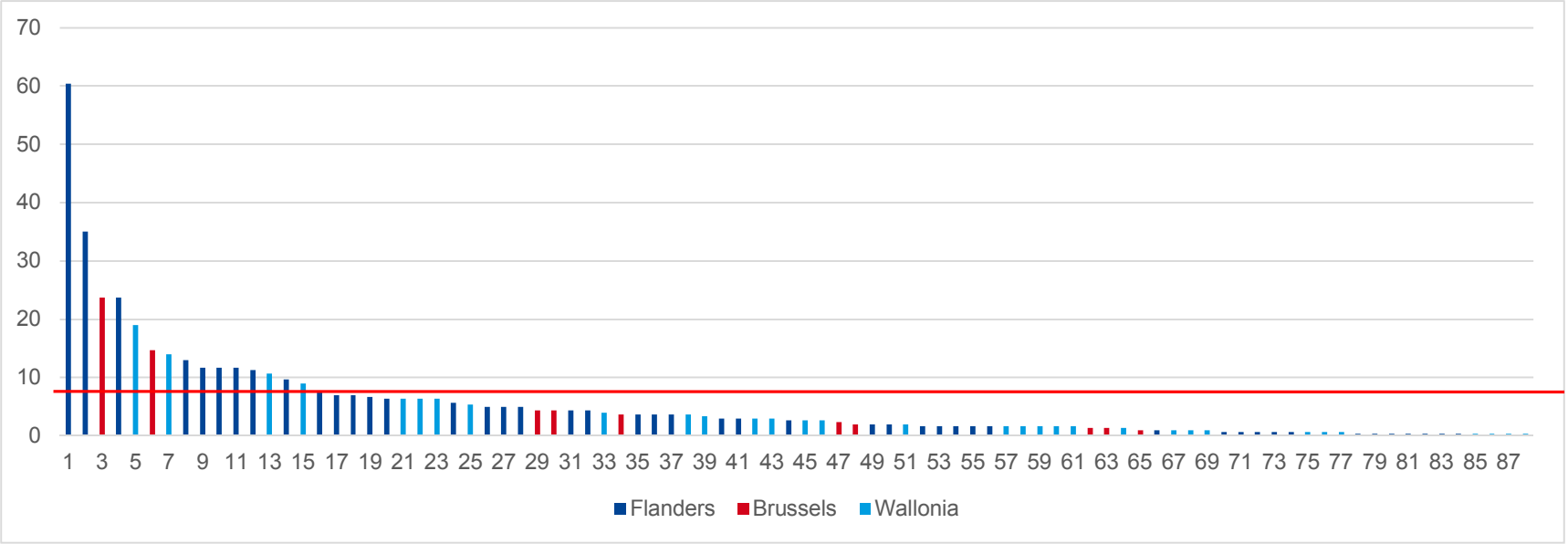
6.3.5.3 *Number of reference centres*

Scenario 1: number of required reference centres based on the number of pancreatic resections for (peri-)pancreatic cancer (2012-2014)

Criterion for the surgical volume

During the 2012-2014 period, 13 hospitals respected the threshold of 10 pancreatic resections for cancer (on average for the three years; 8 in Flanders, 3 in Wallonia, and 2 in Brussels; see Figure 68).

Figure 68 – Average yearly number of pancreatic resections for patients with a (peri-)pancreatic cancer per hospital, 2012-2014



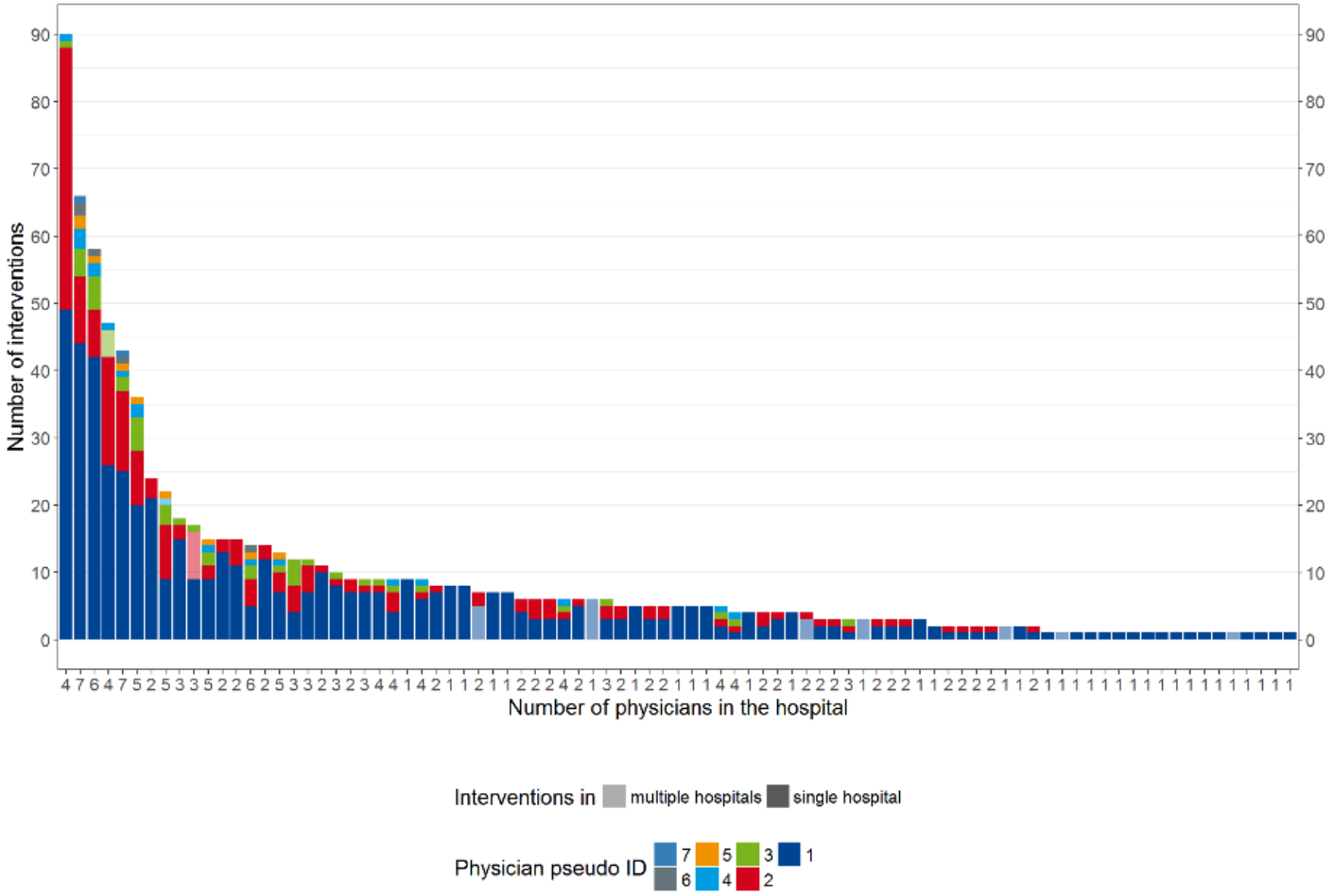
Source: Belgian Cancer Registry[524]

Criterion for the number of surgeons

As shown in Figure 69, it can also be expected that the recommendation of at least two surgeons per hospital was respected. After all, in 2013 (2014 not yet available), all hospitals that reached the minimal threshold of 10 interventions (all causes) had at least two surgeons. Although desirable, the information about the number of surgeons per centre that performed pancreatectomies for cancer patients was nevertheless not available. Therefore, it is possible that these two surgeons are experienced in pancreatic resections but maybe not in pancreatic resections for patients with a cancer.

A volume-outcome association for pancreatic cancer surgery has been found not only at the centre level, but also for surgeon volume and outcome indicators, for example mortality.[497] No minimum threshold for surgeon volume for pancreatic resections or Whipple procedures was found in literature. However, in KCE Report 113 on the 'volume-outcome for surgical interventions', a statistically significant inverse association between the volume of surgeons and the 2-year mortality for pancreatic cancer was found: 58% for surgeons performing less than 6 interventions per year and 43% for surgeons performing at least 6 interventions per year. Although the 'practice makes perfect' argument presumes an impact of surgeon volume on outcomes, this has to be further investigated.

Figure 69 – Number of physicians per hospital performing pancreatic resections (all causes), in 2013



Only interventions with norm code 0 or 5 (second intervention in same session) are taken into account. Interventions with norm code 1 or 2 are not retained as they indicate assistance to an intervention by another physician (56.2% of interventions have a reimbursed assistance). Source: RIZIV –INAMI data.

Criteria for patient management

With 13 reference centres, it can be expected that the threshold of 40 patients/centre/year for the whole onco-surgical approach will be reached. Indeed, there were on average 2 003 patients newly diagnosed during the 2012-2014 period. This will give an average number of 154 patients to manage per centre, assuming an equal distribution of patients between centres and assuming that all patients with a (peri-)pancreatic cancer will have a contact with the reference centre (at least for a second opinion).

Other scenarios

As shown in Table 56, the number of reference centres varies between 5 and 27 according to the scenario. With 5 reference centres, the number of patients to manage could become important, creating the risk of waiting time (see Table 57).

Table 56 – Number of reference centres required for pancreatic resections according to the scenario

	Number of reference centres			
	Flanders	Brussels	Wallonia	Total
Scenario 1: 10 pancreatic resections for patients with a cancer (2012-2014)	8	2	3	**13**
Scenario 2: 10 pancreatic resections (all patients, 2013-2015)	16	3	5	**24**
Scenario 3: 10 Whipple procedures for patients with cancer (2012-2014)	6	2	2	**10**
Scenario 4: 20 Whipple procedures (all patients, 2013-2015; based on volume threshold in the Netherlands)	2	1	1	**5**
Scenario 5: 10 pancreatic resections for patients with a cancer (2014)	12	2	4	**18**
Scenario 6: 10 pancreatic resections (all patients, 2015)	17	3	7	**27**
Scenario 7: 10 Whipple procedures for patients with a cancer (2014)	8	2	3	**13**
Scenario 8: 20 Whipple procedures (all patients, 2015; based on volume threshold in the Netherlands)	2	1	1	**5**
Extrapolation from England (see section 6.3.4)	-	-	-	**5**
Extrapolation from France (see section 6.3.4)	-	-	-	**-**
Extrapolation from the Netherlands (see section 6.3.4)	-	-	-	**13**
Extrapolation from Denmark (see section 6.3.4)				**7**

Table 57 – Average number of patients according to the number of reference centres (assuming an equal distribution weight)

	Average number per year (2012-2014 period)	Average number per year, per reference centre						
Number of reference centres		5	7	10	13	18	24	27
Number of new diagnoses of peri-pancreatic cancer	**2 003**	401	286	200	154	111	83	74
Number of pancreatic resections (all patients)	**797**	159	114	80	61	44	33	30
Number of pancreatic resections for patients with a cancer	**467**	93	67	47	36	26	19	17

6.3.6 *What is the future number of reference centres required (horizon 2025)?*

6.3.6.1 *Expected evolution for 2025*

Patients with a new diagnosis of pancreatic cancer

According to the Belgian Cancer registry, the number of patients diagnosed with pancreatic cancer is expected to rise from 1 675 in 2013 to more than 2 600 by 2025[x] (2 690; 95% CI: 2 471-2 908), due to a combination of the ageing and growth of the population and an increase in cancer risk over time in males and females.[520]

Table 58 – Projection for 2025

	N [95%CI] Males	WSR [95%CI] Males	N [95%CI] Females	WSR [95%CI] Females
Pancreas (C25)	1 392 [1 275; 1 508]	10.5 [9.7; 11.4]	1 298 [1 196; 1 400]	8.3 [7.6; 9.0]

Source: Belgian Cancer Registry[520]; N: Absolute numbers - number of new cancer diagnoses. WSR: Age-Standardised Rate, using the World Standard Population (N/100 000 person-years)

x These projections were obtained from linear and log-linear Poisson regression models by extrapolating the observed incidence trends for the period 2004-2013. The projections of potential population growth published by Statistics Belgium were used for the evolutions in the population size and age distribution.[520]

Patients with a new diagnosis of (peri-)pancreatic cancer

Projections on the number of patients with a (peri-)pancreatic cancer were not available (within the timeframe of this study). We therefore used the current percentage difference between new diagnoses of pancreatic cancer and (peri-)pancreatic cancers for the 2012-2014 period (i.e. +21.5%). This gives an estimated number of 3 267 patients diagnosed with a (peri-) pancreatic cancer in 2025 (see Table 59).

Pancreatic resections for cancer

As described above, the number of (peri-)pancreatic cancers will increase by 2025. It is nevertheless difficult to predict how many patients will be eligible for surgery in 2025. Therefore, we decided to assume the same percentage as currently (i.e. about 24% for the 2012-2014 period, see Table 59).

Pancreatic resections, all causes

To determine the number of resections for all patients, we used the current percentage difference between the number of resections for cancer and the number of resections for all causes (i.e. +70.7% in the 2012-2014 period, see Table 59).

Table 59 – Estimated number of patients in 2025

	Base case estimate	Lower estimate	Upper estimate
Number of new diagnoses of pancreatic cancer	2 690	2 471	2 908
Number of new diagnoses of peri-pancreatic cancer	3 267	3 001	3 532
Number of pancreatic resections for cancer	783	719	846
Number of pancreatic resections (all patients)	1 336	1 227	1 444

6.3.6.2 Patient management per reference centre in 2025

Table 60 shows the average number of patients that the references centres could have to manage in 2025. If we limit the number of reference centres to the lower estimate obtained in the previous section (i.e. 5 centres), the number of resections per hospital as well as the total number of patients with a (peri-) pancreatic cancer could become important and hospitals could not have enough capacity to manage all these patients, creating important waiting times.

Table 60 – Patients management in 2025 (base case estimates), according to the current number of reference centres

	Base case estimate	Average number of patients per reference centre in 2025						
Number of reference centres		5	7	10	13	18	24	27
Number of new diagnoses of pancreatic cancer	**2 690**	538	384	269	207	149	112	100
Number of new diagnoses of (peri-) pancreatic cancer	**3 267**	653	467	327	251	181	136	121
Number of pancreatic resections for patients with cancer	**783**	157	112	78	60	43	33	29
Number of pancreatic resections (all patients)	**1 336**	267	191	134	103	74	56	49

6.4 Oesophageal cancer

6.4.1 Description of the pathology

The two main histological types of malignant neoplasm of the oesophagus (ICD-10 C15) are squamous cell carcinoma (54.3%) and adenocarcinoma (45.3%; see Table 61).[520]

When discussing about cancer of the oesophagus, it should also be noted that cancer of the gastro-oesophageal junction (ICD-10 C16.0) is usually included. According to the TNM staging manual 7th edition, tumours with an epicentre within 5 cm of the gastro-oesophageal junction and extending into the oesophagus should be classified as oesophageal tumours and tumours with an epicentre in the stomach greater than 5 cm from the gastro-oesophageal junction or those within 5 cm of the gastro-oesophageal junction without extension in the oesophagus are to be classified as a gastric tumour.[504]

Because the symptoms are rather non-specific and appear at a late stage in the development of the disease, the diagnosis of oesophageal cancer is often done at an advanced stage. It should nevertheless be noted that diagnostic and staging techniques have improved during the latest years with the introduction of advanced endoluminal procedures.[494]

Guidelines usually agreed that surgical resection is the standard curative treatment for patients with resectable oesophageal cancer if permitted by the nutritional status (or after its improvement such as via feeding jejunostomy).[504] Oesophageal cancers are considered as unresectable in case of 'metastatic disease, positive lymph nodes outside the region of surgery and/or radiotherapy (i.e. the cervical, thoracic and upper abdominal compartment), advanced locoregional disease (e.g. tracheooesophageal fistula), or severe comorbidity'.[504] It should also be noted that oesophageal surgery is now increasingly performed in a setting of multimodality therapy, i.e. in combination with chemotherapy, with or without radiotherapy. Progress has also been made in the palliative setting, with the increasing beneficial impact of endoluminal interventional techniques, combined or not with systemic therapy and/or radiotherapy.[494]

Table 61 – Epithelial tumours of oesophagus by sub-entity, for 2009-2013

Sub-entities	N	CR
Squamous cell carcinoma with variants of oesophagus	2 522	4.61
Adenocarcinoma with variants of oesophagus	2 103	3.85
Salivary gland type tumours of oesophagus	4	0.01
Undifferentiated carcinoma of oesophagus	14	0.03

Source: Belgian Cancer Registry[520]
N: Absolute numbers - number of new cancer diagnoses registered between 2009-2013, CR: Crude (all ages) Rate (N/100 000 person-years)

6.4.2 Burden of oesophageal cancer in Belgium

For the 2009-2013 period, oesophageal cancer (C15-C16.0, i.e. with cancer of the gastro-oesophageal junction) was diagnosed in 6 906 new patients. Some variations in the WSR age standardised rates can be observed across the years. Each year, the number of new diagnoses was higher for males than for females (see Table 62 and Table 63).[524] The five-year survival for the 2009-2013 cohort was estimated at 23.5% for males and 26.0% for females.[520]

If we look at the absolute number of new diagnoses per age group of 5 years in 2013, oesophageal cancer (only C15) was most frequently diagnosed in the age group of 65-69 years old in both males and females. Moreover, in all age groups, oesophageal cancer (only C15) was more frequently diagnosed in males than in females (see Figure 70).[525]

A KCE study performed in collaboration with the Belgian Cancer Registry for the 2004-2008 period on 5 813 patients with cancer of the oesophagus (ICD-10: C15.0) or of the gastro-oesophageal junction (ICD-10: C16.0) showed that most of the specified tumours were located in the gastro-oesophageal junction (C16.0; 25.0%) and in the lower third of the oesophagus (C15.5; 20.3%).[498] In this cohort of patients, most patients with a reported clinical stage had a stage of IV (34.5%) or III (29.0%). It should also be noted that for most patients who underwent a surgery and for which the pathological stage was reported, it was a pStage II (34.7%) or pStage I (28.9%) (see Table 64).

Table 62 – Oesophageal cancer (C15-C16.0): absolute numbers per gender (N), 2009-2013

	2009	2010	2011	2012	2013
Males	992	990	1 090	1 055	1 071
Females	306	325	348	357	372

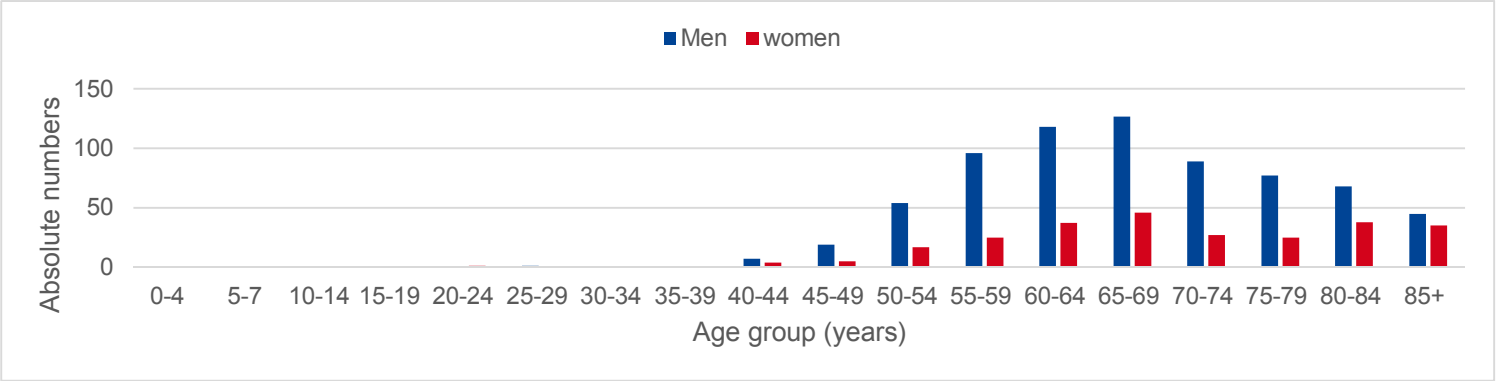
N: Absolute numbers - number of new cancer diagnoses registered in the period. Source: Belgian Cancer Registry[524]

Table 63 – Oesophageal cancer (C15-C16.0): Age-Standardised Rate, using the World Standard Population (WSR), 2009-2013

	2009	2010	2011	2012	2013
Males	10.7	10.3	11.2	11.0	10.6
Females	2.5	2.6	2.8	2.8	3.0

WSR: Age-Standardised Rate, using the World Standard Population (N/100 000 person-years). Source: Belgian Cancer Registry[524]

Figure 70 – Oesophageal cancer (C15): absolute number of new diagnoses in 2013, gender distribution by age group



Source: Belgian Cancer Registry[525]

Table 64 – Oesophageal cancer (C15-C16.0): distribution by disease stage, 2004-2008 period

	cStage			pStage		
	N	% of total	% of known	N	% of total	% of known
Known stages	3 425	58.9	100.0	1 525	77.1	100.0
In situ	7	0.1	0.2	-	-	-
I	401	6.9	11.7	441	22.3	28.9
II	843	14.5	24.6	529	26.8	34.7
III	993	17.1	29.0	420	21.2	27.5
IV	1 181	20.3	34.5	135	6.8	8.9
Unknown stage	2 388	41.1	NA	452	22.9	NA

Source: KCE report 200[498]*; cStage: Clinical stage; pStage: Pathology stage.*

6.4.3 Current practice in Belgium

6.4.3.1 Number of surgical procedures per centre (all causes)

Table 65 presents the number of oesophageal resections for all causes for the years 2009-2015. The average number of interventions per hospital increased from 6.75 in 2009 to 9.11 in 2015, mostly because of a reduction in the number of hospitals performing oesophageal resections. The median number of interventions remained stable (i.e. 4 interventions, except 3 in 2011; see Table 65).[528]

In 2015, a total of 492 interventions were performed in 54 hospitals (see Table 65 and Figure 71). Half of the number of interventions was carried out by 4 hospitals.[528]

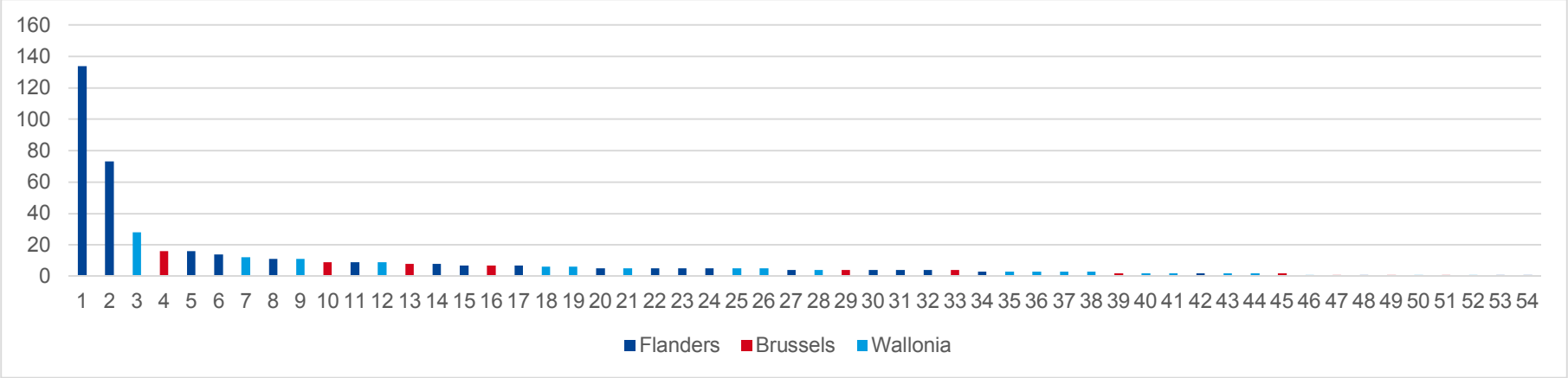
For the 2009-2013 period (to match the period for which data from the Belgian Cancer Registry are available), a total number of 2 270 oesophageal resections have been performed, i.e. an average of 454 interventions per year. A total of 84 hospitals performed at least one oesophageal resection during this period.

Table 65 – Overview of oesophageal resections (all causes) per hospital in the 2009-2015 period (latest year available)

	2009	2010	2011	2012	2013	2014	2015
Number of interventions	405	438	458	499	470	500	492
Number of hospitals*	60	62	66	67	63	55	54
Average	6.75	7.06	6.94	7.45	7.46	9.09	9.11
Median	4	4	3	4	4	4	4

*Source: Atlas AIM-IMA[528];*Some hospitals underwent a merger during the study period. The number of hospitals is based on the hospitals that were active at the end of the observation period, i.e. in 2015.*

Figure 71 – Number of oesophageal resections (all causes) per hospital and per region in 2015



Source: Atlas AIM-IMA[528]

6.4.3.2 *Number of surgical procedures for oesophageal cancer per centre*

Table 66 presents the number of oesophageal resections for cancer for the years 2009-2013. During this period, a total number of 1 817 oesophageal resections have been performed for a cancer, i.e. an average of 363.4 interventions per year. A total of 80 hospitals performed at least one oesophageal resection for cancer during this period.

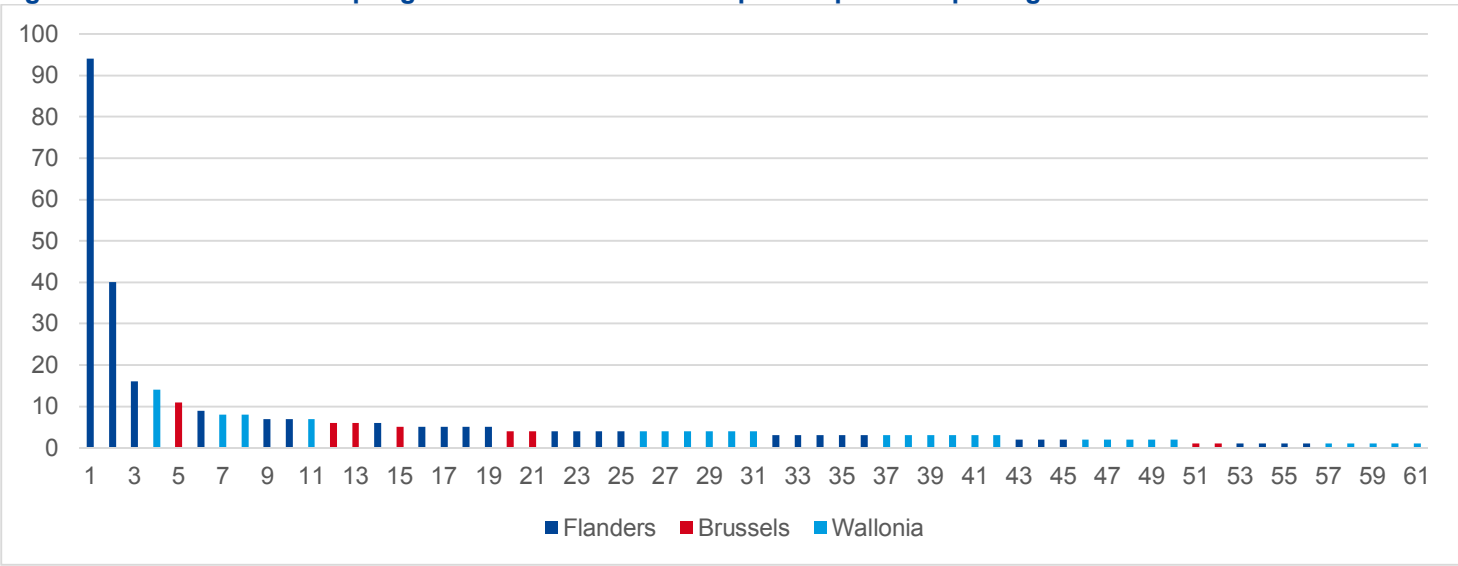
In 2013, a total of 372 interventions for cancer were performed in 61 hospitals, with an average of 6.1 and a median number of 4 interventions per hospital (see Table 66). Half of the number of interventions was carried out by 7 hospitals.[524]

Table 66 – Overview of oesophageal resections for oesophageal cancer per hospital in the 2009-2013 period (latest year available)

	2009	2010	2011	2012	2013
Number of interventions	314	357	376	398	372
Number of hospitals	54	61	62	62	61
Average per hospital	5.8	5.9	6.1	6.4	6.1
Median	3.0	3.0	3.0	3.5	4.0

Source: Belgian Cancer Registry[524]

Figure 72 – Number of oesophageal resections for cancer per hospital and per region in 2013



Source: Belgian Cancer Registry[524]

6.4.3.3 *Specific requirements per phase of the clinical pathway*

Recommendations of the working group on oesophageal cancer performed in KCE Report 219 are summarized in Table 67 and in Box 25.[494]

Table 67 – Phase(s) of the clinical pathway for which reference centres are required for patients with oesophageal cancer

Phase of the Clinical Pathway	Reference Centre	Peripheral centre	Details
MOC	**X**	**X**	• MOC (for all patients) can be done in a peripheral centre but a second opinion from a reference centre is needed.
Diagnostic confirmation and clinical TNM staging	**X**	**X**	• Traditional tests can be performed in peripheral centres (endoscopy and biopsy, CT, PET/CT, echography, barium swallow). Digitalised imaging that can be edited must be transmitted at the reference centre for the second opinion MOC. Diagnostic test can also be repeated at a reference centre when deemed necessary. • New technologies and techniques must be performed in a reference centre: Endoluminal manipulation / instrumentation (e.g. Endoscopic mucosal resection –EMR– and endoscopic submucosal dissection –ESD–) and interventional imaging (e.g. specific CT guided diagnostic procedures, EUS guided FNA, specific surgical diagnostic procedures); requiring specific equipment (Endoluminal equipment / Specialised imaging techniques) and professional expertise to interpret results. • When deemed necessary, specimens must be reviewed by an expert pathologist in a reference centre (e.g. high grade dysplasia, pT1a – EMR/ESD)
Therapeutic modalities	**X**	**	• In a peripheral centre**: Procedures classified as local care but only after discussion at the multidisciplinary team in the reference centre and subject to agreement in network clinical guidelines. • In a reference centre: Organ saving techniques (e.g. EMR/ESD), new surgical techniques (e.g. vagal sparing oesophagectomy), new protocols using e.g. existing therapeutic modalities, second line chemotherapy, experimental chemotherapeutic agents and/or biologicals, clinical trials. Facilities and equipment required in the reference centre: • One single location

			• Radiation oncology: 2 linear accelerators ranging from 6 – 15 Mv with on board imaging; appropriate immobilisation devices, IMRT, brachytherapy, PET/CT • Dedicated Intensive Therapy Unit • Patients are to be clustered in an identifiable OC surgical dedicated sector, including surgical ward, and looked after by a OC specialised dedicated multidisciplinary medical and paramedical team • Simultaneous combination therapies e.g. chemotherapy + concurrent radiotherapy are to be performed in the same centre.
Follow-up	**X**	**X**	• Referral to a reference centre is required for specific situations such as follow-up of clinical trials, surgical complications, recurrent disease (new MOC mandatory), EMR/ESD follow-up, nutritional issues, toxicity and side effects of multimodal therapy.

Source: Addendum to KCE report 219[494], concrete proposal for oesophageal cancers

Box 25 – General and specific criteria (in addition to those required by the oncology care programme) to be fulfilled by a hospital that would like to become a reference centre for oesophageal cancer

'Human Resources and dedicated team

Specialized staff

- Involved specialties are: radiology, nuclear medicine, pathology, endoscopy and interventional endoscopy, radiation oncology, medical/GI oncology, surgery, anaesthesiology and intensive care, pain clinic.
- Within each involved specialty, at least one colleague with a special focus on oesophageal cancer has to be identified as an expert in oesophageal cancer. This colleague is taking on the responsibility for all oesophageal cancer issues related to his/her specialty including scientific and educational activities, quality issues and quality assurance, patient centred aspects, and is representing the involved specialty at the second opinion MOC.

Multidisciplinary management

- Besides the involved medical specialties, multidisciplinarity includes a wide spectrum of paramedical professions, e.g. dieticians, physiotherapists, speech therapists, dosimetrists, physicists, psychologists, onco-nurses, lab technicians, data nurses and data managers, nursing staff and technologists in different diagnostic and therapeutic segments. All of these professions should designate within their group individuals with a special focus on oesophageal cancer related issues.

Required facilities and equipment

- Options for multidisciplinary consultation (both inpatient and outpatient) should be available
- Audio-visual equipment (e.g. webcam, tele-pathology) is essential
- IT infrastructure for adequate data registration
- Fully integrated electronic medical file
- Surgery: infrastructure for major thoraco/abdominal surgery and related anaesthesiology infrastructure on one campus located facility
- Dedicated Intensive Therapy Unit: patients are to be clustered in an identifiable oesophageal cancer surgery dedicated sector and looked after by EC specialised dedicated nursing staff and intensivists
- On the ward, in particular the surgical ward, the patients are to be clustered in an identifiable oesophageal cancer surgery dedicated sector and looked after by a in oesophageal cancer specialised dedicated nursing staff
- Radiotherapy: 2 linear accelerators ranging from 6 – 15 Mv with on board imaging; appropriate immobilisation devices, IMRT, brachytherapy. Restrict radiotherapy to recognised centres (no referral to satellite centres). Combination therapy (e.g. concurrent radiochemotherapy) has to be administered in one single centre
- Chemotherapy: Restrict chemotherapy to recognised centres for oncologic care
- Interventional imaging PET/CT scan, MRI, High resolution CT
- Collaboration with a reference laboratory for pathology: access to tumour bank, access to molecular biology techniques/technologies
- Other: access to rehabilitation programs
- Facilities to organise and conduct high quality clinical trials

Patient centred care

- Time line:
  - Maximum 2 weeks from index endoscopy to 1st MOC
  - Maximum 2 weeks between 1st and second RC MOC
  - Maximum 2 months between diagnosis and initiation of therapy as decided at the RC MOC
  - Maximum 4 weeks between RC MOC and initiation of therapy
- General practitioner to be involved in every major step of the diagnostic and therapeutic process

- Continuity of care (care covered 7 days a week by specialised staff, agreements concerning the continuity of care...)
- Support services for the patient (identification of a care coordinator, support for patient information (e.g. informative flyers on cancer of the oesophagus)
- Shared care: formal links with collaborative centres (Consideration of E-Health solutions, e.g. shared case management systems, expert systems for tele-expertise and shared repository of cases)
- For the patient: freedom of choice of his/her treating specialist team and this without any negative financial impact for the patient

Minimal volume of patients

- The work-up towards minimum volumes is time-consuming and is to be seen as a proactive process as it will require the set-up of effective collaboration between the clinical network centres. It is assumed that this process will require a time frame of at least 3 years
- At that time point the minimum hospital volume (taking into account the actual numbers of newly diagnosed patients in Belgium) is 50 new patients/year as registered in the RC MOC
- Within the same context, minimum volume of oesophagectomies for oesophageal cancer is 12/year
- Volume will be linked to quality and quality assurance aspects in order to obtain the accreditation of RC (see point 5)
- These volume criteria are to be re-evaluated and adjusted after another time slot of 3 years

Quality Assurance

- All new patients presenting with oesophageal cancer have to be registered in a registry that will be peer-reviewed and centrally controlled
- Annual activity report ensuring transparency: i.e. containing information on number of new diagnoses, type and location of tumour, comprehensive diagnosis and MOC report, therapeutic protocol and strategy
- Capacity to propose quality indicators (structure, process, outcomes)
  - Measurement of quality indicators proposed by the KCE report 200
  - Curative resection rates for oesophageal cancer
  - Outcome: 90 days mortality after surgery <5%
  - Measurement of 1 and 5-year survival outcomes after surgery or other types of radical treatment, adjusted for the case-mix
  - Number of second opinions
  - Specific protocols for reporting and recording complications
- Exhaustive and reliable information sent to Belgian Cancer Registry
- Compliance with existing guidelines and documentation of deviations from guidelines
- Involvement in quality initiatives (e.g. benchmarking)

Research and other scientific activities

- Involvement in clinical studies (RCTs, cohort studies, translational studies), participation rate in clinical trials
- Publications in peer-reviewed journals
- Link with a tumour bank
- Development of clinical practice guidelines for diagnosis and care

Educational activities: Teaching and dissemination

- Interdisciplinary training
- Training of future experts in oesophageal cancer should involve a dedicated period in a high volume oesophageal cancer centre. In particular for surgeons, one year in a centre with a high volume i.e. >30 oesophagectomies/year
- Tutorship
- Training personnel, specialists
- Organisation / communication in scientific congresses

Additional comments

- All the criteria above require an engagement from the responsible health care authorities to provide sufficient funding. Especially, funding for second opinion in expert pathology and radiology is mandatory as well as the funding of the organisational aspects (e.g. the mandatory second opinion MOC, the logistics related to the influx of an increased volume in the RC)'

CT = Computed Tomography; EC = Endoscopic; GI = Gastrointestinal; IMRT = Intensity-modulated radiotherapy; IT = Information Technology; MOC = Multidisciplinary Oncological Consultations; MR(I) = Magnetic Resonance (Imagine); PET = Positron Emission Tomography; RC = Reference Centre.

6.4.4 International standards for oesophageal resections

6.4.4.1 France

In France, oesophageal resections for cancer must be performed in hospitals that obtained the authorization to perform digestive surgery for cancer (with a minimal threshold of 30 digestive surgery interventions per centre per year). In 2015, 631 hospitals obtained such an authorization for a population of 66 415 161, i.e. an average population of 105 254 per hospital.[529]

It should also be noted that beside the specific criteria that have been defined for all cancer surgery (see Box 18 of section 6.2.3), additional criteria have been defined for oesophageal cancer surgery, i.e.:

- the patient's file must be discussed in the multidisciplinary consultation meeting;
- the indication for surgery must be validated during this meeting;
- the adequacy of the technical platform to the planned intervention and the continuity of post-operative care must be assessed during this meeting;
- the surgeon who will operate the patient must participate to this meeting; and
- an access, on the spot or by convention, to operative endoscopy and radiology intervention should be available.[346]

6.4.4.2 England

In England, all patients diagnosed with oesophageal or gastric cancer are initially discussed by the local multidisciplinary team but should then be transferred to a specialist multidisciplinary team with diagnostic details (endoscopy and histology, basic staging from CT scanning and detail of the patient's co- morbidity). Palliative and supportive care that does not involve tumour shrinking or debulking therapy can be delivered locally but only after discussion with the specialist multidisciplinary team and according to network clinical guidelines. Endoscopic therapies (including endoscopic mucosal resection and endoscopic ablative therapies) and resection surgery should only be carried out in the host hospital of a specialized team.[542]

Chemotherapy (including neoadjuvant or perioperative chemotherapy) and radiotherapy (including intraluminal radiotherapy) should be delivered under the care of a member of the specialist team but the site of delivery is subject to agreement in the network's guidelines.[542]

In London, the resection surgery rate was estimated to be around 20% of all patients (10% for oesophagus and 24% for gastro-oesophageal junction and stomach). The majority of oesophago-gastric cancer patients suitable for surgery required multi-modality treatments, usually surgery in conjunction with chemotherapy. Specialist oesophago-gastric surgery in London is currently undertaken at three sites but they planned to reduce this number to two and then one centre in the coming years.[543]

Moreover, according to the contracts of the NHS England, specialist oesophageal and gastric cancer services should serve a population of at least 1 million people or more (they added this should be 1.3 million if it was based on the minimum numbers of resections that should be performed by the centre, i.e. a minimum of 60 oesophageal and gastric resections per centre per year) and there should be at least 4-6 surgeons within the team.

This is based on the professional association of Upper Gastrointestinal Surgeons (AUGIS) opinion that recommends a minimum of 15 to 20 resections per year for an individual specialist surgeon working within centres comprising at least 4-6 surgeons.[542]

These specialist services are required to agree with their local cancer networks on referral criteria, clinical protocols, network policies and treatment pathways, etc.[542]

To avoid too long waiting times for cancer care, it is also stated that gastro-oesophageal cancer services must achieve:[542]

- a two week wait for all patients with a suspected cancer;
- 31 day wait from diagnosis to first treatment;
- 31 day wait to subsequent treatment;
- 62 day wait from urgent GP referral or screening referral or consultant upgrade to first treatment.

During the second quarter of 2016, 98% of patients with lower gastrointestinal cancers received their first treatment within 31 days from diagnosis.[532]

If we look at current practice in England, there were 41 specialised centres for a total number of 12 656 new diagnoses of oesophago-gastric cancer (C15-C16) in 2014 (and for a total population of 54 316 600, i.e. an average population of 1 324 795 per centre).[533, 534, 544] Applying these figures (41/12 656) to the Belgian context, with 2 470 new diagnoses (C15-C16) in 2014 [524], gives a total of 8 centres. Since only C15 and C16.0 are the scope of this report, for 1 451 newly diagnosed patients in 2014, 5 centres are needed (see Table 68).

6.4.4.3 The Netherlands

According to the 2017 SONCOS standards, oesophageal cancer surgery should be performed by at least two certified surgeons with demonstrable specific expertise in oesophageal cancer surgery. Moreover, at least 20 oesophageal resection procedures for cancer should be performed per centre annually. Additional requirements can be found in the SONCOS reports (https://www.soncos.org/):[512]

- Adequate endoscopy service with a recovery area for monitoring after a diagnostic or therapeutic procedure;
- Availability of oral endoscopic ultrasound (EUS);
- At least two registered gastroenterologists experienced in endoscopy procedures (dilatations, stent placement, oral endoscopic ultrasound);
- For surgery (as described above):
  - at least two certified surgeons with proven expertise in oesophageal surgery;
  - at least 20 oesophagectomy procedures for oesophageal cancer per year and per centre;
  - for anaesthesia and radiology: at least two specialists with proven expertise in the care of patients undergoing oesophageal surgery for cancer.
- Access on-call 24 hours a day, 7 days a week to an interventional radiologist, skilled in performing interventions on patients with complications as a result of major gastrointestinal and oncological procedures;
- Access to a nuclear medicine service with a PET / CT scan;
- Neo-adjuvant chemotherapy and chemoradiotherapy are available;
- Drug therapy may be carried out by the referring hospital, with the approval of the centre in which the surgery was done. Imaging for evaluation of the tumour should be discussed in the multidisciplinary

consultations done in the centre in which the surgery was carried out. A service level agreement between these centres should be concluded;

- Access to an intensive care unit with personnel skilled in the care of patients after major gastrointestinal and oncological procedures;
- Weekly multidisciplinary consultations with specified representatives[y];
- Specific, rare interventions should be concentrated within several centres in the Netherlands and patients should be referred there;
- Participation in the Dutch Upper GI Cancer Audit (DUCA).

According to the IGZ, 23 hospitals performed oesophageal resections for a primary carcinoma in 2014, for a total number of 2 150 new diagnoses of oesophageal cancer (and a total population of 16 829289, i.e. an average population of 731708 per hospital).[458, 530, 545] Applying these figures to the Belgian context (with 988 new diagnoses in 2014)[524] gives 11 centres. Based on the total population, with a population of 11 311 117 in Belgium on January 2016,[530] this would give 15 centres.

For the 23 hospitals that performed oesophageal resections for a primary carcinoma in 2014 in the Netherlands, 2 hospitals did not reach the threshold of 20 interventions (with 14 and 18 interventions respectively).[458] Moreover, with the setup of minimum twenty operations per year as standard, five hospitals have stopped oesophageal resections in the 2011-2012 period and one in the 2013-2014 period.[513]

It should also be noted that 7 of the 8 university hospitals (UMCs) are reference centres for surgery of oesophageal tumours.[538]

6.4.4.4 *Denmark*

In Denmark, resections for oesophageal, cardia, or gastric cancers (C15-C16) must be performed in highly specialised services. In the new 2017 plan, 3 hospitals obtained such an authorization for a population of 5 707 251 people (January 2016), i.e. an average population of 1 902 417 per service.[539, 540] To extrapolate this number to the Belgian situation, we used the number of new diagnoses of oesophageal and stomach cancer (C15-C16) in both countries in 2014 (more recent years not available). With 2 470 and 1 113 new diagnoses of oesophageal and stomach cancers (C15-C16) in Belgium and in Denmark respectively,[524, 541] this would give 7 centres in Belgium. Since only C15 and C16.0 are the scope of this report, for 1 451 newly diagnosed patients in 2014, 4 centres are needed. If the extrapolation was based on the total population in both countries (i.e. 5 707 251 versus 11 311 117 on January 2016),[530] we would obtain 6 centres.

6.4.4.5 *Summary of international standards*

Table 68 summarizes the standards for oesophageal resections applied in France, England, the Netherlands and Denmark. Extrapolations to Belgium must nevertheless be used with caution because different definitions are applied: e.g. concerning the threshold for surgery, we focus on oesophageal resection surgery for cancer (C15 and C16.0) as in the Netherlands, while in France all digestive surgery for cancer is taken into account (stomach, oesophagus, liver, pancreas, and colon-rectum), and in England and in Denmark, the focus is on resections for oesophago-gastric cancer (C15 + C16).

Extrapolations in Table 68 were based on the number of new diagnoses of oesophageal cancer (C15) in the Netherlands and of new diagnoses of gastro-oesophageal cancer (C15-C16) in England and in Denmark.

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y 'Surgeon, gastroenterologist, medical oncologist, radiologist, radiation oncologist, pathologist, nuclear medicine specialist, case manager and/or oncology nurse and/or a nurse specialist in oncology and other nurses if necessary. There must be an option to consult a representative from the reference centre in this weekly meeting.'

Table 68 – Recommendations related to specialised services for oesophageal cancer in France, England, the Netherlands, and Denmark

	Minimum population	Minimum threshold per centre per year	Number of services	Extrapolated to Belgium (based on the number of new diagnoses)
France				
• **Digestive surgery**	-	30	631	-
England				
• **Resections for oesophago-gastric cancer**	1.3 million	60 (15-20 per surgeon)	41	5
The Netherlands				
• **Oesophageal resections**		20	23	11
Denmark				
• **Resections for oesophago-gastric cancer**	-	-	3	4

6.4.5 What is the required number of reference centres in 2017?

6.4.5.1 Scenarios on the number of patients undergoing an oesophageal resection and on the period taken into account

A number of scenarios were developed to identify the required number of reference centres. As for pancreatic surgery, these scenarios are based on a minimum volume of patients for oesophageal resections and on the period in which this minimum volume has to be achieved (the most recent year for which data are available and the average in the last three years).

Table 69 illustrates the number of patients taken into account according to the scenarios.

Table 69 – Number of patients undergoing oesophageal resection surgery according to the scenario

	2011-2013	2013-2015	2013	2015
Number of new diagnoses of oesophageal cancer	4 293 (yearly average: 1 431)	-	1443	-
Number of oesophageal resections (all patients)	1 427 (yearly average: 476)	1462 (yearly average: 487) **(Scenario 2)**	470	492 **(Scenario 4)**
Number of oesophageal resections for patients with cancer	1 146 (yearly average: 382) **(Scenario 1)**	-	372 **(Scenario 3)**	-

(-) = not available. Source: BCR data[524] and Atlas IMA – AIM[528].

6.4.5.2 Minimum volume threshold

As described in section 6.4.3.3, the minimum volume thresholds recommended by the working group on oesophageal cancer in the KCE report on rare and complex cancer were:[494]

- 50 new patients/year as registered in the MOC;
- At least 12 oesophageal resections for oesophageal cancer per year.

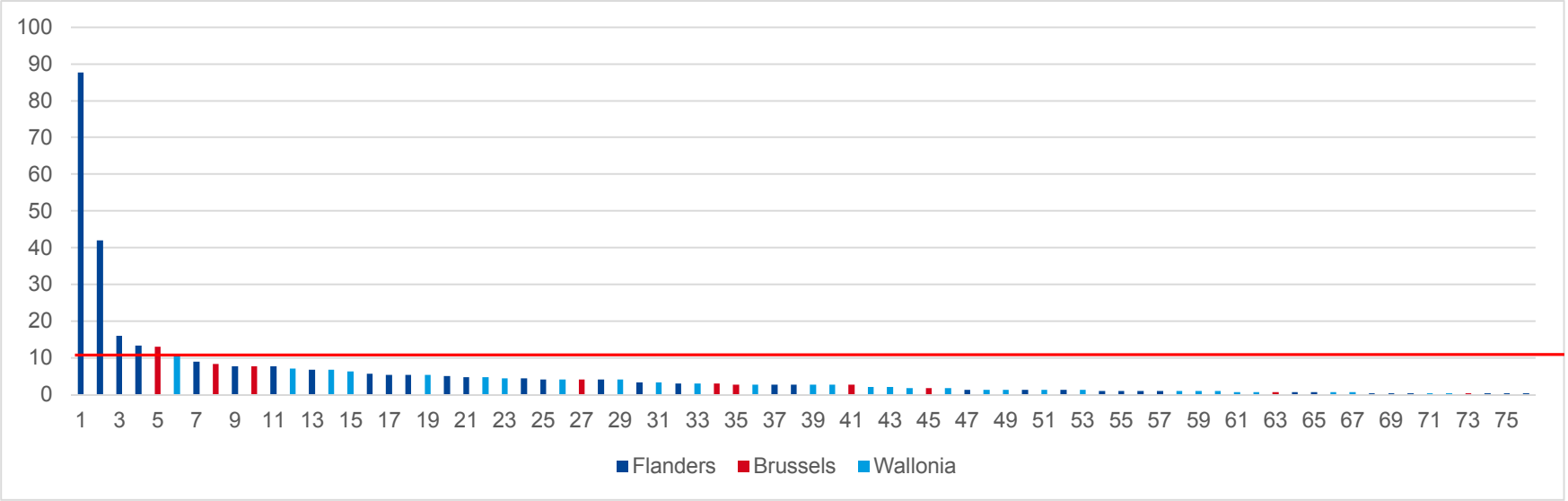
6.4.5.3 Number of reference centres

Base case: number of required reference centres based on the number of oesophageal resections in patients with an oesophageal cancer (2011-2013)

Criterion for the surgical volume

For the 2011-2013 period, 5 hospitals respected an average number of 12 oesophageal resections for cancer per year, 1 in Brussels and 4 in Flanders (see Figure 73). A sixth hospital in Wallonia only respected a threshold of 10 interventions (with an average of 11 interventions during the 2011-2013 period). If it is decided to have at least one hospital by region, also this hospital could be taken into account.

Figure 73 – Average yearly number of oesophageal resections for an oesophageal cancer per hospital, 2011-2013



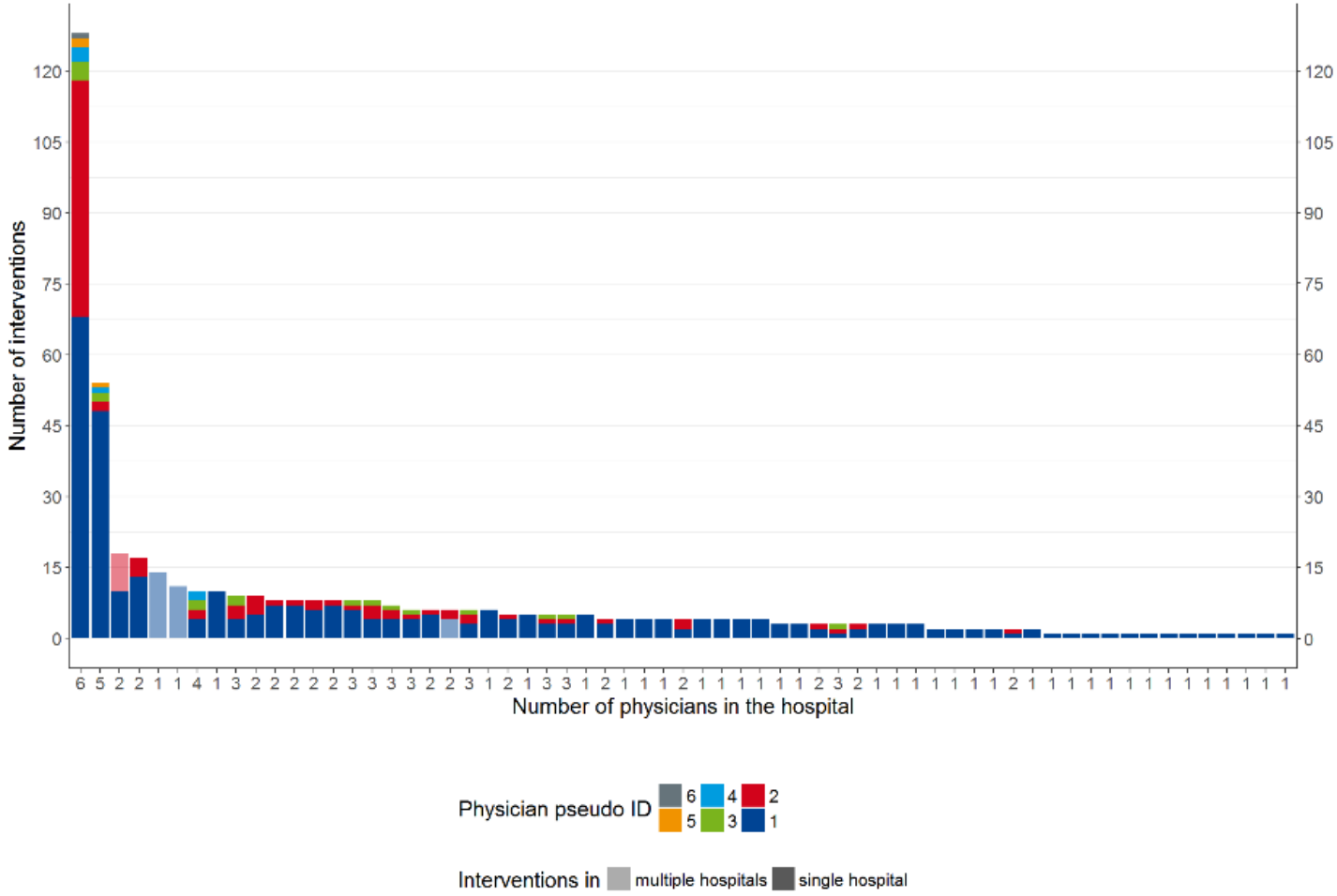
Source: Belgian Cancer Registry[524]

Criterion for the number of surgeons

For oesophageal cancer, there were no recommendations in terms of minimum number of surgeons that should perform oesophageal resections.[494] Nevertheless, it should be noted that if a minimum of two surgeons is considered as appropriate (e.g. because of continuity of care, to ensure that the centre does not depend on one surgeon), this was not respected in all hospitals in 2013 (not respected in 1/5 hospitals that had at least 12 interventions, all causes; see Figure 74).

A volume-outcome association for oesophageal cancer surgery has been found not only at the centre level, but also for surgeon volume and outcome indicators, for example mortality.[497] No minimum threshold for surgeon volume for oesophageal resections was found in literature. In KCE Report 113 on the 'volume-outcome for surgical interventions' a (not) statistically significant inverse association between the volume of surgeons performing oesophageal resections and the 3-months mortality was found: 13.5% for surgeons performing less than 6 interventions per year and 6.4% for surgeons performing at least 6 interventions per year. Results at 2 years were consistent.

Figure 74 – Number of physicians per hospital performing oesophageal resections (all causes), in 2013



Only interventions with norm code 0 or 5 (second intervention in same session) are taken into account. Interventions with norm code 1 or 2 are not retained as they indicate assistance to an intervention by another physician (56.2% of interventions have a reimbursed assistance). Source: RIZIV – INAMI data.

Criteria for patient management

With 6 reference centres, it can be expected that the threshold of 50 new patients per year will be reached. Indeed, there were on average 1 431 patients newly diagnosed during the 2012-2014 period. This will give an average number of 239 patients to manage per centre, assuming an equal distribution of patients between centres and assuming that all patients with an oesophageal cancer will be reviewed in the MOC of a reference centre (at least for a second opinion).

Other scenarios

As shown in Table 70, the number of reference centres required varies between 4 and 11 according to the scenario. Table 71 shows the average number of patients to manage according to the number of reference centres (assuming an equal distribution of patients between hospitals).

Table 70 – Number of reference centres required for oesophageal resections according to the scenario

	Number of reference centres			
	Flanders	Brussels	Wallonia	Total
Scenario 1: 12 oesophageal resections for patients with a cancer (2011-2013)	4	1	(1)*	**5(6)***
Scenario 2: 12 oesophageal resections (all patients, 2013-2015)	3	1	1	**5**
Scenario 3: 12 oesophageal resections for patients with a cancer (2013)	3	(1)*	1	**4(5)***
Scenario 4: 12 oesophageal resections (all patients, 2015)	4	1	2	**7**
Extrapolation from England (see section 6.4.4)	-	-	-	**5**
Extrapolation from the Netherlands (see section 6.4.4)	-	-	-	**11**
Extrapolation from Denmark (see section 6.4.4)				**4**

*(-) extrapolation not done; *added to have at least one centre per region.*

Table 71 – Average number of patients according to the number of reference centres (assuming an equal distribution weight)

	Average number per year (2011-2013 period)	Average number per year, per reference centre				
Number of reference centres		4	5	6	7	11
Number of new diagnoses of oesophageal cancer	1 431	358	286	239	204	130
Number of oesophageal resections (all patients)	476	119	95	79	68	43
Number of oesophageal resections (for an oesophageal cancer)	382	96	76	64	55	35

6.4.6 What is the future number of required reference centres (horizon 2025)?

6.4.6.1 Expected evolution for 2025

Patients with a new diagnosis of oesophageal cancer

According to the Belgian Cancer registry, the number of patients diagnosed with oesophageal cancer (C15-C16.0) is expected to rise from 1 443 in 2013 to around 1 800 by 2025[z] (1 808; 95% CI: 1 698-1 918), mainly due to the ageing and growth of the population.[520]

Table 72 – Projection for 2025

	N [95%CI] Males	WSR [95%CI] Males	N [95%CI] Females	WSR [95%CI] Females
Oesophageal (C15-C16.0)	1 389 [1311; 1466]	11.3 [10.7; 12.0]	419 [387; 452]	3.0 [2.7; 3.2]

Source: Belgian Cancer Registry[520]; N: Absolute numbers – number of new cancer diagnoses; WSR: Age-Standardised Rate, using the World Standard Population (N/100,000 person-years)

Oesophageal resections for cancer

As described above, the number of oesophageal cancers will increase by 2025. It is nevertheless difficult to predict how many patients will be eligible for surgery in 2025. Therefore, we decided to assume the same percentage as currently (i.e. about 27.3% for the 2011-2013 period, see Table 73).

Oesophageal resections, all causes

To determine the number of oesophageal resections for all patients, we used the current percentage difference between the number of resections for cancer and the number of resections for all causes (i.e. +24.5% in the 2011-2013 period, see Table 73).

Table 73 – Estimated number of patients in 2025

	Base case estimate	Lower estimate	Upper estimate
Number of new diagnoses of oesophageal cancer	1 808	1 698	1 918
Number of oesophageal resections for cancer	493	463	523
Number of oesophageal resections, all causes	614	577	651

6.4.6.2 Patient management per reference centre in 2025

Table 74 shows the average number of patients that references centres could have to manage in 2025. If we limit the number of centres to the lower estimate obtained in the previous section (i.e. 4 centres), the number of resections per hospital as well as the total number of patients with an oesophageal cancer could become important and hospitals could not have enough capacity to manage all these patients, creating important waiting times.

[z] These projections were obtained from linear and log-linear Poisson regression models by extrapolating the observed incidence trends for the period 2004-2013. The projections of potential population growth published by Statistics Belgium were used for the evolutions in the population size and age distribution.[526]

Table 74 – Patients management in 2025 (base case estimates), according to the current number of reference centres

	Base case estimate	Average number of patients per reference centre in 2025				
Number of reference centres		4	5	6	7	11
Number of new diagnoses of oesophageal cancer	**1 808**	452	362	301	258	164
Number of oesophageal resections (patients with an oesophageal cancer)	**493**	123	99	82	70	45
Number of oesophageal resections (all patients)	**614**	153	123	102	88	56

6.5 Lung cancer

6.5.1 Description of the pathology

Lung cancer is amongst the most frequently diagnosed cancers. In 2013, it was the second most frequent malignancy in males and the third most frequent in females. Moreover, it is the leading cause of cancer death in males and the second one in females.[520] The two main types of lung cancer are non-small-cell lung cancer (NSCLC) and small-cell lung cancer (SCLC).

According to RARECARE, the most common sub-types are adenocarcinoma (48%), squamous cell carcinoma (28%), and poorly differentiated endocrine carcinoma (18%). Other are considered as rare (see Table 75).[520]

Because surgery is the main therapeutic option providing a chance to cure, it is important that as many patients as possible have access to surgery. Currently, surgery is generally the recommended treatment for patients with non-small cell lung cancer (NSCLC). Surgery may then be followed by chemotherapy. If surgery is not possible, radiotherapy, chemotherapy or a combination of both are used.

For small-cell lung cancer (SCLC), surgery is only used in a small proportion of cases (i.e. cases that are detected very early). In the 2010-2011 period, this concerned 2.3% of patients with SCLC (see Table 76). The usual treatment for small-cell lung cancer is chemotherapy, with or without radiotherapy.

There are three types of lung cancer surgery:

- Lobectomy: one or more large parts of the lung (called lobes) are removed.[546] A lobectomy is the preferred treatment for tumours confined to a single lobe.[505]
- Pneumonectomy: the entire lung is removed. This is usually used when the tumour is located in the middle of the lung or the cancer has spread throughout the lung.[546]
- Wedge resection or segmentectomy: a small piece of the lung is removed. This procedure is only suitable for a small number of patients, i.e. when the cancer is small and limited to one area of the lung (usually very early-stage non-small-cell lung cancer).[546]

In the most recent KCE guidelines on lung cancer, the following recommendations were made for primary surgery in early stage NSCLC (stage cI-II selected stage cIIIA cT3N1):[505]

- 'For patients with resectable NSCLC considered sufficiently fit, surgery aiming at complete resection (R0) is recommended. For tumours confined to a single lobe, a lobectomy is the preferred treatment (strong recommendation, not assigned level of evidence);
- In patients with resectable NSCLC undergoing surgery, at least lobe-specific systematic nodal dissection is recommended (weak recommendation, moderate level of evidence);
- For right sided tumours involving an adjacent lobe, a bilobectomy is recommended; for tumours involving the bronchial ostium and/or the pulmonary artery, a sleeve lobectomy is recommended rather than a pneumonectomy (weak recommendation, very low level of evidence);
- For fit patients with NSCLC limited to one lobe, sublobar resection (wedge resection or segmentectomy) is only recommended in the framework of a clinical trial (strong recommendation, very low level of evidence);
- For borderline fit patients with NSCLC limited to one lobe, treatment options such as wedge resection or segmentectomy, as well as radical radiotherapy (stereotactic radiotherapy is recommended), can be considered by a multidisciplinary team (weak recommendation, very low level of evidence);
- In patients with resectable NSCLC undergoing lobectomy, either video-assisted thoracoscopic surgery (VATS) or open surgery can be considered. VATS should only be performed by surgeons who are sufficiently trained (weak recommendation, low level of evidence).
- Lung cancer surgery should be carried out in high-volume centres specialised in thoracic surgery (weak recommendation, low level of evidence);
- Before deciding to operate, the multidisciplinary team should consider whether tumour-free resection margins can be achieved and what postoperative quality of life can be expected for the patient.'[505]

For some patients with stage IIIA-N2 disease considered resectable at the start of treatment, induction therapy followed by surgery can be considered. Surgery should also be considered for patients with NSCLC involving the parietal pleura or the chest wall if R0 resection is considered feasible.[505]

Table 75 – Epithelial tumours of lung by sub-entity, for 2009-2013

Sub-entities	N	CR
Squamous cell carcinoma with variants of lung	9 502	17.38
Adenocarcinoma with variants of lung	16 511	30.20
Adenosquamous carcinoma of lung	271	0.50
Large cell carcinoma of lung	1 732	3.17
==Poorly differentiated endocrine carcinoma of lung	6 200	11.34
Salivary gland type tumours of lung	45	0.08
Sarcomatoid carcinoma of lung	148	0.27

Source: Belgian Cancer Registry[520]
N: Absolute numbers - number of new cancer diagnoses registered between 2009-2013, CR: Crude (all ages) Rate (N/100 000 person-years)

Table 76 – Descriptive statistics of major surgery for patients diagnosed in 2010-2011

Category	All patients (N = 12 839)		NSCLC (N = 9 817)		SCLC (N = 2 004)	
	n	%	n	%	n	%
Major Surgery with curative intent	2 172	16.9	2 084	21.2	47	2.3
Total or partial lung excision with lymphadenectomy (227216-227220)	1 677	13.1	1 618	16.5	34	1.7
Total or partial lung excision (227253-227264)	404	3.1	367	3.7	17	0.8
Resection with anastomosis of bronchus or trachea (227275-227286)	139	1.1	135	1.4	2	0.1

Within 9 months after incidence date. Source: Vrijens 2016[499]

6.5.2 Burden of lung cancer in Belgium

For the 2009-2013 period, lung cancer (C34) was diagnosed in 39 908 new patients. An increase in the WSR age standardised rates can be observed across the years for females (from 20.89 in 2009 to 23.55 in 2013) and a decrease for males (from 56.19 in 2009 to 53.63 in 2013). Each year, the number of new diagnoses remained higher for males than for females (see Table 77).[524]

If we look at the absolute number of new diagnoses per age group of 5 years in 2013, lung cancer (C34) was most frequently diagnosed in the age group of 65-69 years old in both males and females. Moreover, in all age groups, lung cancer was more frequently diagnosed in males than in females (see Figure 75).[525]

The five-year survival for the 2009-2013 cohort was estimated at 15.8% for males and 22.6% for females.[520]

A KCE study performed in collaboration with the Belgian Cancer Registry for the 2010-2011 period on 12 839 patients with lung cancer (ICD-10: C34) showed that most of the specified tumours were located in the lower or upper lobe. Both males and females are most often diagnosed in advanced stages. In the 2010-2011 cohort of patients, half of the patients had a clinical stage IV (see Table 79).

Table 77 – Lung cancer (C34): absolute numbers per gender (N), 2009-2013

	2009	2010	2011	2012	2013
Males	5 520	5 662	5 657	5 813	5 725
Females	2 077	2 243	2 345	2 364	2 502

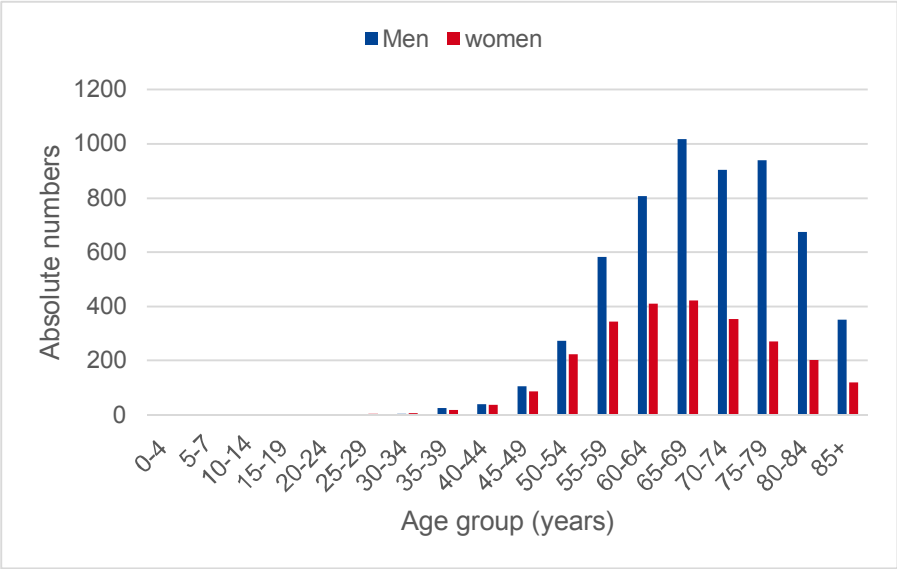
N: Absolute numbers - number of new cancer diagnoses registered in the period.
Source: Belgian Cancer Registry[524]

Table 78 – Lung cancer (C34): Age-Standardised Rate, using the World Standard Population (WSR), 2009-2013

	2009	2010	2011	2012	2013
Males	56.19	55.81	55.16	55.75	53.63
Females	20.89	22.07	22.56	22.44	23.55

WSR: Age-Standardised Rate, using the World Standard Population (N/100 000 person-years)
Source: Belgian Cancer Registry[524]

Figure 75 – Lung cancer (C34): absolute number of new diagnoses in 2013, gender distribution by age group



Source: Belgian Cancer Registry[525]

Table 79 – Lung cancer (C34): tumour localisation and distribution by disease stage, 2010-2011 period

	All patients (N = 12 839)		NSCLC (N = 9 817)		SCLC (N = 2 004)	
	n	%	n	%	n	%
Tumour localisation						
C34.0 Main Bronchus	773	6.0	501	5.1	231	11.5
C34.1 Upper Lobe, lung	4 699	36.6	3 669	37.4	619	30.9
C34.2 Middle Lobe, lung	448	3.5	344	3.5	65	3.2
C34.3 Lower Lobe, lung	2 399	18.7	1 930	19.7	295	14.7
C34.8 Overlapping lesion of lung	34	0.3	22	0.2	5	0.2
C34.9 Lung, Not otherwise specified	4 486	34.9	3 351	34.1	789	39.4
Tumour laterality						
Left	4 847	37.8	3 662	37.3	778	38.8
Right	6 553	51.0	5 083	51.8	948	47.3
Unknown	1 439	11.2	1 072	10.9	278	13.9
Clinical stage*						
X*	3 002	23.4	2 229	22.7	583	29.1
Non missing:						
I	1 412	14.4	1 107	14.6	48	3.4
II	748	7.6	619	8.2	69	4.9
III	2 535	25.8	1 987	26.2	378	26.6
IV	5 142	52.3	3 875	51.1	926	65.2
Pathological stage$						
X*	441	20.3	384	18.4	17	36.2
Non missing:						
I	972	56.2	952	56.0	20	66.7
II	481	27.8	475	27.9	6	20.0
III	234	13.5	230	13.5	3	10.0
IV	44	2.5	43	2.5	1	3.3

**X = missing category; The % for stages I, II, III and IV are computed excluding the X category; $ For 2 172 operated patients only*
Source: KCE report 266[499]

6.5.3 Current practice in Belgium

6.5.3.1 Number of surgical procedures per centre (all causes)

Table 80 presents the number of lung resections for all causes for the years 2009-2015. The average number of interventions per hospital increased from 25.1 in 2009 to 32.1 in 2015, mostly because of an increase in the number of lung resections. The median number of interventions also increased from 13.5 to 20 (see Table 80).[528]

In 2015, a total of 2 954 interventions was performed in 92 hospitals (see Table 80 and Figure 76). Half of the number of interventions was carried out by 13 hospitals.[528]

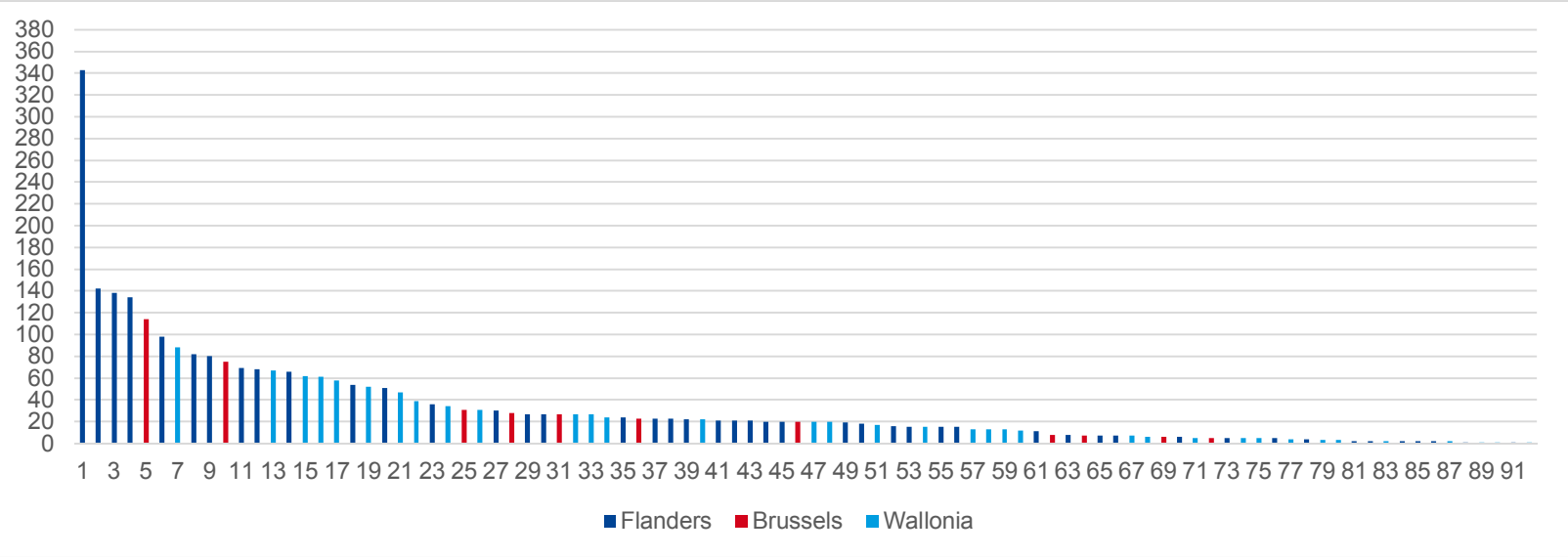
For the 2009-2013 period (to match the period for which data from the Belgian Cancer Registry are available), a total number of 12 195 lung resections were performed, i.e. an average of 2 439 interventions per year. A total of 100 hospitals performed at least one lung resection.[528]

Table 80 – Overview of lung resections (all causes) per hospital in the 2009-2015 period (latest year available)

	2009	2010	2011	2012	2013	2014	2015
Number of interventions	2 307	2 311	2 391	2 579	2 607	2 787	2 954
Number of hospitals*	92	93	93	95	95	92	92
Average	25.1	24.9	25.7	27.2	27.4	30.3	32.1
Median	13.5	15	15	15	15	17.5	20

*Source: Atlas AIM-IMA[528].*Some hospitals underwent a merger during the study period. The number of hospitals is based on the hospitals that were active at the end of the observation period, i.e. in 2015.*

Figure 76 – Number of lung resections (all causes) per hospital and per region in 2015



6.5.3.2 Number of surgical procedures for lung cancer per centre

Table 81 presents the number of lung resections for lung cancer for the years 2009-2013. During this period, a total number of 7 075 lung resections were performed for a cancer, i.e. an average of 1 415 interventions per year. A total of 94 hospitals performed at least one lung resection for cancer during this period.

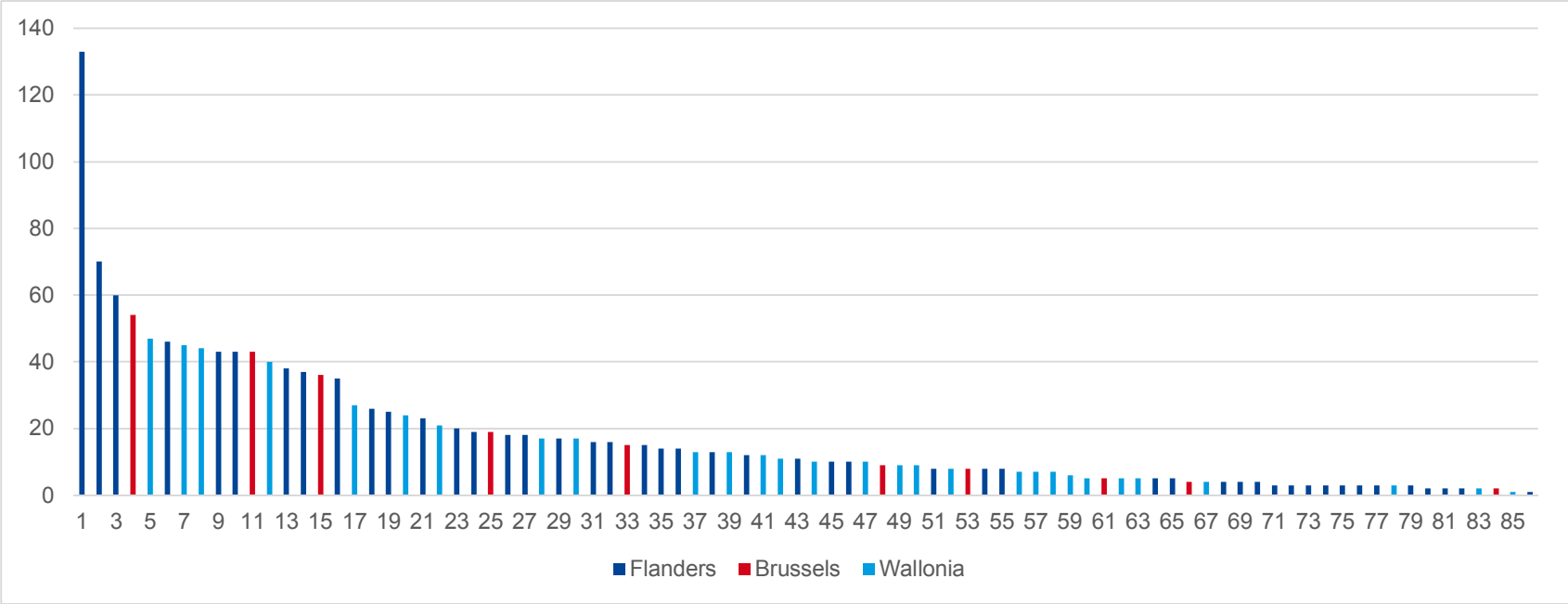
In 2013, a total of 1 503 interventions for cancer were performed in 86 hospitals, with an average of 17.5 and a median number of 10.5 interventions per hospital (see Table 81 and Figure 77). Half of the number of interventions was carried out by 15 hospitals.[524]

Table 81 – Overview of lung resections for lung cancer per hospital in the 2009-2013 period (latest year available)

	2009	2010	2011	2012	2013
Number of interventions	1 353	1 410	1 377	1 432	1 503
Number of hospitals	86	89	88	88	86
Average per hospital	15.7	15.8	15.6	16.3	17.5
Median	8.0	10.0	9.5	10.5	10.5

Source: Belgian Cancer Registry[524]

Figure 77 – Number of lung resections for cancer per hospital and per region in 2013



Source: Belgian Cancer Registry[524]

6.5.3.3 *Specific requirements per phase of the clinical pathway*

Lung cancer was not taken into account in the KCE report on rare and complex cancers.[494]

6.5.4 *International standards for lung resections*

6.5.4.1 *France*

In France, lung resections for cancer must be performed in hospitals that obtained the authorization to perform thoracic surgery for cancer (with a minimal threshold of 30 thoracic surgery interventions for cancer per centre per year). In 2015, 149 hospitals obtained such an authorization.[529] Because it was not clear what thoracic surgery encompasses, no extrapolation to the Belgian context was done.

6.5.4.2 *England*

The NHS England would like that all thoracic units carry out at least 150 lung cancer resections per year for 2018/19. They also added that no units should provide a lung cancer surgical service where less than 70 patients are treated per year and that the minimum population served by thoracic surgical units would need to be in the order of 1.5 million.[547]

To avoid too long waiting times for cancer care, it is also stated that lung cancer services must achieve;[532]

- a two week wait for all patients with a suspected cancer;
- 31 day wait from diagnosis to first treatment;
- 31 day wait to subsequent treatment;
- 62 day wait from urgent GP referral or screening referral or consultant upgrade to first treatment.

During the second quarter of 2016, 98% of patients with lung cancers received their first treatment within 31 days from diagnosis.[532]

If we look at current practice in England, there were 29 surgical resection units for the treatment of lung cancer in England (for a total number of 37 453 new cases of lung cancer in 2014 and a total population of 54 316 600, i.e. an average population of 1 872 986 per centre)[534, 548, 549] Applying these figures (29/37 453) to the Belgian context (with 8 452 new diagnoses in 2014)[524], gives 7 reference centres. Based on the total population, with a population of 11 311 117 in Belgium on January 2016,[530] would give 6 centres.

6.5.4.3 *The Netherlands*

The following requirements have been defined by the 2017 SONCOS standards for lung carcinoma:[512]

- At least two pulmonologists, two surgeons, one radiation oncologist, two radiologists/nuclear medicine specialists and one pathologist each with a proven expertise in lung cancer;
- Weekly multidisciplinary consultations with specified specialistsaa
- An adequate endoscopy service in which bronchoscopy and endobronchial ultrasound can be performed; with a minimum of 100 endoscopy per year on average for a 3 year period;
- Access to endo-oesophageal ultrasound.
- Access to urgent radiodiagnostic, with ultrasound, CT scan and angiography;

aa Pulmonologist, (lung and/or thoracic) surgeon, radiation oncologist, radiologist, pathologist, nuclear medicine specialist, case manager and/or oncology nurse and/or a nurse specialist in oncology and other nurses if necessary. There must be an option to consult a representative from the reference centre in this weekly meeting.

- Access to a nuclear medicine service with SPECT-CT and PET / CT.
- Access to (minimally invasive) diagnostics of the mediastinum;
- A time for diagnostics involving expansion to the mediastinum up to five weeks;
- A possibility to perform perioperative analysis of frozen sections;
- Access to molecular diagnostics in a standardised way via the Department of Pathology, with at least mutations, translocations and immunohistochemistry that are relevant to treatment
- Neo-adjuvant chemotherapy, chemoradiotherapy and stereotactic radiotherapy should be available, with a record of the service level;
- At least 50 new patients with lung cancer should be treated per year per centre;
- For surgery: At least 20 lung resections (segmental resection, lobectomy and pneumonectomy) per year per centre, performed by a certified lung surgeon or thoracic surgeon;
- In centres where lung resections are carried out:
  - It should be possible to perform a thoracotomy in emergency at all times;
  - There should be an access to an intensive care unit with personnel skilled in the care of patients following lung surgery;
- Both centres that treat lung cancer, perform lung resections and/or offer treatment with radiotherapy must participate in the respective national registers, i.e. the Dutch Lung Surgery Audit and the Dutch Lung Radiotherapy Audit.
- A centre that offers immunotherapy must meet the '*Nederlandse Vereniging van Artsen voor Longziekten en Tuberculose*' (NVALT) quality requirements and must participate in the NVALT 'Expensive Medicines' registration.

The Dutch Association for Thoracic Surgery (*Nederlandse Vereniging voor Thoraxchirurgie*, NVT) determined that hospitals should have at least two surgeons with specialized expertise. Concerning the minimum threshold, a distinction was made between lung surgeons (with a minimum threshold of 20 resections per year per team) and cardiothoracic surgeons (with a minimum threshold of 50 resections per year per team).

In 2014, 49 hospitals carried out lung resections for a total number of 12 168 new diagnoses of lung cancer (and a total population of 16 829 289, i.e. an average population of 343 455 per hospital).[458, 545] An extrapolation of these figures to the Belgian context (with 8 452 new diagnoses in 2014 or a population of 11 311 117 in 2016[524, 530]), corresponds with 34 or 33 centres, respectively.

Among these 49 hospitals, 36 hospitals had lung surgeons only, 10 had cardiothoracic surgeons only, and 3 had both lung and cardiothoracic surgeons. In 2014, the minimum threshold of 50 interventions per teams for cardiothoracic surgeons was respected in all centres while for lung surgeons, two centres did not respected the threshold of 20 interventions per team.[458]

It should also be noted that 3 of the 8 university hospitals are reference centres for thoracic surgery of central tumours.[538]

6.5.4.4 Denmark

In Denmark, resections for lung cancers (T4) must be performed in highly specialised services. In the new 2017 plan, 4 hospitals obtained such an authorization for a population of 5707 251 people (January 2016), i.e. an average population of 1 426 813 per service.[539, 540] To extrapolate this number of services to the Belgian situation, we used the number of new diagnosis of lung cancer (C34) in both countries in 2014 (more recent years not available). With 8 452 and 4 689 new diagnoses of oesophageal cancers (C34) in Belgium and in Denmark respectively, this would give 7 centres in Belgium.[524, 541] If the extrapolation was based on the total population in both countries (i.e. 5 707 251 versus 11 311 117 on January 2016),[530] we would obtain 8 centres.

6.5.4.5 *Summary of international standards*

Table 82 summarizes the standards for lung resections applied in France, England, the Netherlands and Denmark. Again, extrapolations to Belgium must nevertheless be used with caution because different definitions are used between countries and it was not clear to what extend thoracic surgery for cancer or lung cancer surgery differed. In France and in England, it seems than only lung cancer is considered. In the Netherlands, the SONCOS standards focus on cancer patients while the standards of the Dutch Association for Thoracic Surgery are determined for all patients (all causes surgery, with a threshold of 50 cardiothoracic surgeries).

Extrapolations to Belgium were based on the number of new diagnoses of lung cancer (C34) in all countries.

Table 82 – Recommendations related to 'specialized services' for lung cancer in France, England, the Netherlands, and Denmark

	Minimum population	Minimum threshold per centre per year	Number of services	Extrapolated to Belgium (based on the number of new diagnoses)
France				
• **Thoracic surgery for cancer**	-	30	149	31
England				
• **Lung cancer surgery**	1 500 000	70	35	7
The Netherlands				
• **Lung surgery**		20	39	NA
• **Cardiothoracic surgery**	-	20-50	13	NA
• **Total**		NA	49	34
Denmark				
• **Lung cancer surgery (T4)**		-	4	7

6.5.5 What is the required number of reference centres in 2017?

6.5.5.1 Scenarios on the number of patients undergoing a lung resection and on the period taken into account

As for pancreatic and oesophageal cancer, a number of scenarios were developed to identify the required number of reference centres. As for pancreatic surgery, these scenarios are based on a minimum volume of patients for oesophageal resections and on the period in which this minimum volume has to be achieved (the most recent year for which data are available and the average in the last three years).

Table 83 illustrates the number of patients taken into account according to the scenarios.

Table 83 – Number of patients undergoing lung resection surgery according to the scenario

	2011-2013	2013-2015	2013	2015
Number of new diagnoses of lung cancer	24 406 (yearly average: 8 135)	-	8 227	-
Number of lung resection (all patients)	7 577 (yearly average: 2 526)	8 348 (yearly average: 2 783) **(Scenario 2)**	2 607	2 954 **(Scenario 4)**
Number of lung resections for patients with a cancer	4 312 (yearly average: 1 437) **(Scenario 1)**	-	1 503 **(Scenario 3)**	-

(-) = not available. Source: BCR data[524] and Atlas IMA – AIM[528].

6.5.5.2 Minimum volume thresholds

A previous KCE report analysed the relationship between the hospital's surgical volume and outcomes for operated lung cancer patients. For this analysis, only NSCLC patients with unique tumours who underwent thoracic surgery with curative intent were included. To determine the surgical volume of hospitals, the number of unique patients diagnosed with lung cancer (including patients with multiple tumours) between 2009-2011 undergoing surgeries with curative intent within 9 months after incidence during the years 2010-2011 were counted. To obtain an annual surgical volume for each hospital, this number was then divided by two.[499]

Based on expert opinion, centres were then categorized as:

- Very low-volume centres: less than 10 patients per year
- Low-volume centres: between 10 and 19 patients per year
- Medium-volume centres: between 20 and 39 patients per year
- High-volume centres: at least 40 patients per year

To assess the relation between volumes and outcomes, statistical modelling was used (logistic regression on odds ratios for 60-day mortality and multivariate analyses using Cox proportional hazard models for overall (observed) 1-year and 3-year survival). Adjustments for potential confounders were done: sex, age group, histological subtype, sub-localization, combined stage, number of days of hospitalization prior to lung cancer diagnosis, WHO performance status and comorbidities (see the KCE report 266 for more details).[499]

The analysis showed that 1-year and 3-year survival rates are higher in high-volume centres, but the results at three years are less pronounced. The effect of surgical volume on post-operative mortality is not demonstrated, except for very low-volume centres (<10) which display worse results than other centres.[499]

Based on these results and according to the opinion of experts within the RIZIV-INAMI working group reflecting on the elaboration of conventions for these reference centres, a threshold of 20 interventions per centre per year and of 10 interventions per physician per year was chosen.

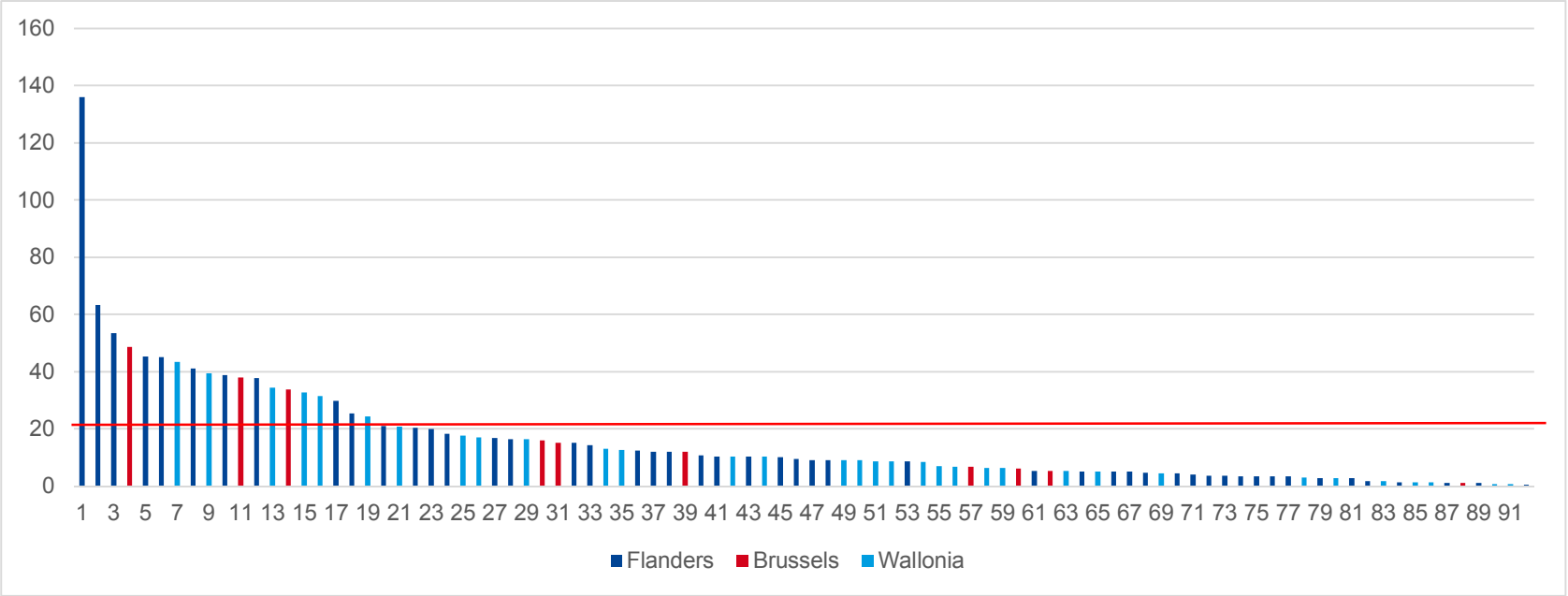
6.5.5.3 Number of reference centres

Base case: number of required reference centres based on the number of lung resection procedures for lung cancer (2011-2013)

Criterion for the surgical volume

As shown in Figure 78, 23 hospitals respected an average number of 20 lung resections per year for the 2011-2013 period (13 in Flanders, 7 in Wallonia, and 3 in Brussels).

Figure 78 – Average yearly number of lung resections for a lung cancer per hospital, 2011-2013



Source: Belgian Cancer Registry[524]

Criterion for the number of surgeons

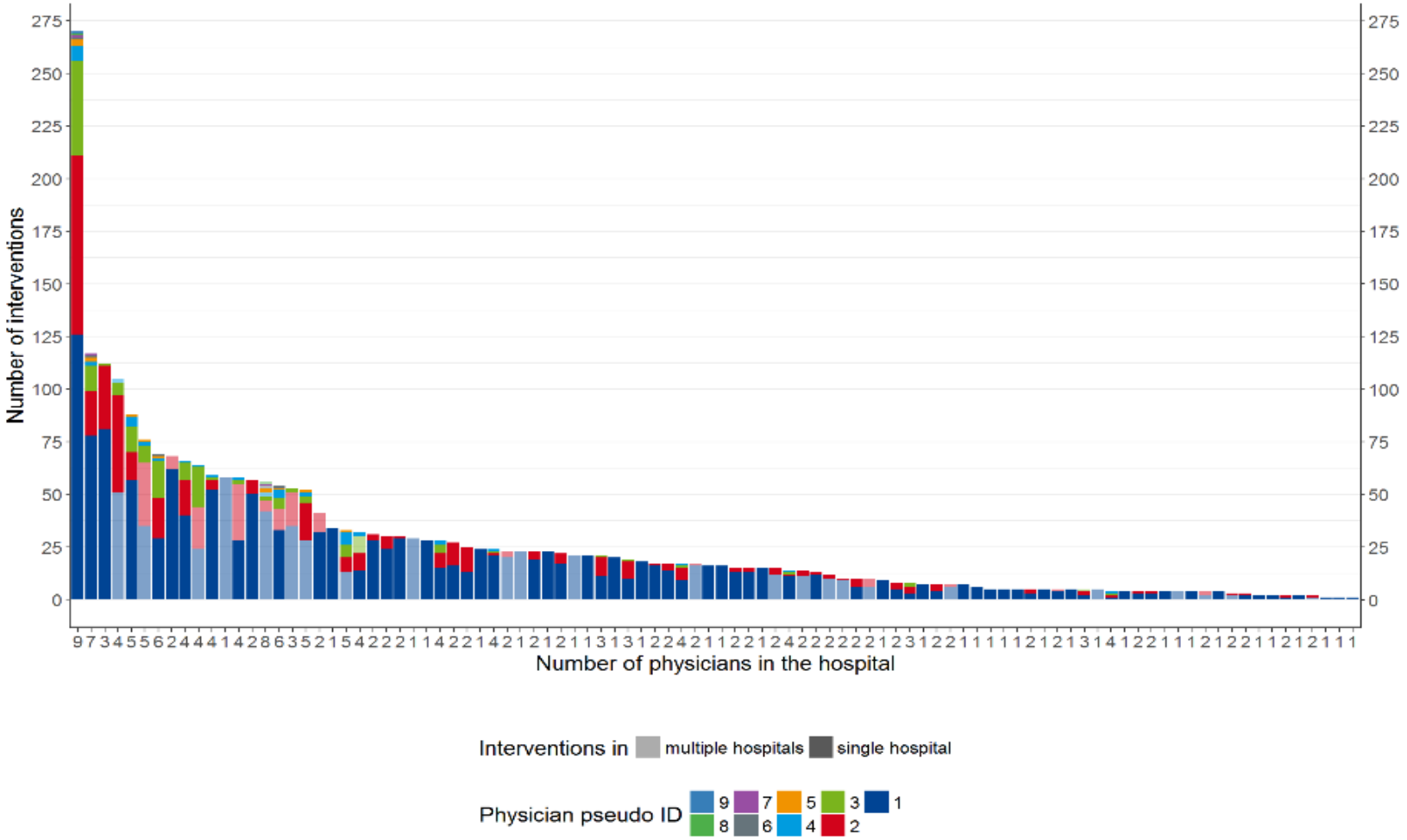
For lung cancer, there were no recommendations in terms of minimum number of surgeons that should perform lung resection. Nevertheless, it should be noted that if a minimum of two surgeons is considered as appropriate (e.g. because of continuity of care, to ensure that the centre does not depend of one surgeon), this was not respected in all hospitals in 2013 (not respected in 9 out of 40 hospitals that had at least 20 interventions (for all causes, i.e. not only for cancer, see Figure 79). Moreover, among these hospitals, only 12 had at least 2 surgeons that performed at least 10 interventions.

Criteria for patient management

No criteria on patient management were defined but with 23 reference centres and an average of 8 135 patients newly diagnosed during the 2011-2013 period, this will give an average number of 354 patients to manage per centre, assuming an equal distribution of patients between centres and assuming that all patients with a lung cancer should have a contact with the reference centre, at least for a second opinion (e.g. concerning the diagnostic or the need for surgery).

Because we have no details on what would be the patients distribution in the reality, further analyses are not possible.

Figure 79 – Number of physicians per hospital performing lung resections (all causes), in 2013



Only interventions with norm code 0 or 5 (second intervention in same session) are taken into account. Interventions with norm code 1 or 2 are not retained as they indicate assistance to an intervention by another physician (56.2% of interventions have a reimbursed assistance). Source: RIZIV – INAMI data.

Other scenarios

As shown in Table 84, the number of reference centres required varies between 7 and 48 according to the scenario. Table 85 nevertheless shows that with a limited number of reference centres (i.e. 7, based on extrapolations from England and Denmark), the number of patients to manage could be important, creating important waiting times.

Table 84 – Number of reference centres required for lung resections according to the scenario

	Number of reference centres			
	Flanders	Brussels	Wallonia	Total
Scenario 1: 20 lung resections for patients with a cancer (2011-2013)	13	3	7	**23**
Scenario 2: 20 lung resections (all patients; 2013-2015)	21	6	15	**42**
Scenario 3: 20 lung resections for patients with a cancer (2013)	13	3	7	**23**
Scenario 4: 20 lung resections (all patients; 2015)	25	7	16	**48**
Extrapolation from England (see section 6.5.4)	-	-	-	**7**
Extrapolation from France (see section 6.5.4)	-	-	-	**-**
Extrapolation from the Netherlands (see section 6.5.4)	-	-	-	**34**
Extrapolation from Denmark (see section 6.5.4)	-	-	-	7

Table 85 – Average number of patients according to the number of reference centres (assuming an equal distribution weight)

	Average number per year (2011-2013 period)	Average number per year, per reference centre				
Number of reference centres		7	23	34	42	48
Number of new diagnoses of lung cancer	**8 135**	1 162	354	239	194	169
Number of lung resections (all patients)	**2 526**	361	110	74	60	53
Number of lung resections (for lung cancer)	**1 437**	205	62	42	34	30

6.5.6 What is the future number of required reference centres (horizon 2025)?

6.5.6.1 Expected evolution for 2025

Patients with a new diagnosis of lung cancer

According to the Belgian Cancer registry, the number of patients diagnosed with lung cancer (C34) is expected to rise from 8 227 in 2013 to around 10 700 by 2025[bb] (10 693; 95% CI: 10 271-11 114). They specified that 'although the lung cancer incidence risk is decreasing over time for males, the number of projected cancer diagnoses still increases due to the ageing and growth of the population. The cancer incidence risk in females is increasing over time, together with an ageing and growing population resulting in a much stronger increase in the projected number of lung cancer diagnoses compared to males.'[520]

Table 86 – Projection for 2025

	N [95%CI] Males	WSR [95%CI] Males	N [95%CI] Females	WSR [95%CI] Females
Lung (C34)	6 525 [6 284; 6 765]	48.5 [46.8; 50.2]	4168 [3987; 4349]	33.7 [32.3; 35.2]

Source: Belgian Cancer Registry[520]; N: Absolute numbers - number of new cancer diagnoses; WSR: Age-Standardised Rate, using the World Standard Population (N/100 000 person-years)

Lung resections for cancer

As described above, the number of lung cancers will increase by 2025. It is nevertheless difficult to predict how many patients will be eligible for surgery in 2025. Therefore, we decided to assume the same percentage as currently (i.e. about 18.2% for the 2011-2013 period, see Table 87).

Lung resections, all causes

To determine the number of lung resections for all patients, we used the current percentage difference between the number of resections for cancer and the number of resections for all causes (i.e. +75.7% in the 2011-2013 period, see Table 87).

Table 87 – Estimated number of patients in 2025

	Base case estimate	Lower estimate	Upper estimate
Number of new diagnoses of lung cancer	10 693	10 271	11 114
Number of lung resections for cancer	1 943	1 866	2 019
Number of lung resections, all causes	3 414	3 279	3 549

[bb] These projections were obtained from linear and log-linear Poisson regression models by extrapolating the observed incidence trends for the period 2004-2013. The projections of potential population growth published by Statistics Belgium were used for the evolutions in the population size and age distribution.[520]

6.5.6.2 *Patient management per reference centre in 2025*

Table 88 shows the average number of patients that references centres could have to manage in 2025. If we limit the number of centres to the lower estimate obtained in the previous section (i.e. 7 centres), the number of resections per hospital as well as the total number of patients with a lung cancer could become important and hospitals could not have enough capacity to manage all these patients, creating important waiting times.

Table 88 – Patients management in 2025 (base case estimates), according to the current number of reference centres

	Base case estimate	Average number of patients per reference centre in 2025				
Number of reference centres		**7**	**23**	**34**	**42**	**48**
Number of new diagnoses of lung cancer	10 693	1 528	465	315	255	223
Number of lung resections (for lung cancer)	1 943	278	84	57	46	40
Number of lung resections (all patients)	3 414	488	148	100	81	71

7 RADIOTHERAPY SERVICES

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7.1 Introduction

Radiotherapy is an example of a high-cost medical service requiring large investments and input from specialised staff. The aim of this in-depth study is to measure the current infrastructure situation of radiotherapy departments in Belgium (availability) and then to assess the current and future radiotherapy treatment and resource needs as a function of current and future cancer incidence data and (optimal) radiotherapy utilisation rates.

In order to carry out this analysis, information from different data sets was combined. The main source of information came from data collected through a quality indicator project (QI project) of the Belgian Federal College for Physicians in Radiation-Oncology. In addition, the analysis used data from the National Institute for Health and Disability Insurance (RIZIV – INAMI, period 2005-2015) and data originating from the BELdARt project[cc]. Current and future cancer incidence data were made available through the Belgian Cancer Registry.

[cc] Project emanating from the collaboration between the Nuclear Technologic Center (NuTeC), the College for Physicians in Radiation-Oncology and the Belgian Hospital Physicists Association (BHPA), which encompassed a basic audit of each clinical EBRT device in all Belgian radiotherapy departments.

Box 26 – Radiotherapy: some definitions

EBRT: External Beam Radiotherapy. Use of high energy X-ray beams such as photon and electron beams delivered through equipment located outside of the patient.

IORT: Intraoperative Radiation Therapy. Treatment modality delivering high dose radiotherapy to the tumour bed during surgery.

BR: Brachytherapy. Internal radiation where one or more radioactive sources are placed in or close to target volume, limiting the dose to the healthy tissues.

Orthovoltage radiotherapy. X-rays with low energy, used to irradiate the skin or superficial tumours.

SBRT: Stereotactic Body Radiation Therapy. SBRT uses X-rays for stereotactic positioning and sometimes implanted markers to give a very high irradiation dose to a very precise target, maximally sparing health tissue.

IGRT: Image-guided radiotherapy. The use of two and/or three dimensional imaging, during the course of a radiation therapy treatment, in order to verify and correct for patient setup and to precisely deliver the radiation therapy treatment.

3D-CRT: 3D conformal radiotherapy. External radiotherapy technique that uses three-dimensional image information (e.g. CT scan) to optimise the size, shape and energy of the radiation beams as best as possible to the location and shape of the target volume, and to maximize the saving of the healthy tissues.

IMRT: Intensity Modulated Radiation Therapy. Further refinement of 3D-CRT, with the radiation intensity of the radiation beams being modulated to the density of the irradiated tissues, in order to better conform the irradiation to the irradiated target volume with maximum dose savings on the healthy tissues.

7.2 Availability – current situation in Belgium

7.2.1 Programming and licensing rules for radiotherapy departments

Belgian legislation contains provisions on licensing standards for radiotherapy departments and equipment (section 7.2.1.1). In addition, programming standards establish the maximum number of radiotherapy departments (section 7.2.1.5).

7.2.1.1 Licensing rules for major medical equipment and major medico-technical services

Definition of major medical equipment and medico-technical services

Article 51 of the Hospital Act[550] defines major (or heavy) medical equipment as equipment for diagnosis or treatment that is expensive because of the purchase price or because of the expensive operating costs (i.e. requiring highly specialised personnel).

The list of major medical equipment is defined by the Royal Decree (RD) of 25 April 2014[551] listing these technologies: Computer Tomography (CT); Single Photon Emission Computed Tomography (SPECT)-CT; Positron Emission Tomography (PET)-CT; Magnetic Resonance Imaging (MRI), 'extremity only' included; Positron Emission Tomography in combination with Magnetic Resonance Imaging (PET-MRI); and radiotherapy equipment that uses (the emission of) photons, proton beams or carbon ions.

Already in 1976 a Royal Decree determined which equipment could be considered as major medical equipment (RD of 16 June 1976). However, because not only the equipment but also the context in which the equipment is used determines whether certain activity is expensive or not, the legislator decided to also regulate medical and medico-technical services. The RD of 5 April 1991[552] lays down the standards to be met by a radiotherapy department in order to be licensed as a major medico-technical service. The term 'major' was however removed from the title of the RD of 5 April 1991 by the RD of 17 September 2005. The paragraphs below give a brief overview of the infrastructural and functional requirements as described by the RD of 5 April 1991[dd].

Infrastructural requirements

The radiotherapy department should be located within a general hospital and be in possession of:

- Irradiation unit: this unit allows the delivery of external beam radiation treatments (EBRT) through the use of external beam radiotherapy devices, of which the most commonly used are known as LINACs (linear accelerators). In addition, it should include a mould room, areas for clinical examination adjacent to the treatment machines, simulation and treatment planning rooms, as well as administrative and storage facilities;
- Consultation unit: this unit comprises an area reserved of patient consultation before, during and after treatment (follow-up);
- Hospitalisation unit: care units should be available for radiotherapy patients needing to be hospitalized;
- Brachytherapy unit: an application room and care unit meeting the radiation protection requirements should be available, along with adequate technical space for storage and handling of the radioactive sources.

dd These norms are currently under review and updated by a Task Group representing all National Radiotherapy Societies and under the responsibility of the Belgische Vereniging voor Radiotherapie-Oncologie vzw / Association Belge de Radiothérapie-Oncologie asbl, in collaboration with the Agence Fédérale de Contrôle Nucléaire/ Federaal Agentschap voor Nucleaire Controle.

Functional requirements

The radiotherapy department also has to respect the regulation concerning its equipment, documentation system and staffing levels.

7.2.1.2 Equipment

The radiotherapy department should have a minimum of two EBRT machines (LINACs and/or a cobalt unit) and a device for surface and contact therapy. The department also needs equipment for localisation, patient immobilization and treatment planning, including a simulator, hard- and software to define the spatial distribution of individual patient doses (i.e. a planning system) and dosimetric equipment. Furthermore, the department should have the necessary equipment to deliver brachytherapy.

7.2.1.3 Documentation management

Data regarding the patient's radiation treatment must be recorded and saved. This includes the data of the treatment itself but also the medical history and clinically relevant information.

7.2.1.4 Staffing levels

The RD also describes the minimal staffing levels required for a radiotherapy department to be authorized to deliver radiotherapy treatments. This concerns the specialized medical staff (accredited specialists in radiotherapy) including the head of department, the physicists and/or engineers specialised in medical physics and technical staff and the nursing and administrative staff.

Satellite centres

The Royal Decree of 5 April 1991 (Art.3 § 1bis) allows radiotherapy departments to operate a satellite radiotherapy centre, based in another hospital that does not hold the license for radiotherapy. This is possible only under strict conditions which are as follows:

- There should be an official collaboration agreement between the two involved hospitals;
- There should be a common head of department;
- The satellite should have at least two LINACs (amended by the RD of 17 September 2005)[553] and
- In one of the involved centres (satellite or not), there should be a minimum of 500 new patients per year.

7.2.1.5 Programming standards establish the maximum number of radiotherapy departments

Programming standards are defined in the RD of 9 July 2000: the number of radiotherapy departments is limited to the number of departments licensed at the date the RD came into effect (30 August 2000). There is, however, one exception, that is if no other radiotherapy department is located in the same province and the distance between the concerned location and any other radiotherapy department is at least 50 km (amended by the RD of 12 February 2001).[554] This exception relates only to satellite centres.

A hospital association with several radiotherapy sites is considered as one radiotherapy department (RD of 1 August 2006).

7.2.2 Current legislation concerning reimbursement

Belgian radiotherapy departments are considered as 'major medico-technical services' as stated by the RD of 25 April 2014[551]. They are financed through parts B3 and A3 of the hospital budget, called the Budget of Financial Means (see Box 27); and through billing of radiotherapy related activities.

Box 27 – The Budget of Financial Means (BFM)

Non-medical hospital services such as services for accommodation, accident and emergency services, and nursing activities provided during an inpatient stay or a surgical day stay are paid for by a budget. A national hospital budget, which is a closed-ended budget, is defined annually by Royal Decree. The BFM consists of three major parts: part A covers capital and investment costs (transferred to the federated authorities since the 6th State reform); part B covers operational costs; and part C covers some corrections (positive or negative) of budgets for past financial years. Parts A, B and C each consist of subparts of which subparts B3 and A3 are relevant for radiotherapy departments.

Subpart B3 covers the costs of nursing and technical personnel, administrative and general costs, cost of consumables, equipment and facility maintenance costs. A3 financing aims to cover the investment costs of part of the medical equipment. Only LINACs are financed, for a period of up to 10 years, yet the amount of € 90 000 annually is insufficient to cover the entire investment. Moreover, the financing is limited to a maximum number of EBRT devices per department, depending on the activity level of the department. Other necessary equipment such as (CT) simulators, planning and operating systems or brachytherapy equipment is not financed. The lack of coverage for investment and for operational costs is typically cross-financed through the honoraria. As a rule of thumb, it can be stated that only one fourth of a radiotherapy department financing comes through the hospital budget, whereas the remainder comes from the physician fees (KCE Report 198).[555]

These fees - or billing of radiotherapy related activities - are performed using codes managed by the National Institute for Health and Disability Insurance (RIZIV – INAMI)[ee]. An overview of the current billing codes can be found in Table A. 2 in Appendix.

7.2.3 Radiotherapy infrastructure in Belgium

The current availability and distribution of radiotherapy departments and equipment are described in the following sections. The presented data is primarily based on the 2016 data collected through the Quality Indicator Project of the Belgian Federal College for Physicians in Radiation-Oncology.

7.2.3.1 Number of hospitals with a radiotherapy department

Radiotherapy departments with EBRT machines

In January 2017, a total of 25 hospitals had a license number authorizing them to operate a radiotherapy department. However, in 2015, two hospitals (Sint Augustinus Ziekenhuis of the GZA – Gasthuis Zusters Antwerpen and Middelheim Ziekenhuis of the ZNA – Ziekenhuis Netwerk Antwerpen) - each holding a license - concluded a 'hospital association' for their radiotherapy departments. This hospital association, called the Iridium Kankernetwerk Antwerpen, and possessing two licence numbers, is now composed of one primary hospital and four satellite centres.

As a consequence, the actual Belgian radiotherapy landscape consists of 24 primary radiotherapy departments that operate a total of 72 EBRT devices. In addition, there are 13 satellite centres with in total 18 EBRT devices. This results in a total of 90 EBRT devices for Belgium operating in 37 different locations (see Table 89).

ee The billing codes are currently under review.

Of this total number of EBRT devices, 87 are LINACs and three are dedicated stereotactic devices. Two of these dedicated stereotactic devices are located in the primary centre, namely a Cyberknife® in CHU Liège and a VERO® in UZ Brussel. The third dedicated stereotactic device is the Gammaknife® from Bordet, located in the satellite site Erasme.

The geographical spread of these radiotherapy departments, along with their size and associations, is visualized in Figure 80. This figure demonstrates that the different radiotherapy departments (primary centres + satellites) are quite well spread across Belgium with a slight exception for the Luxembourg region in which there is only one satellite centre with one LINAC available for the entire region.

When looking at the proportion of hospital sites in which radiotherapy equipment is available, this varies across the regions as demonstrated in Table 90. Only hospital sites with C, D or CD beds are included. This choice was made to exclude for example hospital sites with only geriatric of rehabilitation beds or sites with only a polyclinic. The data show that Brussels is the region with the highest proportion of hospital sites having an integrated radiotherapy department (41.2%) while Flanders is the region with the lowest proportion (21.8%).

Table 89 – Number of EBRT devices per region/per city/per hospital

Number of EBRT devices	Number of EBRT devices primary hospital	Number of EBRT devices satellite	Primary hospital to which the satellite is associated	Total number of EBRT devices
Brussels region	**18**	**1**		**19**
CHIREC – Edith Cavell	2			
Clinique St Jean	2			
Cliniques Universitaires St Luc	3			
Europaziekenhuizen – St Elisabeth	2			
Institut Jules Bordet	4			
Erasme		1*	Institut Jules Bordet	
UZ Brussel/Campus Jette	5*			
Flemish region	**36**	**10**		**46**
Aalst	**4**	**2**		**6**
Onze Lieve Vrouw Ziekenhuis	4			
Algemeen Stedelijk Ziekenhuis		2	UZ Brussel	2

Antwerpen	**4**	**4**		**8**
St Augustinus – GZA[1]	**4**			
Middelheim Ziekenhuis – ZNA[1]		2	St Augustinus	
Jan Palfijn – ZNA[1]		1	St Augustinus	
KLINA[1]		1	St Augustinus	
Brugge	**3**			**3**
AZ Sint Jan	3			
Duffel	**2**			**2**
AZ Sint-Maarten	2			
Genk		**2**		**2**
Ziekenhuis Oost-Limburg/Campus Sint-Jan[2]		2	Jessa Ziekenhuis	
Gent	**8**			**8**
AZ Sint-Lucas	4			
UZ Gent	4			
Hasselt	**3**			**3**
Jessa Ziekenhuis/Campus Virga Jesse[2]	3			3
Kortrijk	**3**			**3**
AZ Groeninge	3			3
Leuven	**5**			**5**
UZ Gasthuisberg	5			5
Roeselare	**2**			**2**
AZ Delta	2			
Turnhout	**2**			**2**
AZ Turnhout/Campus Sint-Elisabeth	2			
Sint-Niklaas		**2**		**2**
AZ Nikolaas[1]		2	St Augustinus	

Walloon region	**18**	**7**		**25**
Baudour	**2**			**2**
EpiCURA - Clinique Louis Caty	2			
Charleroi	**4**			**4**
CHU André Vésale	2			
Grand Hôpital de Charleroi/Site Saint Joseph	2			
La Louvière	**2**	**1**		**3**
Centre Hospitalier de Jolimont	2			
CHU Tivoli		1	CHU André Vésale	
Libramont		**1**		**1**
CHA Vivalia		1	CHU Liège	
Liège	**3**	**2**		**5**
CHU Liège	3*			
CHC Saint Joseph		1	CHU Liège	
CHR Citadelle		1	CHU Liège	
Mouscron		**2**		**2**
CH de Mouscron		2	Clinique et Maternité Saint Elisabeth	
Namur	**4**			**4**
Clinique et Maternité Saint Elisabeth	4			
Ottignies		**1**		**1**
Clinique St Pierre Ottignies		1	Cliniques Universitaires St Luc	
Verviers	**3**			**3**
CHR Verviers	3			
Overall total amount of LINACs	**72**	**18**		**90**

*Source: QI Project; EBRT: External Beam Radiotherapy; *: departments possessing dedicated stereotactic equipment); [1]: departments associated to form Iridium Kankernetwerk Antwerpen; [2]: Jessaziekenhuis and Ziekenhuis Oost Limburg are associated through Limburgs Oncologisch Centrum*

Figure 80 – Geographical spread of radiotherapy departments across Belgium

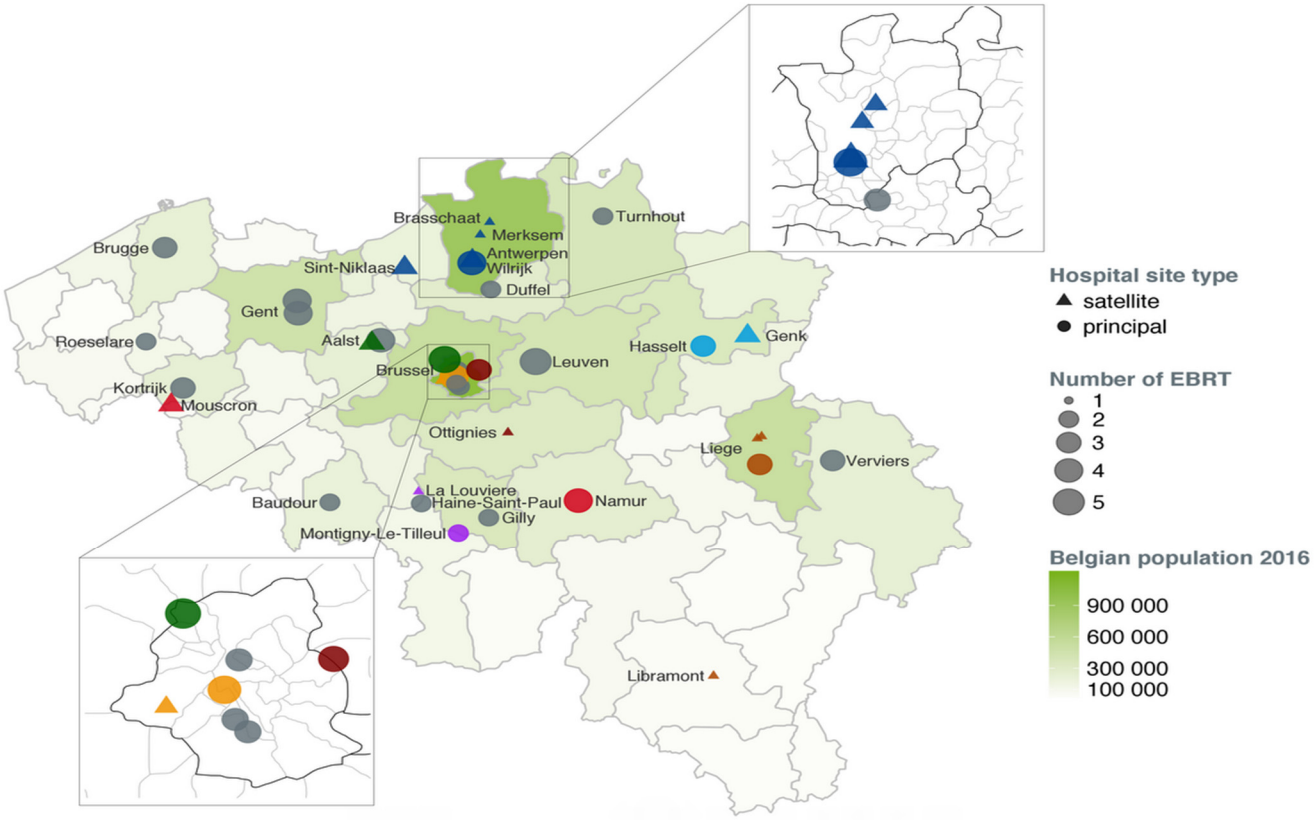


Figure illustrating the geographical distribution of radiotherapy departments taking into account the population density, the size of the radiotherapy department (number of EBRT devices/department) and the association between the primary department and their satellites (colour coding)

Table 90 – Proportion of radiotherapy departments integrated within an acute hospital site

Region	Number of radiotherapy departments	Number of acute hospital sites*	Proportion of hospital sites with integrated RO access
Brussels region	*7*	*17*	*41.2%*
Walloon region	*13*	*52*	*25.0%*
Flemish region	*17*	*78*	*21.8%*
Total	***37***	***147***	***25.2%***

Source: Federal Public Service (FPS) Health, Food Chain Safety and Environment;
** Only hospital sites with C, D or CDs bed are included; RO = radiation oncology*

Radiotherapy departments with IORT devices

Some radiotherapy departments have also invested in the acquisition of intraoperative radiation therapy devices (IORT), which allow the delivery of a high dose of radiation to the tumour bed during operative procedures. Currently, the most typical indication for these IORT devices is breast-conserving radiotherapy for early-stage breast cancer. These types of devices can be found in six hospitals, one of which is a satellite centre. The highest number of these IORT devices is found in the Flemish region (four devices in primary centres). The two remaining devices are found in the Walloon (one satellite centre) and Brussels (one primary centre) region.

Radiotherapy departments with brachytherapy

It is also worthwhile mentioning that 17 primary radiotherapy departments are delivering brachytherapy (BT) treatments. Two are located in Brussels, 11 are located in the Flemish region and four in the Walloon region. BT can be delivered through afterloading devices, or with temporary or permanent implants of radioactive sources. To date, no database provides an overview of the BT afterloaders across Belgium.

Radiotherapy departments with orthovoltage equipment

A total of seven orthovoltage devices are still available of which two are not clinically used. Of the five remaining ones, two are located in the Flemish region, one in Brussels and two in the Walloon region.

7.2.3.2 Number of EBRT devices per radiotherapy department

As demonstrated in age number of EBRT devices per primary radiotherapy department is 3.8. There are, however, regional variations with the average number being 3.7, 3.4 and 4.0 EBRT devices per department in the Brussels, Walloon and Flemish region respectively (and keeping in mind that two of the Brussels' departments have satellite centres located outside of the Brussels region). When analysing the number of EBRT devices per individual radiotherapy site, the mean decreases to 2.4 EBRT devices per hospital site. Furthermore, the analysis demonstrates a mean number of 1.4 EBRT devices per satellite centre. Indeed 37% of satellite centres (n=5) only possess one EBRT device – the remainder possessing two EBRT devices. The inclusion of IORT devices only has a minor effect on these numbers.

Table 91 – Number of EBRT devices per radiotherapy department

	Total	Brussels region	Walloon region	Flemish region
Mean number of EBRT devices/primary hospital*	3.8 (4.0)	3.7 (3.8)	3.4 (3.6)	4.0 (4.4)
Mean number of EBRT devices/hospital site	2.4 (2.5)	2.7 (2.9)	1.9 (2.0)	2.6 (2.8)
Mean number of EBRT devices/satellite	1.4 (1.5)	1 (1)	1.2 (1.3)	1.7 (1.7)

Numbers between brackets: number of EBRT devices including IORT devices

** The equipment of the two satellites sites located in regions other than that of their primary hospital, were included in the mean number of EBRT devices of the primary hospital's region (= Brussels region).*

7.2.3.3 Types of EBRT devices

Image Guided Radiation Therapy (IGRT) capability

Image guided radiotherapy is an important modality of state-of-the-art radiotherapy, as image guidance allows for verification of the target volume position, which again is a prerequisite for precise treatment delivery. Based upon the collection of Quality Indicator Data *of the Belgian* Federal *College for Physicians in Radiation-Oncology* (QI project) for 2016, all equipment is equipped for IGRT, with 96.6% of the equipment capable of MV (megavoltage) imaging and 64.4% capable of kV (kilovoltage) imaging (Table 92). More than two thirds or 71.3% of the equipment is also capable of performing volumetric IGRT which allows for the acquisition of 3D imaging for patient positioning verification. Nevertheless, there is less kV imaging available In the Brussels region compared to the Flemish and Walloon region (35.3% versus 69.6% and 70.8% respectively). A small number of EBRT devices are also capable of performing other types of imaging such as surface imaging.

Intensity Modulated Radiation Therapy (IMRT) capability

Intensity modulated radiotherapy is a treatment technique which allows to precisely conform the dose to the target volume, resulting in higher doses being delivered to the target volume while minimising the dose to the adjacent healthy tissues. It is considered state-of-the-art for a number of clinical indications, such as prostate and head and neck cancer. EBRT devices in the Brussels region have overall a lower capability to deliver static as well as rotational IMRT. Whereas static IMRT is available on more than 95% of EBRT devices in both Flanders and Wallonia, in the latter region the number of EBRT devices amenable to rotational IMRT is about 10% higher than in the Flemish region (Table 92).

Table 92 – Technical capabilities of EBRT equipment

Sites	Number of equipment (LINACs only)	IGRT capabilities				IMRT capabilities	
		MV imaging	kV imaging	Volumetric imaging	Other imaging	Static IMRT	Rotational IMRT
Brussels region	17	94.1%	35.3%	64.7%	17.6%	76.5%	64.7%
Brussels	**17**	**16**	**6**	**8**	**3**	**13**	**11**
CHIREC – Edith Cavell	2	2	0	0	0	2	0
Clinique St Jean	2	2	1	1	0	1	1
Cliniques Universitaires St Luc	3	3	1	2	1	2	3
Europaziekenhuizen – Sint- Elisabeth	2	2	0	2	0	2	2
Institut Jules Bordet	4	4	3	3	0	4	2
UZ Brussel/Campus Jette	4	3	1	3	2	2	3
Flemish region	46	93.5%	69.6%	69.6%	10.9%	93.5%	71.7%
Aalst	**6**	**4**	**3**	**2**	**3**	**5**	**3**
Onze Lieve Vrouw Ziekenhuis	4	4	2	1	1	4	2
Algemeen Stedelijk Ziekenhuis	2	0	1	1	2	1	1
Antwerpen	**8**	**8**	**6**	**6**	**0**	**8**	**6**
AZ Klina	1	1	1	1	0	1	1
GZA Sint-Augustinus	4	4	3	3	0	4	3
ZNA Jan Palfijn	1	1	1	1	0	1	1
ZNA Middelheim	2	2	1	1	0	2	1
Brugge	**3**	**3**	**2**	**1**	**0**	**3**	**2**
AZ Sint-Jan	3	3	2	1	0	3	2
Duffel	**2**	**2**	**1**	**1**	**0**	**2**	**2**
AZ Sint-Maarten	2	2	1	1	0	2	2
Genk	**2**	**2**	**2**	**2**	**0**	**2**	**2**
Ziekenhuis Oost-Limburg/Campus St-Jan	2	2	2	2	0	2	2
Gent	**8**	**8**	**6**	**6**	**0**	**7**	**7**
AZ Sint-Lucas	4	4	2	2	0	3	3
UZ Gent	4	4	4	4	0	4	4

Hasselt	**3**	**3**	**3**	**3**	**0**	**3**	**3**
Jessa Ziekenhuis/Campus Virga Jesse	3	3	3	3	0	3	3
Kortrijk	**3**	**3**	**2**	**2**	**1**	**3**	**2**
AZ Groeninge	3	3	2	2	1	3	2
Leuven	**5**	**5**	**5**	**5**	**1**	**5**	**4**
UZ Gasthuisberg	5	5	5	5	1	5	4
Roeselare	**2**	**2**	**2**	**2**	**0**	**2**	**1**
AZ Delta	2	2	2	2	0	2	1
Turnhout	**2**	**2**	**0**	**2**	**0**	**2**	**1**
AZ Turnhout – Campus Sint-Elisabeth	2	2	0	2	0	2	1
Sint-Niklaas	**2**	**2**	**1**	**1**	**0**	**2**	**1**
AZ Nikolaas	2	2	1	1	0	2	1
Walloon region	**24**	**100.0%**	**70.8%**	**75.0%**	**16.7%**	**95.8%**	**83.3%**
Baudour	**2**	**2**	**1**	**1**	**0**	**2**	**1**
EpiCURA - Clinique Louis Caty	2	2	1	1	0	2	1
Charleroi	**4**	**4**	**3**	**3**	**1**	**3**	**3**
CHU André Vésale	2	2	1	1	1	1	1
Grand Hôpital de Charleroi/Site Saint Joseph	2	2	2	2	0	2	2
La Louvière	**3**	**3**	**3**	**3**	**2**	**3**	**3**
Centre Hospitalier de Jolimont	2	2	2	2	1	2	2
CHU Tivoli	1	1	1	1	1	1	1
Libramont	**1**	**1**	**1**	**1**	**0**	**1**	**1**
CHA Vivalia	1	1	1	1	0	1	1
Liège	**4**	**4**	**4**	**4**	**0**	**4**	**4**
CHU Liège	2	2	2	2	0	2	2
CHR Citadelle	1	1	1	1	0	1	1
CHC Saint Joseph	1	1	1	1	0	1	1
Mouscron	**2**	**2**	**2**	**2**	**0**	**2**	**2**
CH de Mouscron	2	2	2	2	0	2	2

Namur	**4**	**4**	**2**	**2**	**1**	**4**	**2**
Clinique et Maternité St Elisabeth	4	4	2	2	1	4	2
Ottignies	**1**	**1**	**0**	**0**	**0**	**1**	**1**
Clinique St Pierre Ottignies	1	1	0	0	0	1	1
Verviers	**3**	**3**	**1**	**2**	**0**	**3**	**3**
CHR Verviers	3	3	1	2	0	3	3
Total	**87**	**96.6%**	**64.4%**	**71.3%**	**13.8%**	**92.0%**	**74.7%**

*This data includes LINACs only and excludes IORT and dedicated SBRT devices; * Iridium kankernetwerk Antwerpen*

Evolution over time in IGRT and IMRT capabilities of EBRT devices

Comparing the data collected through the BELdARt project[ff] and the 2016 *College QI* data, it can be observed that the evolution of equipment has allowed for almost a doubling of the number of equipment capable of performing rotational IMRT; in 2013, 38% of EBRT equipment was capable of rotational IMRT delivery as compared to 74.7% in 2016. The relative differences in overall IMRT capabilities between 2013 and 2016 have only slightly changed, with an increase of 13% of EBRT devices capable of IMRT delivery. Regarding overall IGRT capability, no increase in numbers has been observed in the three-year period, but the types of IGRT modalities have changed in favour of more advanced IGRT capability, with more specifically an increase of 3D imaging (volumetric IGRT).

7.2.3.4 Number of EBRT devices per 100 000 population

Based on the number of equipment available in the radiotherapy departments and the updated Belgian population data, there are 0.80 EBRT devices available per 100 000 Belgian inhabitants, which is equivalent to 1 device per 125 000 inhabitants (Table 93). The number of EBRT devices per 100 000 inhabitants available in the Brussels region is double the number of EBRT devices available in the Flemish and Walloon regions (1.68 versus 0.77 and 0.72 respectively).

[ff] Project emanating from the collaboration between the Nuclear Technologic Center (NuTeC), the College for Physicians in Radiation-Oncology and the Belgian Hospital Physicists Association (BHPA), which encompassed a basic audit of each clinical EBRT device in all Belgian radiotherapy departments.

Table 93 – Number of EBRT devices per 100 000 inhabitants

Region	Number of inhabitants[gg]	Number of EBRT devices (figures between brackets include IORT)	Number of EBRT devices/100 000 inhabitants (excl. IORT)	Total number of RT devices/100 000 inhabitants (incl. IORT)
Brussels region	1 187 890	19 (20)	1.60	1.68
Walloon region	3 602 216	25 (26)	0.69	0.72
Flemish region	6 477 804	46 (50)	0.71	0.77
Total	**11 267 910**	**90 (96)**	**0.80**	**0.85**

Numbers between brackets: number of EBRT devices including IORT devices

7.2.4 Activity profile of radiotherapy centres and satellites

7.2.4.1 EBRT treatments

The 2015 activity profiles of the Belgian radiotherapy departments were collected through the College QI project (data collected in 2016).

As demonstrated in Figure 81 the total number of EBRT treatments reported varies substantially across Belgian radiotherapy departments, with a figure in 2015 amounting to a total of 35 087 treatments in Belgium[hh] (EBRT treatments and retreatments). This number is lower than the actual situation as it excludes the EBRT treatments of two satellite centres for which the data is unavailable. The number of billed treatments, as recorded by the RIZIV – INAMI for 2015, is equivalent to 34 547 treatments. This figure may however exclude a number of retreatments, as only a maximum of 3 series can be reimbursed on annual basis.

Number of treatments per EBRT device

As shown in Figure 82 the number of treatments per EBRT device ranges from 216 to 576 treatments annually. The mean number of treatments per EBRT device is the lowest in the Brussels region and highest in the Flemish region with 294, 389 and 462 treatments/EBRT device for the Brussels, Walloon and Flemish region respectively. This amounts to an overall national mean of 399 treatments delivered per EBRT device. There seems to be no clear distinction between university and non-university hospitals.

The number of sessions per treatment

The mean number of sessions (or fractions) delivered per EBRT device on annual basis ranges from 4 281 to 10 781 sessions with a mean of 6 989 sessions per EBRT device (Figure 83). Through further analysis of the data, it is possible to determine the mean number of sessions (fractions) per treatment as a function of the radiotherapy department involved. On a national level, there is an average of 17.3 sessions per treatment (range: 12 to 25). In the Brussels region, this number is lower than in the Walloon and Flemish region with an average of 16.7 versus 18.5 and 18.4 sessions per treatment respectively (Figure 84).

[gg] Data from Federal Planning Bureau consulted on 12/2016 (population data as of January 2016)

[hh] For two departments the total number of EBRT treatments is based on 2016 data.

EBRT treatment techniques

When looking at the different types of treatment techniques being used by the different departments, one observes that the proportion of 3D conformal treatments remains important (49.6% of EBRT treatments) (Figure 85). However, the proportion of IMRT treatments also plays an important part with a mean of 34.9% of EBRT treatments being delivered as IMRT treatments.

Finally, in 2015, 18 and 17 departments were involved in cranial (SRS) and extra cranial (SBRT) stereotactic treatment delivery, respectively. The proportion of SRS and SBRT compared to the other types of treatment techniques is low. However, those departments equipped with dedicated stereotactic equipment have 15-17 % of their treatment qualified as being stereotactic treatments comparatively to the other departments in which the proportion of stereotactic treatments are generally below 6%.

Ten departments are also involved in Total Body Irradiations – a majority of them being university based – their numbers varying between 18 and 27 TBIs in 2015.

Activity data is also available for all departments possessing IORT devices except for one (n=5). The mean number of IORT treatments is 56.4, with treatment numbers by department ranging from 10 to 137 treatments performed in 2015 (Figure 86).

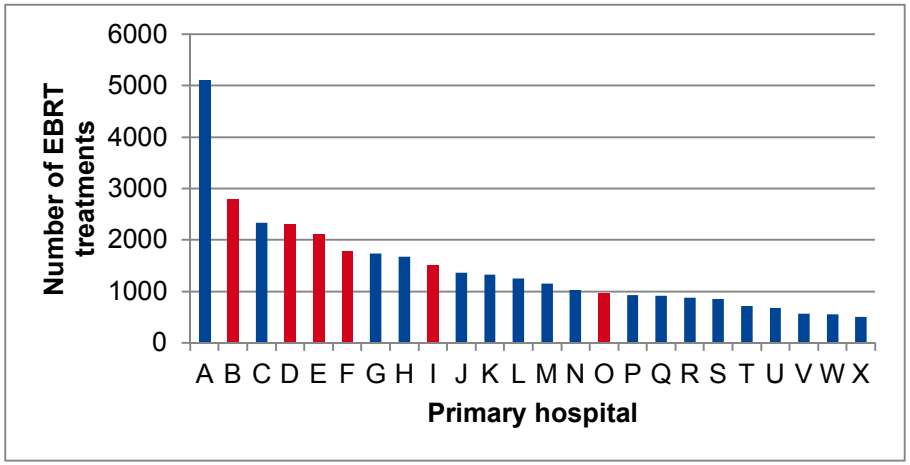
Evolution of EBRT treatments over time

The trend of EBRT treatments over a ten-year period can be visualised through the analysis of the RIZIV – INAMI data, which gathers the number of reimbursements executed on a yearly basis through the different billing codes (Table A. 2). Over the past ten years, the number of EBRT treatments that were billed has steadily risen from 28 351 treatments in 2005 to 34 547 treatments in 2015 (Figure 87).

As illustrated in Figure 88, it can also be noticed that the number of category IV treatments, including IMRT, TBI, SRS and SBRT has risen, with 1 531 in 2005 and 12 476 category IV treatments in 2015 (800% increase). Similarly, the number of category III treatments has also evolved, with an increase from 9 291 treatments in 2005 to a maximum of 14 755 treatments in 2012, after which a slow decrease is observed. Conversely, the number of category II treatments has significantly decreased over this same period of time, starting at 9 829 treatments in 2005 and decreasing to 1 731 treatments in 2015.

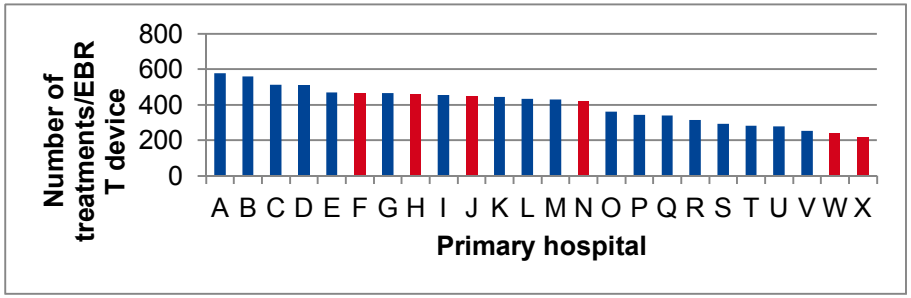
In fact, the category II treatments have almost become obsolete, as they have been progressively replaced by the more complex category III treatments. In parallel with this, the gradual acquisition of more modern EBRT devices, capable of IMRT and IGRT, has allowed for a further evolution from 3D conformal treatments into IMRT techniques, explaining the decline of the former as of 2012. As a result, category IV treatments have slowly been replacing the category II and III treatments, with the number of IMRT treatments in 2015 for the first time exceeding the number of conformal 3D treatments. Conversely, it is reassuring to observe that the proportion of category I treatments, accounting for treatments with purely palliative intent for symptom control, have remained stable over time – accounting for 25% of all EBRT treatments.

Figure 81 – Total number of EBRT treatments for the 24 primary hospital radiotherapy departments



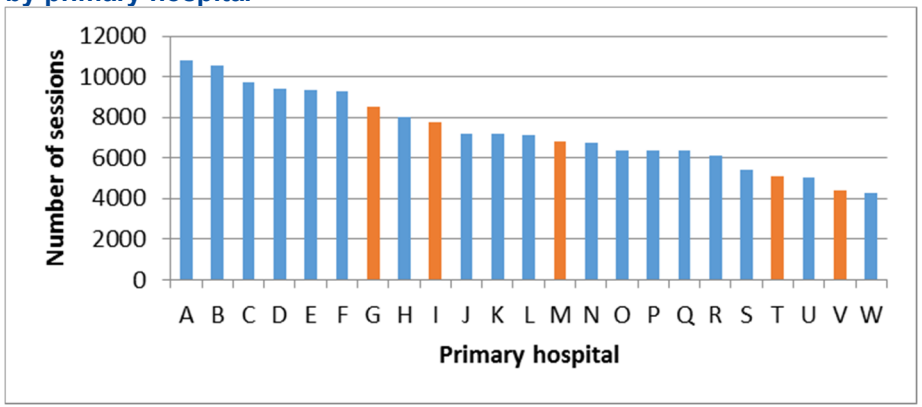
Data based on the 2015 QI project data collection except for two centres for which 2016 activities data was used (Centre A and Centre K). University hospitals are highlighted in red.

Figure 82 – Average number of EBRT treatments per EBRT device, annually and by primary hospital



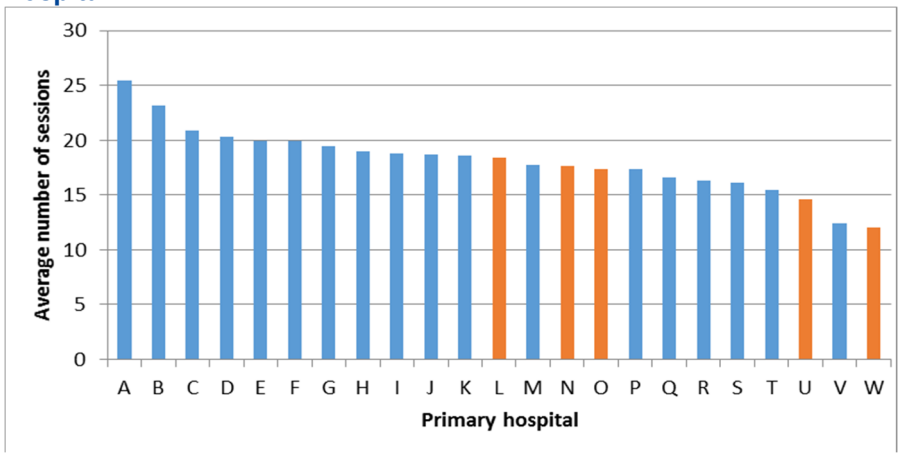
University hospitals are highlighted in red.

Figure 83 – Average number of sessions (fractions) per EBRT device by primary hospital



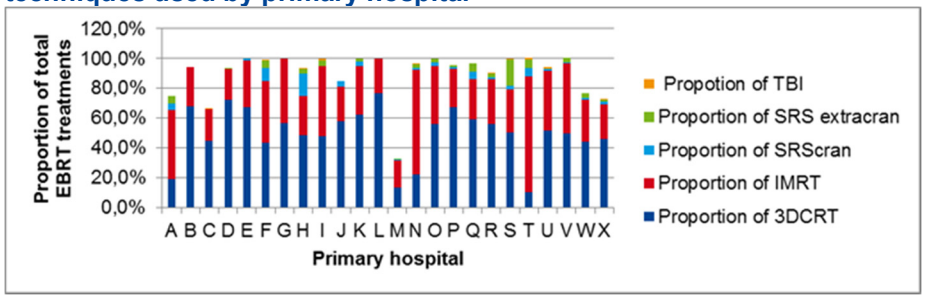
The number of sessions was not available for one hospital. University hospitals are highlighted in red.

Figure 84 – Average number of sessions per treatment, by primary hospital



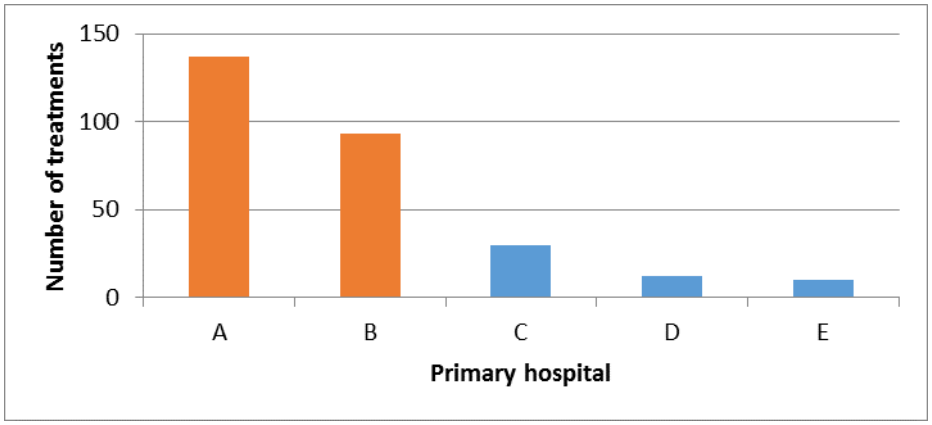
The number of sessions was not available for one hospital. University hospitals are highlighted in red.

Figure 85 – Proportional distribution of the different types of treatment techniques used by primary hospital



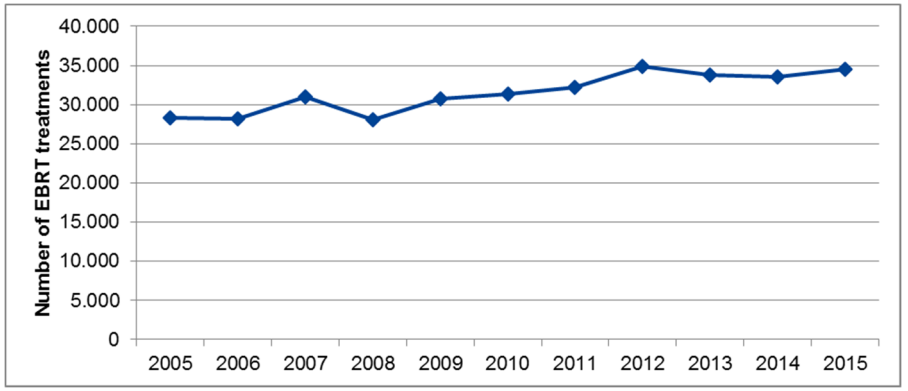
Those departments delivering treatment categorized as category II treatments are those for which the sum of the different types of EBRT does not add up to 100% as this was a type of treatment that was not included in the data collection of the College QI project.

Figure 86 – Intraoperative activities in five departments possessing IORT devices



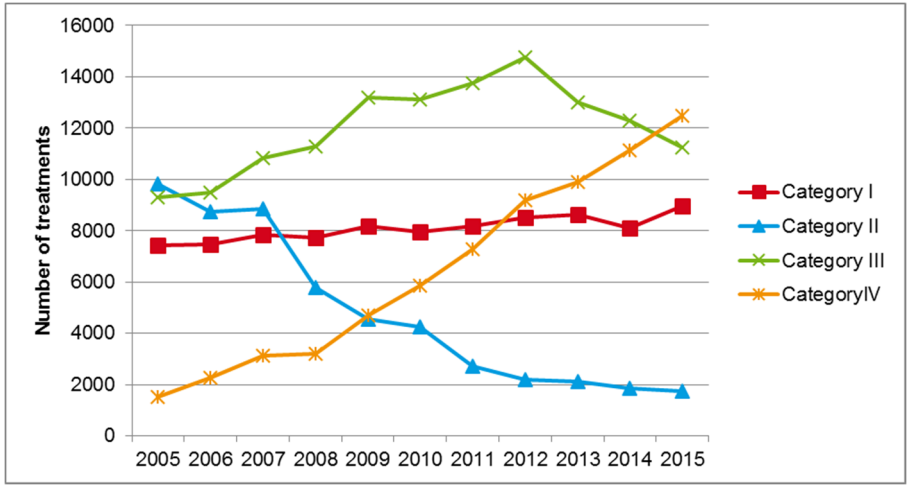
IORT data is not available for a 6th department which is equipped with an IORT device.

Figure 87 – Evolution over time of total number of EBRT treatments



**Data from RIZIV – INAMI (2005-2015)*

Figure 88 – Evolution of the different categories of EBRT treatments over time

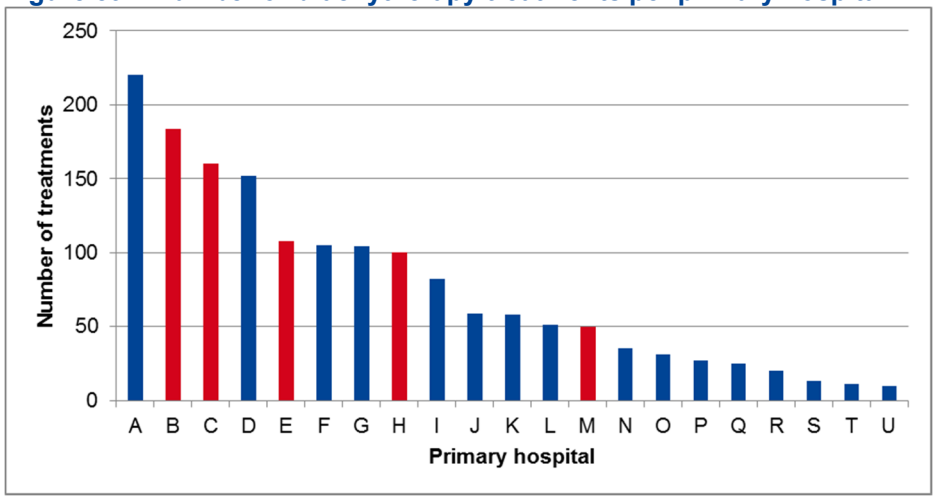


Data from RIZIV – INAMI (2005-2015)

7.2.4.2 BT treatments

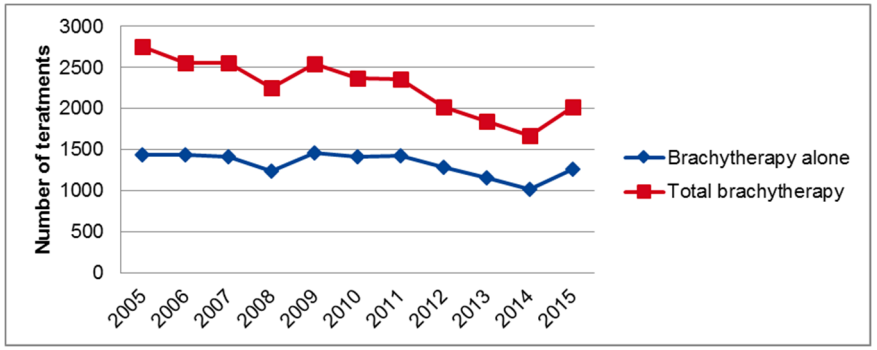
As previously stated, BT treatments are also being delivered by a significant amount of departments. Although information concerning the number of devices available in each department is not readily available, the College QI project has collected the number of BT treatments having been delivered by the different departments in 2015. This is illustrated in Figure 89 with a total of 1 605 BT treatments across Belgium. The highest proportion of BT treatments is being delivered in the Flemish region and the lowest in the Walloon region. Over the past ten years, the number of BT treatments has slowly decreased with an overall decrease of -11.7% for BT treatments alone and of -26.7% for BT treatments combined with EBRT treatments (Figure 90).

Figure 89 – Number of brachytherapy treatments per primary hospital



Data based on the 2015 QI project data collection except for two centres for which 2016 activities data was used (Centre A and Centre K). University hospitals are highlighted in red.

Figure 90 – Evolution of the total number of BT treatments over time



Data from RIZIV – INAMI (2005-2015). In this figure brachytherapy alone refers to the number of treatments in which brachytherapy was the sole radiotherapy modality used in the treatment. The term 'total brachytherapy' refers to brachytherapy treatments which were delivered along with another modality of radiotherapy.

7.3 Needs – current and future situation in Belgium

7.3.1 Introduction

The setting-up of modern radiation therapy departments is a complex process, which requires the installation and integration of high technology equipment and the parallel education of highly specialised professionals. The aim of this section is to evaluate the resource needs in terms of EBRT devices, as a function of the number of EBRT treatments required. It is of uttermost importance that these resources are in accordance with the number of treatments required in order to guarantee optimum standards of care (ex: no treatment delays) and to avoid over- or underutilisation of the devices.

The RT landscape in Belgium must therefore not only guarantee present-day optimal standards of care, but also be configured in a manner that provides maximum opportunity to address the anticipated future RT treatments.

The resources needed to date will be determined by the actual and optimal number of treatments in 2015, while the future resource needs will be based on the projection of patients requiring RT by 2025. This section will solely focus on equipment needs but it is important that this element is always highly correlated with human resources needs.

7.3.2 Methodology

The number of EBRT devices is determined by the number of EBRT treatments needed to treat the *current* and *projected* (2025) national cancer caseload. To do so, the following elements are required:

- The number of EBRT treatments, which depends on the cancer incidence;
- A model converting the number of EBRT treatments into the number of EBRT devices required (=number of EBRT devices allowing for the delivery of a defined number of EBRT treatments).

7.3.2.1 Cancer incidence

Methodology

All incidences and trends described in this section are based on the standard cancer registration database of the Belgian Cancer Registry, a population-based registry covering incidences in Belgium from 2004 onwards, with a completeness of more than 95% (www.kankerregister.org/www.registreducancer.org).

Incidences were calculated for a selection of tumour types, originally defined by CCORE (Australian Collaboration for Cancer Outcomes Research and Evaluation; see also section 7.3.2.4) in the context of radiotherapy utilisation calculations.[556] This CCORE selection encompasses tumour types for which radiotherapy might be a treatment option. The exact selection criteria are provided in Table 94.

Table 94 – Tumour type definitions

Tumour	ICD-10 code[557]	Topography (ICD-O-3)[558]	Morphology code (ICD-O-3)[558]	Behaviour of the tumour
Bladder	C67.0-C67.9			
Brain		C70.0-C72.9	9384,9400:9421,9424,9440:9442	Benign or invasive
			9450:9451,9191,9392,9393,9470:9474, 9490,9500:9504,9508,8680,9350:9362, 9385:9390,9461:9469,9475:9489,9491:9499, 9505:9507,9520:9523	Invasive
Breast	C50.0-C50.9			
Cervix	C53.0- C53.9			
Colon*	C18.0-C18.9			
Gall Bladder	C23.0-C23.9			
Head and Neck	C10.0-C14.9 C30.0-C32.9			
Kidney	C64.0-C64.9			
Leukaemia			9728,9811,9836,9729,9837,9727, 9835,9670,9823,9840,9861,9867, 9870,9872,9873,9874,9891,9910, 9930,9898,9866,9871,9896,9897, 9865,9895,9984,9931,9920,9987, 9863,9875	
Liver	C22.0-C22.9			
Lung	C34.0-C34.9			
Lymphoma	C81.0-C81.9			
Melanoma	C82.0-C86.9			
Myeloma	C90.0-C90.9			
Oesophagus	C15.0-C16.0			
Ovary	C56.0-C56.9			
Pancreas	C25.0-C25.9			

Prostate	C61.0-C61.9	
Rectum	C20.0-C20.9	
Stomach	C16.1-C16.9	
Testis	C62.0-C62.9	
Thyroid	C73.0-C73.9	
Uterus	C54.0-C55.9	
Vagina	C52.0-C52.9	
Vulva	C51.0-C51.9	
Other		
Anus	C21.0-C21.9	
Biliary	C24.0-C24.9	
Mesothelioma	C45.0-C45.9	
Myelodysp. syndrome	C99.0-C99.9	
Skin (non-Melanoma, non-SCC/SBCC)	C44.0-C44.9	not in (8720:8790,8050:8110)
Small intestine	C17.0-C17.9	
Soft tissue	C47.0-C47.9 C49.0-C49.9	
Unknown primary	C80.0-C80.9	

To describe incidences for 2014, Nobs, CR and WSR are used.[520] CR is the crude incidence rate and is calculated by dividing the number of new cases observed during a given time period (2014) by the corresponding number of people in the population at risk (Belgian population). The crude rate is expressed as the number of new cancer diagnoses per 100 000 person years. WSR stands for the World Standardised incidence Rates. It is a weighted average of the individual age-specific rates using the World Standard Population. The WSR is the incidence that would be observed if the population of Belgium had the age structure of the World Standard Population. Since age has a powerful influence on the risk of cancer, this standardisation is necessary when comparing several populations that differ with respect to their age structure. WSR is expressed as the number of new cases per 100 000 person years. Not mentioned in Table 95 but used in this text is the Male/Female (M/F) ratio that is calculated by dividing the corresponding WSRs.

Trends in age-standardised incidence (WSR) over time (2004-2014) were quantified by the Annual Percentage Change (APC), which expresses a mean multiplicative change per year.[520] The APC is estimated from a least squares regression on the logarithm of the WSR versus incidence year. Due to the log transformation, no APC can be obtained if the WSR is zero for at least one year. In cases where the relation of the WSR with incidence year cannot be adequately fit with a log-linear model (i.e. a constant APC for the full data range cannot be assumed), a piecewise log-linear model is estimated in which the different linear segments are connected at certain joinpoints. This model results in an estimated APC per time segment of which an Average Annual Percentage Chance (AAPC) is calculated as the average of the APC estimates per segment weighted by the corresponding segment length.

A 95% confidence interval (CI) and p-value for the overall AAPC were calculated from the final regression model. When the 95% CI for the AAPC contains the value zero, no significant trend with incidence year is observed.

Analyses were performed by cancer type (Table 95), and by subcategory within the cancer type (being stage where applicable, see Table A. 3 in Appendix). For analyses by stage, the combined stage (combstage) was considered, in which the pathological stage is prioritized over the clinical stage except in case of clinical distant metastases which is always defined as stage IV. Different subcategories were used for tumour types in which staging is not applicable, such as brain (glioma, embryonal tumours, other neuro-epithelial tumours), leukaemia (lymphoid, myeloid), lymphoma (Hodgkin and non-Hodgkin disease). Given their low incidences, no subcategories were provided for the cancer types listed within the 'other' category (anus, biliary, mesothelioma, myelodysplastic syndrome, skin, small intestine, soft tissue, unknown primary).

Incidence results

In the cancer registration database of the Belgian Cancer Registry (BCR), 67 820 new diagnoses of cancer (all invasive tumours, except non-melanoma skin cancer) are counted for Belgium for the incidence year 2014. Restricting to the selection of cancer types defined in Table 94, 65 111 new diagnoses of cancer were made in Belgium in 2014, of which 34 362 in males and 30 782 in females.

Incidence by tumour type

Prostate cancer is the most frequent cancer in males in Belgium (23.1% of all male cancer diagnoses in 2014), followed by lung (16.9%) and colon (without rectosigmoid junction, 11.1%). In women, breast cancer is responsible for one third of all tumours, representing the most frequent tumour type (34.0% of all female cancer diagnoses in 2014 in Belgium). Colon cancer (10.0%) and lung cancer (8.6%) are the second and third most frequently occurring cancer types in women, respectively. Together, these four tumour types represent 52% of all new cancer diagnoses in males and females together.

Within the digestive tract (including colon, gallbladder, liver, oesophagus, pancreas, rectum, stomach, anus, biliary tract and small intestine), colon cancers are the most frequent (42.5% of all digestive tract cancers for males and even 47.6% for females). Rectal cancers are the second most frequent digestive tract cancers (males: 18.3%, females: 14.6%), followed by pancreatic cancers in females (13.0%) and oesophageal cancers in males (11.9%).

Cervix, ovary, corpus uteri, vagina and vulva are considered as the female genital organs. Of these organs, cancers of the corpus uteri are the most common (45.3%). Ovarian cancers are at the second place with 26.1% and cervical cancers are the third most common cancers of this group (20.1%).

Most of the cancers that occur in both sexes, have higher incidences in males compared to females. Mesothelioma revealing the highest male/female ratio (M/F ratio: 7.0), several other cancers also occur at least twice as often in males as in females: this is the case for cancers of the bladder (M/F ratio 5.1), oesophagus (3.5), head and neck (3.2), liver (2.6), lung (2.2), kidney (2.1) and rectum (2.1). Exceptionally, cancer diagnoses are more frequently made in females, such as melanoma (M/F ratio 0.7), cancer of the gallbladder (0.6) and thyroid cancer (0.3).

Incidence by stage

In addition to incidences by tumour type as shown in Table 95, Table A. 3 in Appendix shows the number of new cancer diagnoses by stage for tumour types in which staging is applicable according to the TNM[ii] staging system. Even for tumour types for which a staging system exists, the stage of the disease at time of diagnosis is not always provided to the BCR by the oncological care programmes or the laboratories for pathological anatomy. Although registration of staging information has tremendously increased over time, some cancer types remain with a relatively high proportion of unknown stages for incidence year 2014. 20% or more missing staging information is noted for cancers of liver and stomach in both males and females, and cancers of oesophagus, pancreas, ovary, vagina and cervix in females.

Restricting to those cancers for which staging information is available, the proportional distribution of the stages within each cancer type can be calculated. Some cancer types are most frequently diagnosed at early stage (even stage I): this is the case for melanoma and cancers of the testis, thyroid, corpus uteri, vulva, kidney and cervix.

Indeed, more than 90% of all malignant melanomas with known stage are diagnosed in prognostic favourable stages (males: 73% stage I and 18% stage II, females: 81% stage I and 14% stage II). Testicular cancer also often presents as a stage I disease (89% of known stages). The high amount of early stage thyroid cancers (mostly T1a differentiated thyroid cancers) is suspect for overdiagnosis of this cancer type resulting from more aggressive treatments for thyroid diseases in general, as recently shown by BCR in collaboration with the Belgian Healthcare Knowledge Centre (KCE).[560] Similarly, the broad use of imaging techniques might play a role in the incident diagnoses of early stage kidney cancers (67-68% stage I-II).

In contrast to ovarian cancers often diagnosed in advanced stages (40% stage III, 31% stage IV), other cancers of the female genital tract more often present in earlier stage (cancers of corpus uteri, vulva and cervix cancer: 75%, 69% and 50% stage I, respectively). This finding is strongly related to the occurrence of alarming symptoms, which typically present late in ovarian cancers in contrast to the other cancer types.

Cancers of bladder, breast, prostate and rectum are also often diagnosed at early stages but with no clear benefit for stage I.

At the other side, some cancers unfortunately have already invaded adjacent organs or metastasized to regional nodes and/or distant sites at time of discovery: examples can be found in cancers of oesophagus and stomach, head and neck, liver, gall bladder, lung and pancreas (respectively 60%, 55%, 60%, 58%, 65%, 71% and 62% of the known stages are stage III-IV).

For most cancer types, the staging distribution is highly similar for males compared to females.

[ii] The TNM staging system is a classification system that describes the extent of the disease, based on the size and extension of the tumour (T), the absence/presence of tumour involvement of the lymph nodes (N), and the absence/presence of distant metastases (M) (Sobin et al., 2002[559] and 2009[527]).

Incidence over time

When studying incidence trends over time (2004-2014) for Belgium, incidence rates are decreasing in males (0.6% annually), while the risk for females increased with 0.8% annually.

Cancer-type specific calculations reveal decreasing trends in males for prostate, stomach, head and neck, lung and bladder cancer, and in females for cancers of vagina, ovary, corpus uteri, brain and gallbladder. The opposite is noted for cancers of the liver, thyroid, pancreas and melanoma, for which incidences are increasing over time for both sexes.

Sex-dependent changes over time are observed for head and neck, stomach and lung cancer. In head and neck cancer, incidences are decreasing in males but increasing in females. This effect is even bigger for lung cancer, with an AAPC of -1.1 [-1.3;-0.9] for males and 4.2 [3.5;5.0] for females. The increasing prevalence of female smokers over time presumable plays a major role in these observations. For stomach cancer, incidences are decreasing for both sexes, but more dramatically in males compared to females.

In most cancer types, the evolution over time by stage of the disease is concordant amongst all known stages, and without major differences between males and females. Exceptions are noted for rare cancers such as cancer of the gallbladder in females, in which early stage diseases seem to decrease over time in contrast to the more advanced cancer stages. Similar peculiarities are observed in other rare cancers (vulva, liver cancer in females), but the small number of observations probably plays a role in the fluctuating pattern.

The results for prostate cancer must be interpreted with caution: for this disease, stage I seems to in-crease, the opposite being seen for stage II. Changes in the TNM classification influence these observations: at the transition between the 6th (incidence years 2004-2009) and 7th (incidence years 2010-2014) TNM edition, a stage migration occurred for a large number of stage II prostate cancers towards stage I.[527, 559]

The negative AAPC values for unknown stages (X, NA) conform a better notification of staging information to the BCR over time. Remarkable evolutions towards more staging availability are not only noted for common cancers such as breast, prostate and lung, but also for less frequently occurring cancer types such as testicular and gall bladder cancer.

Table 95 – Incidence (2014) and incidence trends (2004-2014) by sex and tumour type, Belgium

	Males						Females					
	2014			2004-2014			2014			2004-2014		
Tumour	Nobs	CR	WSR	AAPC	95 % Confidence Interval	p-Value	Nobs	CR	WSR	AAPC	95 % Confidence Interval	p-Value
Bladder	1 909	34.9	15.8	-0.6	[-0.9, -0.2]	0.0037	508	8.9	3.1	0.6	[-0.7, 1.9]	0.3239
Brain	469	8.6	6.2	0.7	[-0.4, 1.9]	0.1893	331	5.8	4.2	-0.9	[-2.3, 0.5]	0.1865
Breast							10 466	184.4	106.4	0.1	[-0.4, 0.5]	0.7581
Cervix							653	11.5	8.0	-0.4	[-1.6, 0.8]	0.4434
Colon	3 823	69.8	35.2	1.5	[0.3, 2.8]	0.0197	3 091	54.5	23.0	1.7	[1.1, 2.4]	0.0002
Gall bladder	35	0.6	0.3	0.9	[-2.7, 4.7]	0.5798	80	1.4	0.5	-0.9	[-4.0, 2.4]	0.5639
Head and neck	1 992	36.4	21.3	-1.3	[-2.1, -0.4]	0.0090	679	12.0	6.7	1.0	[0.2, 1.9]	0.0246
Kidney	1 075	19.6	11.2	1.3	[1.0, 1.6]	<.0001	613	10.8	5.4	0.3	[-0.9, 1.6]	0.5708
Leukemia	942	17.2	10.5	1.7	[0.7, 2.8]	0.0045	711	12.5	6.7	1.2	[-0.4, 2.8]	0.1382
Liver	596	10.9	5.8	7.1	[5.5, 8.6]	<.0001	268	4.7	2.2	6.5	[4.0, 9.1]	0.0002
Lung	5 797	105.9	53.7	-1.1	[-1.3, -0.9]	<.0001	2 655	46.8	24.1	4.2	[3.5, 5.0]	<.0001
Lymphoma	1 409	25.7	15.5	0.7	[0.2, 1.1]	0.0086	1 026	18.1	10.0	-0.1	[-0.7, 0.5]	0.6627
Melanoma	1 193	21.8	13.5	5.4	[4.0, 6.9]	<.0001	1 732	30.5	20.1	5.3	[4.3, 6.3]	<.0001
Myeloma	440	8.0	4.0	1.2	[0.1, 2.3]	0.0379	384	6.8	3.0	-0.4	[-2.0, 1.2]	0.5736
Oesophagus	1 068	19.5	10.2	0.3	[-0.5, 1.0]	0.4333	383	6.7	2.9	1.4	[0.5, 2.2]	0.0059
Ovary							848	14.9	7.6	-3.0	[-4.0, -2.1]	<.0001
Pancreas	871	15.9	8.1	3.3	[2.1, 4.5]	0.0002	844	14.9	6.4	4.1	[3.2, 5.0]	<.0001
Prostate	7 953	145.3	73.4	-3.5	[-4.1, -2.9]	<.0001						
Rectum	1 644	30.0	15.9	0.8	[0.0, 1.5]	0.0495	946	16.7	7.7	-0.1	[-1.0, 0.8]	0.7656
Stomach	540	9.9	4.8	-3.3	[-4.4, -2.1]	0.0001	479	8.4	3.7	-0.5	[-1.8, 0.7]	0.3597

Testis	359	6.6	6.6	3.3	[2.6, 4.0]	<.0001						
Thyroid	267	4.9	3.5	4.3	[2.7, 6.0]	0.0002	805	14.2	10.9	4.7	[3.8, 5.6]	<.0001
Uterus							1 474	26.0	12.0	-1.8	[-2.3, -1.4]	<.0001
Vagina							43	0.8	0.3	-4.4	[-7.9, -0.7]	0.0258
Vulva							237	4.2	2.0	3.2	[2.0, 4.5]	0.0002
Other	1 980	36.2	18.0	-0.1	[-0.8, 0.5]	0.6312	1 526	26.9	11.7	-0.0	[-1.2, 1.1]	0.9491
Anus	65	1.2	0.6	4.0	[1.0, 7.1]	0.0156	115	2.0	1.0	4.7	[2.9, 6.6]	0.0002
Biliary	159	2.9	1.3	0.4	[-1.2, 2.1]	0.5731	129	2.3	0.9	1.1	[-1.3, 3.4]	0.3379
Mesothelioma	246	4.5	2.1	-0.7	[-1.5, 0.0]	0.0598	48	0.8	0.3	0.8	[-3.7, 5.4]	0.7165
Myelodysplastic syndrome	466	8.5	3.7	4.5	[2.7, 6.3]	0.0004	369	6.5	2.4	5.4	[3.7, 7.1]	<.0001
Skin (non-melanoma, non-SCC/BCC)	114	2.1	1.1	-1.1	[-3.0, 0.8]	0.2340	129	2.3	1.0	-1.1	[-2.9, 0.8]	0.2227
Small intestine	188	3.4	1.9	5.4	[3.1, 7.6]	0.0004	160	2.8	1.4	4.3	[1.7, 6.9]	0.0046
Soft tissue	214	3.9	2.5	-0.0	[-1.3, 1.3]	0.9844	147	2.6	1.6	-1.4	[-3.2, 0.4]	0.1263
Unknown primary	528	9.6	4.7	-4.9	[-6.6, -3.2]	0.0001	429	7.6	3.1	-3.7	[-6.2, -1.1]	0.0111
TOTAL	**34 362**	**627.7**	**333.4**	**-0.6**	**[-0.8, -0.3]**	**0.0011**	**30 782**	**542.3**	**288.5**	**0.8**	**[0.7, 1.0]**	**<.0001**

7.3.2.2 *Current number of patients treated with radiotherapy*

Methodology

According to the list of tumour types defined in Table 94, a total of 113 153 patients with a unique cancer diagnosed in 2009-2010 were selected from the population-based database of the Belgian Cancer Registry (BCR) (www.kankerregister.org/www.registreducancer.org). Using the national number for social security as a unique patient identifier, radiotherapy reimbursement data from the Health Insurance Companies, provided by the Intermutualistic Agency (IMA), were coupled to the BCR data (Beraadslaging nr 09/071).[561] These reimbursement data were available for a period ranging from one year before up till five years following the incidence year, limited to the end of 2014. Health insurance being obligatory in Belgium, IMA data also covers more than 98% of the total Belgian population. Analyses were restricted to patients for whom a coupling with IMA data could be established (n=110 367).

All reimbursement codes that can be charged for a radiotherapy course ranging from category 1 to 8 were taken into account. These codes allow a distinction between external beam radiotherapy (EBRT, categories 1-4), EBRT followed by brachytherapy (EBRT-BT, categories 5-6), and BT only (categories 7-8) (see also Table A. 2 in Appendix). All first courses charged within a time window of one month before the incidence date until the end of the observation period were considered.

Analyses were performed by cancer type, and where applicable, by stage (see Table 96 and Table A. 4 in Appendix). For analyses by stage, the combined stage (combstage) was considered, in which the pathological stage is prioritized over the clinical stage except in case of clinical distant metastases which are always defined as stage IV. Different subcategories were used for tumour types in which staging is not applicable, such as brain (glioma, embryonal tumours, other neuro-epithelial tumours), leukaemia (lymphoid, myeloid), lymphoma (Hodgkin and non-Hodgkin disease). Given their low incidences, no subcategories were provided for the cancer types listed within the 'other' category (anus, biliary, mesothelioma, myelodysplastic syndrome, skin, small intestine, soft tissue, unknown primary).

Next to analyses at the Belgian population level, activity profiles per radiotherapy centre were provided. For each tumour type, the number of cancers irradiated per radiotherapy centre licensed within the studied time period (2009-2010; n=25) was studied. A total of 42 742 irradiated patients were included. To assign patients to a centre, the RIZIV – INAMI licensing codes mentioned in the IMA data were used. In case radiotherapy was performed in a satellite centre, the case was assigned to the corresponding 'mother' radiotherapy centre. For 606 cases (of which 442 prostate cancers and 115 non-melanoma, non-SCC/BCC skin cancers), no centre could be assigned as no licensed radiotherapy centre had charged the radiotherapy nomenclature code. Not the number of radiotherapy episodes are used, but the number of patients irradiated by each centre: in case a patient has been treated twice in the same centre, this only counts as one case.

Based on the patients who could be assigned to a centre, the 25 radiotherapy centres (at the time of the data) were listed according to the total number of irradiated patients within the observation period. This listing resulted in four volume categories: low (<p25, dark blue), intermediate-low (p25-p50, light blue), intermediate-high (p50-p75, light red), high (>p75, dark red). The ranking of the centres in volume categories was once done for 'any radiotherapy' (Figure 91), and once for 'any brachytherapy' (EBRT-BT or BT only, Figure 92), and is shown at the top of each respective figure. A distinction was made between university centres (with prefix U-) and non-university centres (with prefix H-): the centres with a U-prefix are those that are treating patients from university hospitals. In second instance, the activity per centre for each cancer type was analysed. Within each cancer type, the total number of irradiated patients were categorized in the same way (using p25-p50-p75), and each centre was assigned a colour code for each cancer type, based on this categorization.

Results

National level

Of the included 110 367 patients, 38.7% underwent at least one RT course within the studied observation period. The vast majority of these courses were EBRT only (35.5%), BT only courses and EBRT-BT combination courses only accounting for very small proportions (1.9% and 1.4%, respectively).

As expected, large differences in these percentages were observed across the studied tumour types. Some tumour types appeared frequently irradiated (e.g. breast: 76.8%, head and neck: 71.9%), some infrequently (e.g. colon: 6.2%, ovary: 6.6%, stomach: 8.2%), and others in between (e.g. lung: 46.2%, oesophagus: 42.2%, prostate: 38.0%, rectum: 57.3%).

Brachytherapy only usage was mainly observed in cancers of the prostate (9.8%), uterus (8.5%) and vagina (7.2%), as anticipated. Combined EBRT-BT coursed were most frequently charged in female cancers such as cervical cancer (23.0%), cancers of uterus (11.0%), vagina (8.4%), and breast (4.8%).

In general, stage I diseases underwent fewest radiation therapies, as illustrated for cervical cancer, head and neck cancer, upper gastrointestinal cancer and cancer of the corpus uteri. As usual surgical treatments can be performed with free margins in early diagnosed cancers, the omission of adjuvant radiotherapy is often justified in these settings. In stage II and III cancers, radiotherapy is more frequently used, either in addition to surgery (e.g. adjuvantly in breast cancer, corpus uteri, pancreas or neo-adjuvantly in rectal cancer), either without surgery (with or without chemotherapy, e.g. head and neck cancer, lung cancer).

Utilization of radiotherapy in stage IV disease, most often indicating radiation of a distant metastatic site, is highly cancer-type dependent, and ranges from 5.4% in cancer of the gallbladder to 83% in head and neck cancer. Of note, in contrast to most other tumour types, stage IV disease in head and neck cancer encompasses loco-regionally advanced cancers which are still considered potentially curable with combination treatments.

Table 96 – Actual radiotherapy utilisation by cancer type, Belgium 2009-2010

Cancer Type	Actual Radiotherapy Utilisation (2009-2010)						
		EBRT (%)		BT only (%)	Any RT (%)	Overall	
	EBRT only	EBRT + BT	Any EBRT			N	%
Bladder	17.3	0.4	17.7	0.1	17.8	3 845	3.5
Brain	70.4	0.0	70.4	0.0	70.4	1 464	1.3
Breast	72.0	4.8	76.8	0.0	76.8	18 980	17.2
Cervix	30.2	23.0	53.3	2.6	55.9	1 128	1.0
Colon	5.8	0.0	5.8	0.5	6.2	10 118	9.2
Gall bladder	3.9	0.0	3.9	0.0	3.9	206	0.2
Head and neck	71.6	0.1	71.7	0.2	71.9	4 558	4.1
Kidney	12.9	0.0	12.9	0.0	12.9	2 662	2.4
Leukaemia	10.0	0.0	10.1	0.2	10.2	2 640	2.4
Liver	8.7	0.0	8.7	4.2	12.8	1 225	1.1
Lung	46.0	0.0	46.1	0.1	46.2	14 417	13.1
Lymphoma	23.3	0.0	23.4	0.0	23.4	4 092	3.7
Melanoma	8.2	0.1	8.3	0.1	8.4	3 667	3.3
Myeloma	26.6	0.1	26.6	0.0	26.6	1 370	1.2
Oesophagus	41.6	0.3	41.8	0.4	42.2	2 373	2.2
Ovary	6.4	0.1	6.4	0.1	6.6	1 538	1.4
Pancreas	10.1	0.0	10.1	0.2	10.3	2 758	2.5
Prostate	27.9	0.2	28.2	9.8	38.0	16 219	14.7
Rectum	57.1	0.0	57.1	0.2	57.3	4 399	4.0

Stomach	8.2	0.0	8.2	0.1	8.2	1 913	1.7
Testis	13.9	0.0	13.9	0.0	13.9	591	0.5
Thyroid	7.9	0.1	8.0	1.5	9.5	1 628	1.5
Uterus (corpus uteri)	14.5	11.0	25.5	8.5	34.0	2 682	2.4
Vagina	44.6	8.4	53.0	7.2	60.2	83	0.1
Vulva	33.2	0.8	34.0	0.5	34.5	388	0.4
Other	23.5	0.2	23.7	0.2	23.9	5 423	4.9
TOTAL	**35.5**	**1.4**	**36.9**	**1.9**	**38.7**	**110 367**	**100.0**

Radiotherapy centre level

The number of patients diagnosed in 2009-2010 and treated with any form of radiotherapy (EBRT and/or BT, see Figure 91) by each radiotherapy centre, ranged from 447 to 3 310. Mostly, the overall activity profile of the centre was concordant with the activity at the level of the cancer types. This was the case for the most commonly irradiated cancers such as lung, breast and prostate cancer. Some relatively frequent radiotherapy indications were irradiated less or more than expected according to the overall activity of the centre, such as head and neck cancer in centre N_09 and N_01, respectively. Cancer types that are less often irradiated even show more variability amongst the centres, as illustrated by cancers of the testis, thyroid and mesothelioma.

For brachytherapy, the activity for the selected tumour types ranges between 3 and 443 cases irradiated by each centre (see Figure 92). The variability of the activity at the level of the cancer type is even more pronounced than when including external beam radiation.

Figure 91 – Distribution of patients treated with radiotherapy amongst the radiotherapy centres, Belgium, 2009-2010: any radiotherapy

Tumour type	Patients (N) treated by RT - Any RT (categories 1-8)																										
	H_10	H_21	H_11	H_20	H_01	H_04	H_03	H_07	H_15	H_05	H_12	U_23	H_18	U_14	H_13	U_24	H_22	H_06	H_16	U_02	U_08	H_17	U_19	H_09	U_25	TOT
Overall	477	728	785	832	943	1068	1155	1156	1209	1359	1379	1433	1536	1562	1587	1869	1993	2163	2193	2283	2511	2842	2850	2913	3310	42136
Bladder																										682
Brain																										1016
Breast																										14571
Cervix																										630
Colon																										628
Gall bladder																										8
Head and neck																										3272
Kidney																										344
Leukaemia																										268
Liver																										157
Lung																										6645
Lymphoma																										957
Melanoma																										307
Myeloma																										365
Oesophagus																										1000
Ovary																										101
Pancreas																										283
Prostate																										5717
Rectum																										2518
Stomach																										156
Testis																										82
Thyroid																										154
Uterus																										911
Vagina																										50
Vulva																										134
Anus																										210
Biliary																										45
Mesothelioma																										191
Myelodysplastic syndrome																										54
Small intestine																										24
Soft tissue																										249
Unknown primary																										407

Figure 92 – Distribution of patients treated with radiotherapy amongst the radiotherapy centres, Belgium, 2009-2010: brachytherapy only

Tumour type	Patients (N) treated by RT - Brachytherapy (categories 5-8)																														
	H_01	U_14	H_10	H_04	H_03	H_21	H_05	H_07	H_18	H_12	H_13	H_20	U_23	U_24	U_02	H_15	H_11	H_06	H_16	H_22	U_08	H_17	U_19	H_09	U_25	TOT
Overall	3	38	39	43	45	57	61	65	72	75	76	79	97	103	104	106	109	115	128	131	140	202	256	390	443	2977
Breast																										919
Cervix																										289
Liver																										51
Prostate																										1184
Uterus																										521
Vagina																										13

7.3.2.3 *Future (2025) number of patients treated with radiotherapy*

Methodology

To calculate the future radiotherapy needs, incidence projection models were used. The incidence projections for the period 2015-2025 were obtained from linear and log-linear Poisson regression models by extrapolating the observed incidence trends for the period 2004-2014. As the observed number of cancer diagnoses represent a counting process, Poisson models were used to model the relation be-tween the crude incidence rate and the incidence year. The population size at the start of the calendar year was taken as the (log-) offset in the Poisson rate models and the number of observed cancer diagnoses as dependent variable. The modelling process consisted of 2 main steps. First a log-linear Poisson model was estimated. If a significant slope at the 5% level was obtained, the estimated log-linear Poisson model was selected as final model in case of a decreasing time trend (this to avoid projections that end up with a negative number of cancer cases) while a new linear Poisson model was estimated in case of an increasing time trend (to avoid exponential extrapolation). When the slope coefficient of the initial log-linear Poisson model was found to be non-significant, the mean yearly crude rate was estimated over the available time period.

Evolutions in the population size and age distribution were taken into account using the projections of potential population growth as published by Statistics Belgium. Gender specific incidence projections were performed per 5-year age category (0-4, 5-9, …, 80-84, 85+) to obtain projected sex and age-specific crude rates. These projected rates were then applied to the projected population to obtain age-sex specific projected incidence counts. Finally these age-sex cancer incidence counts were summed and overall projected numbers of cancer diagnoses were obtained.[520]

For this project, projection models were built for each cancer type and gender. To obtain the projected number of cancer diagnoses in 2025 by subcategory (combined stage or morphology group), the distribution by combined stage/morphology group observed for incidence year 2014 was applied to the total number of diagnoses by cancer type projected for 2025. All projections were performed using SAS software version 9.3 (SAS Institute, Cary, NC, USA).

To obtain the projected number of patients treated by radiation therapy in 2025, the radiotherapy utilisation proportion (any radiotherapy) by cancer type and subcategory observed for incidence years 2009-2010 was applied to the projected number of patients diagnosed in 2025, by cancer type and sub-category (see Table A. 5 in Appendix).

7.3.2.4 *Number of EBRT treatments*

Distinction between the number of cancer patients requiring radiotherapy and the optimal number of EBRT treatments

Although the number of patients requiring radiotherapy is a figure that can directly be derived from the demographic changes and related cancer incidence, it is of importance to understand that the number of cancer patients that require radiotherapy in the course of their disease is not the same as the number of treatments that need to be delivered to serve this cancer population.

The Australian Collaboration for Cancer Outcomes Research and Evaluation (CCORE) group defined the proportion of patients diagnosed with cancer that require radiotherapy *at least once* in the course of their disease, that is the '*optimal utilisation proportion (OUP)'* (see Box 28).[562, 563] This methodology has been applied in different regions around the globe, and has consistently shown that about one out of two cancer patients needs at least one radiotherapy treatment in the course of his/her disease.[564, 565] Using 2012 Belgian Cancer Registry's cancer incidence and diagnosis data, the HERO-project calculated the Belgian OUP to be 53.3%. In other words, for each 100 patients diagnosed with cancer, 53.3 will need at least one EBRT treatment in the course of his/her disease.[556]

Box 28 – Optimal utilization proportion (OUP)

The OUP as determined by CCORE is based on a careful review of literature regarding indications for radiotherapy (RT) by tumour site and stage at diagnosis. RT was deemed a treatment of choice if there was evidence that RT had a superior clinical outcome compared to alternative modalities or no treatment. The end product is a model whereby as a function of a countries' distribution of cancer incidence and stage, it is possible to determine the RT optimal utilization proportion (OUP).[562, 563]

It however does not define *when* this treatment should be delivered. In the vast majority of patients, this treatment will be delivered in the first episode of care following the diagnosis. This will especially be so in case of curative intent treatments. In other patients, the first radiotherapy treatment will however be delayed in time, for example if metastases require a local treatment to palliate symptoms or if a patient, originally treated with surgery at diagnosis, requires radiotherapy for local relapse. The delivery of these treatments will therefore not coincide with the figures on cancer incidence in a certain year.

In addition to these temporal differences, the number of cancer patients requiring radiotherapy and the number of treatments required differ: one cancer patient may need *a number of* EBRT treatments in the course of his/her disease, for example, a first during the curative episode of care and later-on when metastases occur, or for the simultaneous treatment of multiple metastases. These episodes of treatment have been defined as the *retreatment rate,* which on the basis of the available evidence is estimated to be around 25%.[562] In order to estimate the number of EBRT treatments required for a certain population, the optimal number of cancer patients requiring radiotherapy will therefore be converted into the optimal number of EBRT treatments by applying this retreatment rate. The relation between the different concepts discussed above is illustrated in Figure 93(a).

Estimation of actual versus optimal number of treatments

The number of EBRT treatments that are billed through the RIZIV – INAMI can be seen as a proxy for the *actual number* of EBRT treatments delivered (see 7.2.4.1). It is worth mentioning that this figure is lower than the number of treatments reported through the College QI project (see section 7.2.4.1)[jj]. This difference may be due to under-billing of RT activities through the RIZIV – INAMI (the number of treatments billable per year is limited to 3) or due to a different interpretation of the nomenclature used in the definition of the different categories. Conversely, radiotherapy treatment data originating from the BCR have a tendency to underestimate the *current* number of treatments as this data excludes non-cancerous patients that require radiotherapy (e.g. Ductal Carcinoma in Situ of the breast and meningioma), neglects multiple treatments delivered in the same time frame (e.g. multiple palliative irradiations delivered concurrently), exclude patients with multiple tumours and excludes treatments delivered more than five years after diagnosis. In order to overcome this inconsistency, it was decided to base the *actual* number of EBRT treatments upon the 2015 RIZIV – INAMI data (Figure 93(b)) and this in parallel with the 2009-2010 BCR data (Table 96).

Furthermore, a publication by Borras et al. demonstrated that the number of EBRT treatments delivered in Belgium was actually lower than the *optimal* number that can be derived from the OUP of patients needing to be treated, that is, only about 80% of the estimated optimal treatments was actually delivered.[564]

Estimation was also made of the number of treatments that would *'actually' be delivered by 2025*, assuming that the actual practice pattern would remain stable over the decade to come, yet accounting for the evolution of cancer incidence based on demographic changes. This was based on the actual utilisation obtained from the collaborative project of the Belgian Cancer Registry and the Belgian College of Radiotherapy-Oncology which was increased with 25% to account for retreatment (Lievens et al, submitted EJC)[566], It should however be acknowledged that this method protracts the actual underutilisation into the future. Moreover, the BCR-College project obtained even lower figures for actual utilisation than those published by Borras, Lievens et al (2015).[564] The reasons for these are multiple: whereas the Borras group used the actual number of treatments delivered, based on the billing data from the RIZIV – INAMI for the year 2012, the BCR-College project followed a cohort of individual cancer patients, diagnosed in 2009-10, over a 5 year period of time. Apart from relating to a different cohort of patients, the follow-up is thus limited to a maximum of 5 years (thus excluding treatments potentially occurring later in time). In order to obtain a more precise vision of the actual number of radiotherapy treatments in 2025, the percentile increase as estimated by the BCR-College project has thus been applied to the 2010 RIZIV-INAM data .

As previously mentioned, the *actual* number of treatments does not coincide with the *optimal* number of treatments that should be delivered.

In order to obtain the *optimal* number of treatments for this project, the optimal number of treatments needed in Belgium according to the CCORE methodology, applied to the Belgian Cancer Registry data in the HERO-project[564] was increased by 25% to account for retreatment rates and thus obtain the *optimal number of treatments* needing to be delivered[567]. It should be noted that the figures apply to the year 2012 and that minimum estimates were used (see Figure 93 (b)).

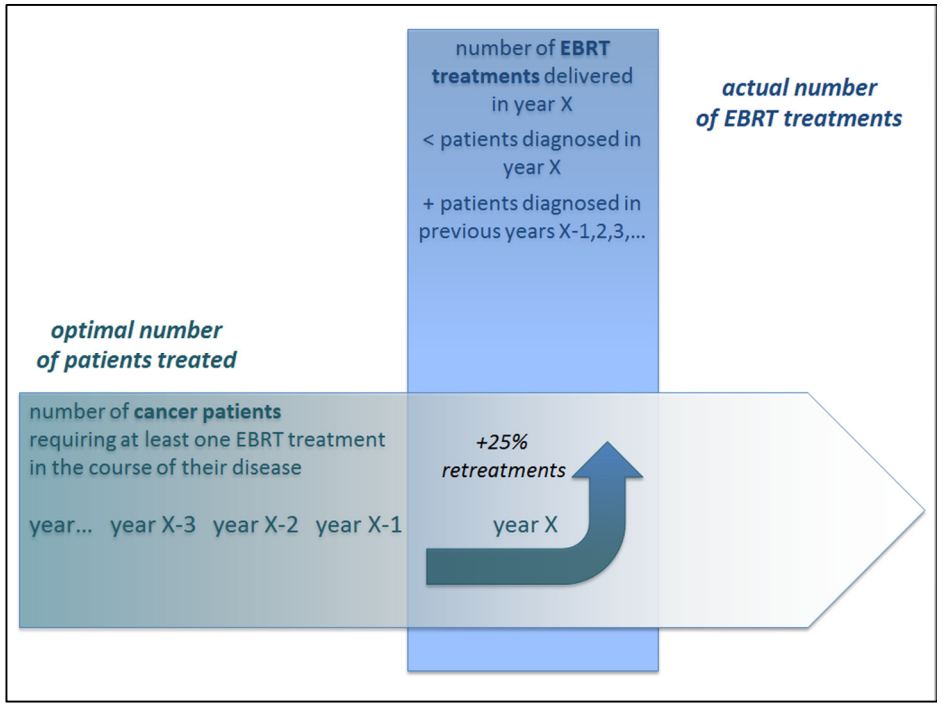
In analogy, the data from another publication from Borras' group were used to calculate the treatment needs projected to 2025.[568] The *optimal* number of treatments to be delivered in 2025, are the published (minimal) number of treatments estimated for 2025, increased by a retreatment rate of 25%.[567]

[jj] As previously mentioned, QI project data underestimate the actual number of treatments as the data of two satellite centres are not included.

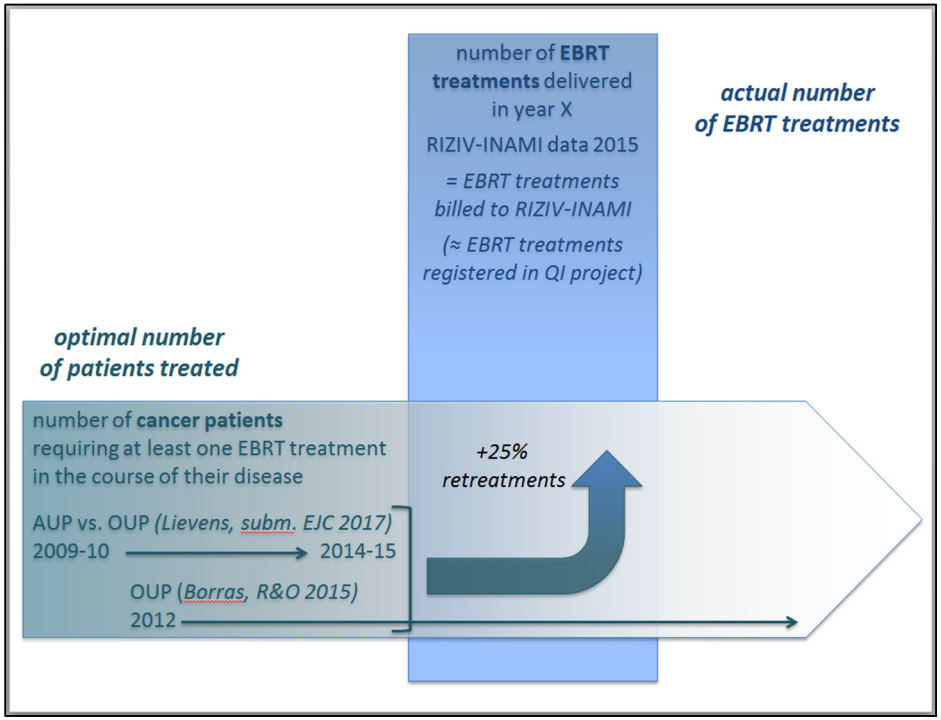
Box 29 – Number of new patients

The notion of 'new patients' is also a concept that is sometimes used to define the number of treatments that need to be delivered. When this is the case, 'new patients' actually refer to the number of patients benefitting from at least one course of RT in the course of their disease (and thus excludes all retreatments).

Figure 93 – Illustration of the concepts underlying and interrelating the number of patients treated and the number of EBRT treatments delivered



(a) Underlying concept used



(b) Inputs used

Integration of treatment complexity

As previously stated, EBRT treatments vary in complexity. This complexity can be illustrated through the categorization used by the RIZIV – INAMI in which category I and II are considered as being 'simpler techniques' while those billed as category IV are the most complex techniques. In order to maintain a vision on complexity for the various sets of calculation (actual and optimal, current and future), the proportion of each category in the 2015 RIZIV – INAMI data (current *actual* treatments) was transposed to the current optimal and for all future scenarios.). Moreover, the proportion of each category as determined in 2010 RIZIV-INAMI data was transposed to the actual BCR data in order to estimate the proportion of complexity use for 2010.

In addition, the complexity was weighted according to the approach used in the Dutch reimbursement system, yielding T2-equivalent treatments.[569] In this approach, a corrective factor is applied in function of the treatment complexity, giving more weight to complex treatment techniques as compared to the 'simpler' techniques. These different corrective factors were applied to the four Belgian reimbursement categories considering that category I treatments are equivalent to the Dutch 'simple technique' category (lower corrective factor) and category IV treatments are equivalent to the Dutch 'special techniques' category (high corrective factor). The result is that the total number of treatments that need to be delivered are weighted to an average category II equivalent.

The equation used is as follows:

T2 equivalent treatment =

0.3 * [number of category I treatments]

+ 1 * [number of category II treatments]

+ 1.7 * [number of category III treatments]

+ 2.9 * [number of category IV treatments]

The data used as inputs in order to calculate the number of EBRT devices required can be found in Table 97. These are available for the 'current' situation (2010 BCR data, 2015 RIZIV – INAMI data, 2012 optimal data (cf. Borras 2015[564])). These data were all extrapolated to 2025 and referred to as future situation.

Table 97 – Number of RT treatments 2015 and 2025 actual and optimal

Radiotherapy treatment input parameters	Actual number of treatments						Optimal number of treatments		
Current	Number of treatments 2010 (based on BCR)			Number of treatments 2015 (RIZIV – INAMI)			Number of treatments 2012 (based on CCORE)		
	Data	Total	Source	Data	Total	Source	Data	Total	Source
Cat I & Cat II (+ electrons)	6 775 3 607 146	**10 528**	*BCR + application of 2010 RIZIV-INAMI complexity ratios*	8 964 1 731 148	**10 843**	*RIZIV-INAMI*	11 284 2 179 186	**13 650**	*Borras, Lievens, et al. (2015)[564] + application of actual 2015 complexity ratios*
Curative 3D-CRT treatments (Cat III)	11 186	**11 186**	*BCR + application of 2010 RIZIV-INAMI complexity ratios*	11 228	**11 228**	*RIZIV-INAMI*	14 135	**14 135**	*Borras, Lievens, et al. (2015)[564] + application of actual 2015 complexity ratios*
Curative IMRT, SBRT treatments (Cat IV)	4 982	**4 982**	*BCR + application of 2010 RIZIV-INAMI complexity ratios*	12 476	**12 476**	*RIZIV-INAMI*	15 706	**15 706**	*Borras, Lievens, et al. (2015)[564] + application of actual 2015 complexity ratios*
Total number of EBRT treatments		**26 695**	*BCR + 25% retreatment rate Barton et al. (2014)[562]*		**34 547**	*RIZIV-INAMI*		**43 491**	*Borras, Barton, et al. (2015)[556] + 25% retreatment (Barton et al., 2014)*
Number of T2-equivalent treatments	39 146		*Slotman & Leer (2003)[569] Slotman & Vos (2013)[570]*	59 733		*Slotman & Leer (2003)[569] Slotman & Vos (2013)[570]*	75 197		*Slotman & Leer (2003)[569] Slotman & Vos (2013)[570]*
Estimated number of new patients	**21 356**		*BCR*	**27 638**		*RIZIV-INAMI - 20% to correct retreatment Borras, Barton, et al. (2015)[556]*	**34 792**		*Borras, Barton, et al. (2015)[556]*
Future (2025)	**Number of treatments 2025 (based on BCR)**			**Number of treatments 2025 (RIZIV-INAMI + BCR estimated increase)**			**Number of treatments 2025 (based on CCORE)**		
	Data	Total	Source	Data	Total	Source	Data	Total	Source
Cat I & Cat II (+ electrons)	9 463 1 827 156	**11 446**	*BCR + application of 2015 RIZIV-INAMI complexity ratios*	10 864 2 145 183	**13 192**	*2010 RIZIV-INAMI data + BCR estimated increase of 36.6% + application of 2015 RIZIV-INAMI complexity ratios*	13 554 2 617 224	**16 395**	*Borras et al. (2016)[568] + application of 2015 complexity ratios*

Curative 3D-CRT treatments (Cat III)	11 853	**11 853**	*BCR + application of 2015 RIZIV-INAMI complexity ratios*	13 912	**13 912**	*2010 RIZIV-INAMI data +BCR estimated increase of 36.6% + application of 2015 RIZIV-INAMI complexity ratios*	16 978	**16.978**	*Borras et al. (2016)[568] + application of 2015 complexity ratios*
Curative IMRT, SBRT treatments (Cat IV)	13 170	**13 170**	*BCR + application of 2015 RIZIV-INAMI complexity ratios*	15 459	**15 459**	*2010 RIZIV-INAMI data +BCR estimated increase of 36.6% + application of 2015 RIZIV-INAMI complexity ratios*	18 865	**18 865**	*Borras et al. (2016)[568] + application of 2015 complexity ratios*
Total number of treatments		**36 469**	*BCR + 25% retreatment rate*		**42 806**	*2010 RIZIV-INAMI data +BCR estimated increase of 36.6% + 25% retreatment rate*		**52 238**	*Borras et al. (2016)[568] + 25% retreatment Barton et al. (2014)[562]*
Number of T2-equivalent treatments	63 055		*Slotman & Leer (2003)[569] Slotman & Vos (2013)[570]*	7 3940		*Slotman & Leer (2003)[569] Slotman & Vos (2013)[570]*	90 321		*Slotman & Leer (2003)[569]*
Estimated number of new patients	**29 175**		*BCR*	**34 245**		*2010 RIZIV-INAMI data +BCR estimated increase of 36.6%*	**41 790**		*Borras et al. (2016)[568]*

7.3.2.5 Conversion of the number of treatments to the number of EBRT devices: the guideline approach

A certain number of publications or national guidelines propose standards, which provide recommendations on the number of EBRT devices required, as per number of treatments, number of inhabitants, or number of new patients. In this report, the following guidelines were used:

- QUARTS guidelines – evidence-based guidelines estimating infrastructure and staffing needs in Europe on a European level.[571]
- International Atomic Energy Agency's 2010's recommendations for National Radiotherapy services.[572]
- National guidelines existing in Denmark, the Netherlands, England and France.[569, 570, 573] These countries were chosen as the expert countries (see section 7.4) due to their extensive expertise in forecasting radiotherapy needs in the context of national cancer plans. For this reason, the same countries were selected to benchmark the Belgian data with. Ireland was not included in this exercise, due to lack of country-specific recommendations.

Integration of complexity into the guidelines

The IAEA and QUARTS guidelines suggest accounting for the complexity of the treatments in which they attribute a higher number of treatments/EBRT device for simpler techniques (450 for QUARTS, 500 for IAEA) and a lower number of treatments/EBRT device for more complex techniques (400 for QUARTS, 200 for IAEA). In order to factor this in in the calculations, it was decided to compute the minimum (i.e. no complexity) and maximum (i.e. 100% complexity) figures. The weighted average was also computed, assuming that treatments categorized as category IV (Table A. 2) in the Belgian nomenclature could be considered 'complex' treatments.

As a consequence, the following equations were used for the weighted average calculations:

Total number of EBRT devices (QUARTS):

[number of category I treatments + number of category II treatments

+ number of category III treatments] / (450 treatments /EBRT device)

+ [number of category IV treatment] / (400 treatments /EBRT device)

Total number of EBRT devices (IAEA):

[number of category I treatments + number of category II treatments

+ number of category III treatments] / (500 treatments/EBRT device)

+ (number of category IV treatment) / (200 treatments/EBRT device)

The approach used in the Dutch reimbursement system, calculating T2-equivalent treatments, has already been explained previously and was integrated in the calculation. In this model, one MV unit is assumed for each 500 T2-equivalent treatments.

Integration of population determinants

The English and French guidelines estimate the need of EBRT equipment as a function of the number of inhabitants. In order to make this calculation for Belgium, the national inhabitants' number was obtained through the Federal Planning Bureau.[574] The population is equivalent to 11 267 910 as of today and is predicted to be equivalent to 11 759 158 in 2025.

It should however be acknowledged that these recommendations are top-down approaches, corresponding to a pre-existing situation. Hence, they tend to be either outdated and/or omit the complexity of the activities underlying current standard-of-care RT treatments.

7.3.2.6 Conversion of the number of treatments to the number of EBRT devices: a Time-Driven Activity-Based Costing approach

A model assessing the cost of RT at national level using a time-driven activity-based costing (TD-ABC) model has been developed in the frame of the Health Economics in Radiotherapy and Oncology (HERO) project of the European Society for Radiotherapy and Oncology. This costing model, allocating the total available resource time to the treatments delivered on the basis of the time required for each separate step in the treatment process, is used in the present study to deduct the number of EBRT devices required to treat the *actual number* of treatments in 2015 (see Table 97). In addition, the aim of this approach was to analyse the impact of different complexity variables (i.e. image-guidance, in vivo dosimetry and motion management), fractionation schedules and operational parameters on the required number of LINACs.

The main assumptions made in the base case scenario, which comprises the actual treatment delivery and image-guidance at the start of the treatment, are as follows:

- The *total available resource time* is defined by the EBRT devices' daily operational hours, which commonly are 8 hours.
- Data on the *duration time per treatment step* are based on published literature (Table 100). However, as these duration estimates may or may not be representative of Belgian current practice, the average duration time was deducted from the minimum and maximum times retrieved from the literature.
- Radiotherapy treatments are defined in terms of techniques and fractionation schedule and per tumour site. Techniques are distinguished in six groups covering the wide spectrum of practice: single field, 2D-RT, 3D-CRT, IMRT, IMRT rotational, stereotactic techniques; fractionation schedules cover normofractionation (>24 treatment sessions, or fractions), hypofractionation (11-24 fractions) and extreme hypofractionation (<11 fractions). The allocation of the actual treatments delivered to the various tumour types and fractionation schedules is estimated through the CCORE decision tree model, in which Belgian cancer incidence data were incorporated for the year 2015, following the approach described by Borras et al. for the HERO-project.[556, 575] Commonly used technicity for each treatment type was defined by expert estimates, but corrected for the known relative complexity (or techniques used) in Belgium, derived from the proportional distribution of the RIZIV – INAMI treatment categories delivered in 2015.

In addition, different scenarios (shown in Table 101) are simulating 1) the impact of complexity features, 2) the impact of combined complexities with changes in the fractionation schedules for specific cases and 3) the impact of changing operational times on the number of treatment devices needed.

It should be noted that machine-specific QA was assumed to be taken care of outside treatment hours, hence was not accounted in the computations.

Complexity

The impact of the three following complexity features on the number of treatment devices needed was considered against the base case scenario. This analysis investigates first the impact of the complexity features one by one, then pairing them two by two and then combining them all.

- IGRT, which has nowadays become a part of routine practice as it ascertains the correct positioning of the patients, was modeled to be performed more frequently. Whereas for palliative indications it remains common that an image is taken only during the first fraction, for curative intent treatments, this is done at least weekly, while for more complex treatments (e.g. IMRT treatments), daily imaging is the standard-of-care. The impact of applying either of these approaches is used in the first sensitivity analysis.
- To account for organ and tumour motion, motion management techniques are frequently applied, e.g. in the treatment of breast and lung tumours. The impact of implementing motion management to all breast and lung cancer patients was tested.
- Lastly, in vivo dosimetry is frequently implemented in order to monitor the dose delivered during treatment delivery. The use of in vivo dosimetry at the first fraction was evaluated.

Fractionation schedules

Shortening the fractionation schedules has a positive impact on the burden for the patient as well as the department, due to reducing the number of travels and of treatment slots. Hypofractionated schedules have been validated in randomised controlled trials for (a subset of) breast, prostate and lung cancer patients, but necessitate using state-of-the-art radiotherapy with adequate QA, in order to avoid increased toxicity. To test the impact of hypofractionation, the base case of this scenario analysis was therefore defined as the combination of all three complexity features described above (daily IGRT, motion management if applicable and in vivo dosimetry). The change in fractionation schedule for the three following tumour sites was explored one by one and conjointly.

- *Breast cancer* treatments were already defined as standard hypofractionated schedules in the base case model (i.e. delivering 15 and 19 fractions) following CCORE methodology, but a more extreme approach delivering 5 fractions has been tested in RCTs and could become the standard in the years to come. This extreme approach was modelled, by changing all 15 or 19 fraction schedules, delivered with either 3D-CRT (52%) or (rotational) IMRT (48%), into a 5 fractions schedule, all delivered with IMRT or rotational IMRT techniques. This scenario represents a transfer of the vast majority of all breast treatments to 5 fractions (9 874 RT courses) and should be seen as the extreme achievable.[576]
- For *lung cancer*, RT courses defined as 30 fractions, delivered either with 3D-CRT (62%), or (rotational) IMRT (38%) techniques in the base case model, were modeled to be treated with 24 fractions, all with (rotational) IMRT, in case of a non-concurrent chemo-radiotherapy approach.[577] This change of fractionation schedule is applied to 62% of lung treatments (or two-thirds of the treatments delivering 60 Gy, i.e. 1 203 EBRT treatments).
- Lastly, the fractionation schedule of *prostate RT treatments* of 37 fractions delivered with IMRT (50%) and IMRT rotational (50%), are redefined to 20 fractions with identical techniques. This change of fractionation schedule concerns 55% of prostate EBRT (1 663 EBRT treatments).[578]

Operational parameter

The impact of extending the operating time of the departments and EBRT devices is analysed by comparing the initial assumption of using it 8 hours per day to 12 hours.

7.3.3 Results

7.3.3.1 RT resource needs to date

The application of the various guidelines to the Belgian context enables independent estimates of the national requirement of EBRT devices. The recommendations for Belgium based on these international guidelines can be found in Table 98. Using *current* treatment data, the Danish and the Dutch guidelines indicate the need for a greater number of EBRT devices with respectively a recommendation of 138 and 119 EBRT devices at the national level. It is important to note that treatment complexity is taken into account in the Dutch approach.

In the calculations based upon the IAEA and QUARTS guidelines, it is possible to calculate the number of required EBRT devices based on the assumption that there are no complex treatments (minimal value in Table 98). Similarly, it is possible to deduce the number of required EBRT devices if all treatments were delivered using complex techniques (maximal value in Table 98).

The resulting figures would then indicate that the demand of EBRT devices is estimated to increase by 12% in QUARTS but even by 151% percent in IAEA with increasing complexity. A weighed average - taking into account the actual proportion of treatment complexity - represents a recommendation of 80 and 107 EBRT devices at a national level, according to the QUARTS and IAEA guidelines respectively.

The QUARTS, English and French approaches seem to recommend a total number of EBRT devices lower than the actual Belgian status of equipment. However, as mentioned, the QUARTS guidelines typically represent a situation retrofitted to a certain point in time, without accounting for the evolution of the RT treatment complexity and/or fractionation schedules. The English and French recommendations, conversely, are based on the number of inhabitants, which disregards the actual needs based on a certain cancer population mix.

Finally, all guidelines calculating the number of EBRT devices per department seem to indicate that the Belgian mean of EBRT devices per department is somewhat lower than the recommendations, except for the

QUARTs guidelines, which recommend 3.2 - 3.6 EBRT devices per department.

When taking into account the *optimal* number of treatments that should be delivered, there is, as to be expected, an increase in the requirements of EBRT devices (Table 98). This increase is globally equivalent to a 26% increase with the exception of those recommendations that derive the required number of EBRT devices from the number of inhabitants, which predict a slower growth in equipment needs.

7.3.3.2 Future RT resource needs by 2025

Based upon the prediction of demographic changes and the ensuing future treatment needs, it is possible to apply the total number of treatments as predicted by applying the percentile increase estimated by the BCR to the 2010 RIZIV-INAMI data and the optimal projections from Borras et al. for 2025 to the different existing guidelines.[568] This allows us to estimate the future needs of EBRT equipment. As shown in Table 97, there is about a 0.82 ratio between the actual number of treatments predicted for 2025 by the BCR and the optimal number of treatments predicted by Borras et al. This translates roughly into a 22% difference in the estimation of equipment needs from the actual and optimal projections for 2025, calculated by the guidelines and taking into account the total number of treatments (Table 99).

As can also be observed in the comparison between Table 98 and Table 99, the need for EBRT equipment would increase with about 24% in the next decade if one would assume that the actual treatment delivery situation were to remain identical (and thus only accounting for demographic and cancer incidence change). On the contrary, this increase would amount to more than 50% if the actual situation of relative under-treatment would improve to the optimal situation as proposed by CCORE-HERO by 2025.

Finally, as predicted, the models based on the number of inhabitants also indicate a limited increase below 5% over the next decade. This approach however completely neglects the evolution in demographic determinants of the population, where, as is well known, the ageing of the population plays an important role in the cancer incidence, hence n radiotherapy needs.[568]

7.3.3.3 Scenario analysis: impact of treatment complexity and fractionation on the EBRT devices needed to date

According to the TD-ABC analysis and the assumed parameters in the base case and scenario analyses, the number of required EBRT machines in Belgium should be between 66 and 106 for 2015, depending on the complexity features and the fractionation schedules considered as current EBRT practice, and assuming an 8-hour operational schedule (Table 101).

As a base case, it was found that in order to deliver 34 547 EBRT courses in 2015, with the given mix in techniques and using IGRT (only) at the beginning of each treatment, 66 EBRT devices would have been required in Belgium. This can however be regarded as a suboptimal situation, as the actual standard-of-care advocates for using more image-guidance in curative intent treatments. The impact of performing more image guidance is major, with increases in EBRT device needs between 4 and 29 machines for IGRT weekly resp. daily. The increases related to the other complexity features, in comparison to the base case scenario, range from 1 for in vivo dosimetry at the first fraction to 11 for motion management applied in breast and lung cancer patients (Figure 94). When complexity features are combined by pairs or jointly, the need of EBRT devices rises with 44% to 61%, corresponding to 95 and 106 EBRT devices (Table 101).

Shorter fractionation schedules compensate for the increased EBRT device needs related to complexity. Because changing the fractionation schedules implies the use for advanced techniques along with complexity features in order to avoid unmeant increases in toxicity, this last number of 106 machines was used as the reference to evaluate the impact of shifting the number of fractions. A modification of the fractionation schedule for breast, lung and prostate EBRT treatments reduces the need of EBRT devices by, respectively, 23%, 1% and 5% (Figure 95).

The most extreme example is clearly the one assuming extremely hypofractionated EBRT for breast cancer, due to the combined effect of large patient numbers and important decrease in fractions. It should be noted that this is an approach that has not been validated clinically at long term; hence this purely shows what could be the maximal impact in the future. Moreover, the CCORE model assumes that all breast cancer patients

are already treated with hypofractionation, which is probably not yet fully implemented in the Belgian context, but data on this are lacking. This means that the assumptions for breast cancer were probably already too optimistic in the base case scenario. Lastly, no attempt was made to adjust the treatment time slots in the extremely hypofractionated breast scenario, which again may be seen as a simplification of reality, leading to an overestimation of the actual gain in needs. As a matter of comparison, the opposite extreme was also modelled, that is, assuming that all curative intent breast cancer treatments would still be delivered with normofractionated schedules. In order to estimate the impact of this scenario, 38% of all patients were modelled to receive 25 fractions and 62% 33 fractions, keeping the same complexity as for the extreme hypofractionation scenario. The resulting figure for EBRT devices needed is 138, which are 56 devices more compared to the 82 in case of full implementation of extremely hypofractionated radiotherapy (Table 101). Although this is a purely theoretical and simplified example (e.g. assuming only fractionation changes, while using the same complexity in both scenarios), it clearly demonstrates the potential of changing practice on resource demands in very frequent tumour types such as breast cancer.

When pushing this modelling exercise to the extreme, combining the cumulated effect of complexity features and all fractionation schedule changes, it is estimated that 74 EBRT devices would be required. A more moderate estimate, only combining the complexity changes with hypofractionation in lung and prostate results in 101 EBRT devices needed (Table 101).

Lastly, a change in organization of care was considered by extending the daily number of device's operational hours from 8 to 12 hours. This operational shift generates a reduction of 67% in terms of EBRT resource needs, regardless of the scenario tested (Figure 96 and Figure 97).

Table 98 – Estimation of current actual and optimal EBRT equipment needs as a function of existing guidelines

Guidelines used	Recommendations			Actual Belgian needs according to RIZIV-INAMI (2015) and recommendations				Optimal Belgian needs according to Belgian OUP (2012) and recommendations			
	Machines at country level	Machines at departmental level (minimum level)	Satellites	Machines at country level***		Machines at departmental level¥		Machines at country level***		Machines at departmental level¥	
				Min	Max	Min	Max	Min	Max	Min	Max
QUARTS ***(Bentzen et al., 2005)***[571]	1 MV*/450 patients**/year; Increasing complexity: 1/400-450 patients**/year	1 MV*/450 patients**/year; Increasing complexity: 1/400-450 patients**/year		77	86	3.2	3.6	97	109	4.0	4.5
	Integrating complexity factor based upon the RIZIV-INAMI category data			80		3.3		101		4.2	
IAEA ***(International Atomic Energy Agency (IAEA), 2010)***[572]		1 MV*/200-500 patients**/year depending on complexity		*(69)*	*(173)*	2.9	7.2	87	217	3.6	9.1
	Integrating complexity factor based upon the RIZIV-INAMI category data			*(107)*		4.4		134		5.6	
Denmark ***(Dunscombe et al., 2014)***[573]	1 MV* per 200 new patients	1 MV*/5 000 fractions and more than 2MV* per department		138				174			
The Netherlands ***(Slotman & Leer, 2003; Slotman & Vos, 2013)***[569, 570]	1 MV*/500 teletherapy treatments (based upon T2 equivalent treatments)	1 MV*/500 teletherapy treatments (T2 equivalent)	Mother centre ≥4; satellite ≥ 2MV* and same QMS	119		5,0		150		6.3	
England**** ***(Royal College of Radiologists, 2003)***[579]	1 MV*/250 000 inhabitants			45				45			
France ***(Dunscombe et al., 2014)*** [573]	1 MV*/140 000 inhabitants			80				80			

*¥Based upon the existing 24 Belgian departments, * MV unit = EBRT device, LINAC; ** Guidelines often refer to the number of patients thus excluding the notion of retreatment – we therefore considered 'total number of treatments' when the models refer to number of patients; *** Rounded up to the nearest integer, **** England recommendations correspond to UK recommendations.*

Table 99 – Estimation of future actual and optimal EBRT equipment needs as a function of existing guidelines

Guidelines used	Recommendations			Actual Belgian needs according to RIZIV-INAMI (2025) and recommendations				Optimal Belgian needs according to Belgian OUP (2025) and recommendations			
	Machine at country level	Machine at departmental level (minimum level)	Satellites	Machine at country level		Machine at departmental level¥		Machine at country level		Machine at departmental level¥	
				Min	Max	Min	Max	Min	Max	Min	Max
QUARTS *(Bentzen et al., 2005)*[571]	1 MV*/450 patients**/year; Increasing complexity: 1/400-450 patients**/year	1 MV*/450 patients**/year; Increasing complexity: 1/400-450 patients**/year		95	107	4,0	4,5		131	4,8	5,4
	Integrating complexity factor based upon the RIZIV-INAMI category data			99		4,1		121		5,1	
IAEA *((International Atomic Energy Agency (IAEA), 2010)*[572]		1 MV*/200-500 patients**/year depending on complexity		*(86)*	*(214)*	3,6	8,9	104	261	4,4	10,9
	Integrating complexity factor based upon the RIZIV-INAMI category data			*132*		5,5		161		6,7	
Denmark *(Dunscombe et al., 2014)*[573]	1 MV* per 200 new patients	1 MV*/5 000 fractions and more than 2MV* per department		171				209			
The Netherlands *(Slotman & Leer, 2003; Slotman & Vos, 2013)*[579]	1 MV*/500 teletherapy treatments (based upon T2 equivalent treatments)	1 MV*/500 teletherapy treatments (T2 equivalent)	Mother centre ≥ 4; satellite ≥ 2MV* and same QMS	148		5,2		181		7,5	
England** *(Royal College of Radiologists, 2003)*[579]**	1 MV*/250 000 inhabitants			47				47			
France *(Dunscombe et al., 2014)* [573]	1 MV*/140 000 inhabitants			84				84			

*¥Based upon the existing 24 Belgian departments, ʏ applying the BCR estimated increase in treatments (36.6%) to the 2010 RIZIV-INAMI data * MV unit = EBRT device, LINAC; ** Guidelines often refer to the number of patients thus excluding the notion of retreatment – we therefore considered 'total number of treatments' when the models refer to number of patients; *** Rounded up to the nearest integer, **** England recommendations correspond to UK recommendations.*

Table 100 – Data source and assumptions of the TD-ABC model

Operational parameters				Source
RESOURCES				
Daily operating hours		8	12 (SA)	Expert estimates
Annual number of working days**		251		Expert estimates
TREATMENT STEPS				
Time estimate per fraction				
treatment delivery	**Average**	**min**	**max**	
1 field	7 min.	7 min.	7 min.	(Beech 2016)[18]
2D-RT	12 min.	9 min.	14 min.	(van de Werf 2012)[580] - (Winkler 2014)[581]
3D-CRT	14 min.	9 min.	18 min.	(van de Werf 2012)[580] - (Hummel 2010)[582]
IMRT	17 min.	9 min.	24 min.	(Vorwerk 2014)[583] - (Budach 2011)[584]
IMRT rotational	10 min.	7 min.	13 min.	(Beech 2016) - (Winkler 2014)[581]
SBRT	22 min.	13 min.	30 min.	(Zabel-du-Bois 2012 – intracranial, extracranial)[585]
image guidance		**min**	**max**	
1 field	6 min.	5 min. *	7 min. *	(Beech 2016)[18]* -(van de Werf 2012)[580]*
2D-RT	6 min.	5 min.	7 min.	(Beech 2016)[18] - (van de Werf 2012)[580]
3D-CRT	5 min.	3 min.	7 min.	(Budach 2011)[584] - (van de Werf 2012)[580]
IMRT	*7 min.*	5 min.	9 min.	(Blank 2012)[586] - (Winkler 2014)[581]
IMRT rotational	*8 min.*	6 min.	10 min.	(Winkler 2014: RapidArc- Tomo)[581]
SBRT	*9 min.*	7 min.	10 min.*	(Zabel-du-Bois 2012)[585] - Winkler 2014)*[581]
motion management		**min**	**max**	
1 field	6 min.	4 min. *	8 min. *	(Remmonnay 2009)*[587]
2D-RT	6 min.	4 min. *	8 min. *	(Remmonnay 2009)*[587]
3D-CRT	6 min.	4 min.	8 min.	(Remmonnay 2009)[587]
IMRT	6 min.	4 min. *	8 min. *	(Remmonnay 2009)*[587]
IMRT rotational	6 min.	4 min. *	8 min. *	(Remmonnay 2009)*[587]
SBRT	6 min.	4 min. *	8 min. *	(Remmonnay 2009)*[587]
in vivo dosimetry		**min**	**max**	

1 field	2 min.	0 min.*	3 min.*	(Ricketts 2016)*[588] – (Ban 2014)*[589]
2D-RT	2 min.	0 min.*	3 min.*	(Ricketts 2016)*[588] – (Ban 2014)*[589]
3D-CRT	2 min.	0 min.*	3 min.*	(Ricketts 2016)*[588] – (Ban 2014)*[589]
IMRT	2 min.	0 min.	3 min .	(Ricketts 2016)[588] – (Ban 2014)[589]
IMRT rotational	2 min.	0 min.*	3 min.*	(Ricketts 2016)*[588] – (Ban 2014)*[589]
SBRT	2 min.	0 min.*	3 min.*	(Ricketts 2016)*[588] – (Ban 2014)*[589]
Frequency of activities				
Treatment delivery		Daily		
- Image-guidance		First fraction		
			Weekly (SA)	
			Daily (SA)	
- Motion management			Daily (SA)	For breast and lung RT courses
- In vivo dosimetry			First fraction (SA)	
RT TREATMENTS				
N° of treatments delivered				Actual number of treatments 2015 (RIZIV-INAMI)
N° of fractions: fractionation schedules per organ site and indication				CCORE EBM (Wang et al., 2016)[590]
Proportion of technicity per fractionation schedule				Expert estimates, corrected for actual RIZIV-INAMI categories

*** National bank holidays during which the department is closed is assumed to be ten days; * Quality management and verification and review of treatment activities in which MV are used were not included in this model because it was assumed that these activities take place outside working hours; (*) A maximum of 5 fractions is estimated to be delivered per week (1fraction/day).*

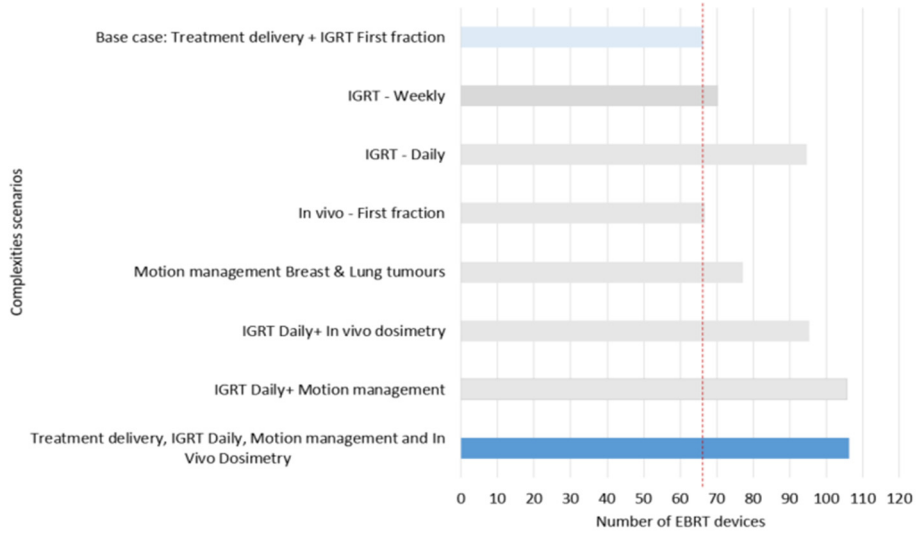
Table 101 – Results of EBRT device needs for all scenarios

Scenarios	Number of EBRT devices needed	Percentile EBRT device needs compared to base case	EBRT device needs for 12 hours operation scenario
Complexity			
Baseline			
Treatment delivery activity + IGRT at first fraction	**66**	**100%**	(44)
Scenario 1			
Baseline +			
A) **Image-guided RT weekly**	70	*106%*	(47)
B) **Image-guided RT daily**	95	*143%*	(63)
Scenario 2			
Baseline + In vivo dosimetry at first fraction	67	*101%*	(44)
Scenario 3			
Baseline + Motion management for breast & lung tumours	77	*117%*	(51)
Scenario 4			
Baseline + IGRT Daily + In vivo dosimetry at first fraction	95	*144%*	(64)
Scenario 5			
Baseline + IGRT Daily + Motion management for breast & lung tumors	106	*160%*	(70)
Scenario 6			
Baseline + All complexities combined	106	*161%*	(71)

Fractionation schedule			
Baseline (cf. scenario 6 above)			
Treatment delivery activity + IGRT Daily + In vivo dosimetry at first fraction + Motion management for breast & lung tumours	**106**	**100%**	(71)
Scenario 7			
Baseline + Breast treatments of 5 fractions (all IMRT)	82	*77%*	(55)
Breast treatments of 33/25 fractions (all IMRT)	*138*	*129%*	*(92)*
Scenario 8			
Baseline + Lung treatments of 24 fractions	105	*99%*	(70)
Scenario 9			
Baseline + Prostate treatments of 20 fractions	101	*95%*	(68)
Scenario 10			
Baseline + All fractionation schedules combined	74	*70%*	(50)

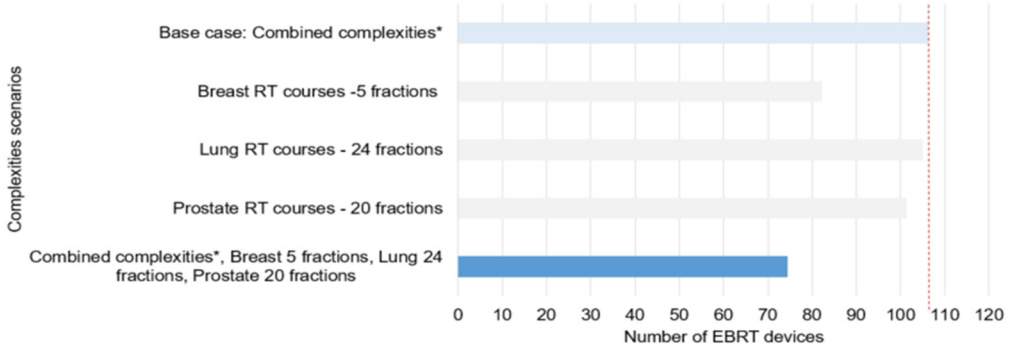
Note: All EBRT estimations displayed in the table were rounded to the nearest integer.

Figure 94 – Number of EBRT devices required for scenarios on complexity features



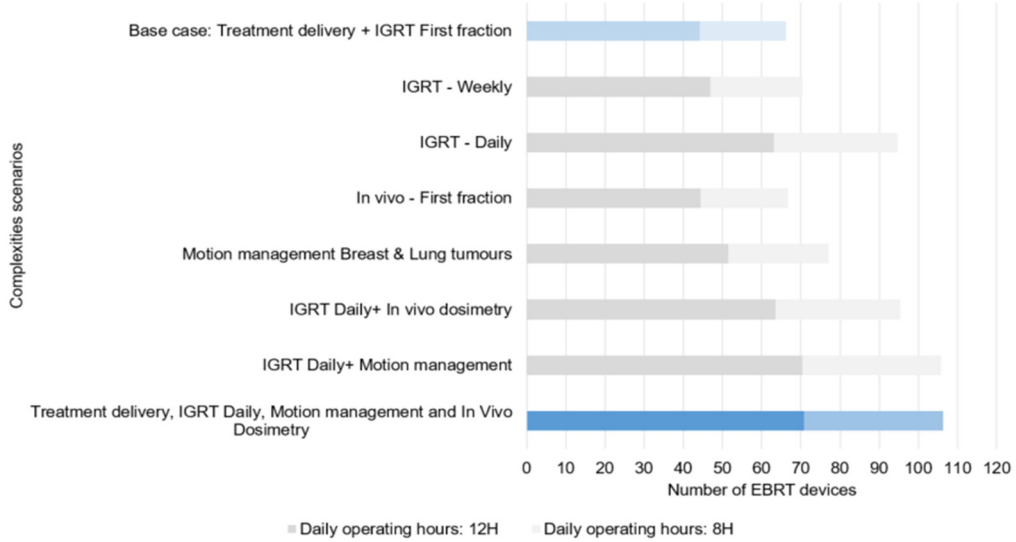
The red dotted line extends the results of the base case scenario to the other ones.

Figure 95 – Number of EBRT devices required for scenarios on fractionation schedules



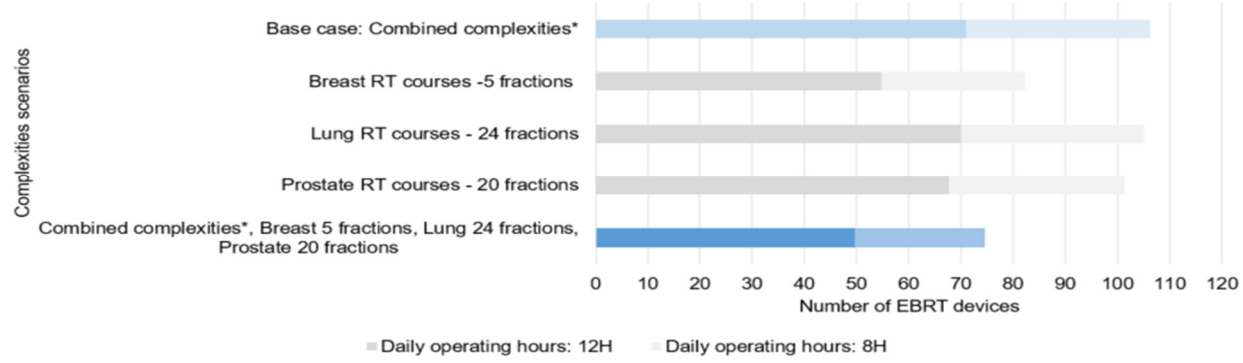
**Base case encompasses the following treatment steps: treatment delivery, IGRT daily, in vivo dosimetry at first fraction and motion management for breast and lung cancers.*
The red dotted line extends the results of the base case scenario to the other ones.

Figure 96 – Number of EBRT devices required for scenarios on complexity features for a change in operational parameter



**Base case encompasses the following treatment steps: treatment delivery, IGRT daily, in vivo dosimetry at first fraction and motion management for breast and lung cancers.*

Figure 97 – Number of EBRT devices required for scenarios on complexity features and fractionation schedules for a change in operational parameter



**Base case encompasses the following treatment steps: treatment delivery, IGRT daily, in vivo dosimetry at first fraction and motion management for breast and lung cancers.*

7.4 How are radiotherapy services organised in a selection of countries?

7.4.1 Introduction

Data for comparison between the selected European countries come from the Health Economics in Radiation Oncology (HERO) project. Initiated by ESTRO, this project has provided a validated picture of the European radiotherapy landscape in terms of the availability of equipment, personnel and guidelines. An 84-item questionnaire was distributed to the 40 countries of the European Cancer Observatory, of which 34 provided partial or complete responses. There was a huge variation in the availability and sophistication of treatment equipment and staffing levels across Europe.

The median number of MV units per million inhabitants was 5.3, but there was a seven-fold variation across the European countries. Table 102 shows the HERO equipment indicators for Belgium, and the five benchmark countries (Ireland, the Netherlands, France, United Kingdom highlighting England and Denmark), and the European median. The five benchmark countries have been selected in order to cover a varied spectrum of practices, both taking into account a fair geographic representation of the diversity in Europe, and selecting countries were some experiences in planning and rationalisation took place over the years. Finally, the five benchmark countries have been strict collaborators of the HERO project, and the baseline data on staffing and equipment were already available in the HERO papers.

Table 102 – Calculated indicators for availability of radiotherapy equipment in Belgium, the five countries, and the median of all 28 European countries included in the HERO database (2011-2013)

	Indicators									
Countries	**Depart-ments / mil inh**	**MV units / mil inh**	**MV units / dep**	**MV units with IMRT**	**MV units with IGRT**	**Sim / dep**	**Sim / MV unit**	**Sim with 3D**	**Courses / dep**	**Courses / MV**
Belgium	2.3	8.2	3.6	78%	63%	1.2	0.3	72%	1 387	381
Denmark	1.3	9.5	7.6	94%	89%	2.0	0.3	100%	2 526	334
France	2.6	6.9	2.6	92%	53%	1.0	0.4	84%	1 088	417
Ireland	2.6	7.0	2.7	31%	31%	1.0	0.4	75%	698	262
The Netherlands	1.3	7.9	6.3	95%	95%	1.8	0.3	79%	2 652	422
United Kingdom	1.2	5.0	4.3	59%	35%	1.9	0.4	82%		
European median	1.7	5.3	2.6	73%	45%	1.4	0.5	72%	1 173	419

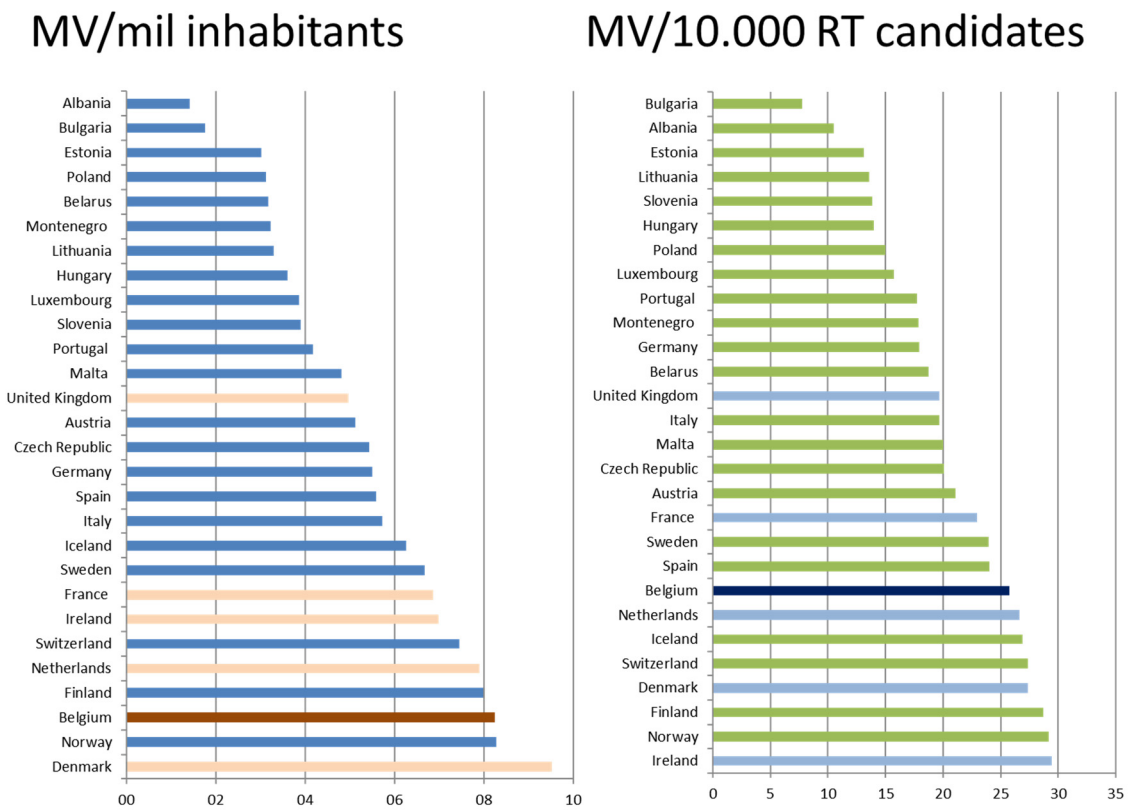
Average staffing figures per million inhabitants were 12.8 for radiation oncologists, 7.6 for physicists, 3.5 for dosimetrists, 26.6 for radiation therapists and 14.8 for nurses. Again, there was a 20-fold variation, even after grouping personnel with comparable duties in the radiotherapy process.

Guidelines for capital and human resources were declared for most countries, but without explicitly providing metrics for developing capital and human resource inventories in many cases.

The evidence-based need for radiotherapy now and in future was subsequently studied. Decision trees of the evidence-based indications were used to calculate the Optimal Utilization Proportion (OUP) by tumour site. Of note, it was found that Belgium had the highest OUP of all European countries (53.3%), due to a relatively high proportion of tumour sites where radiotherapy plays a major role.

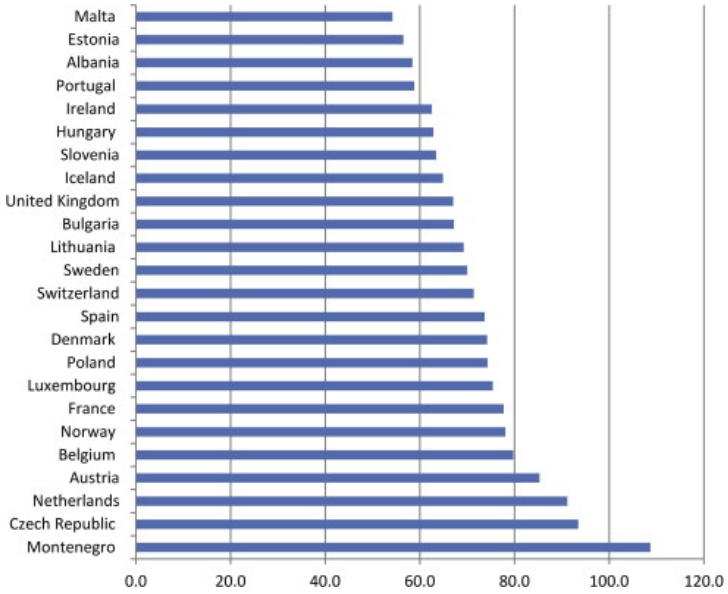
Information about the OUP was used to calculate a new, and potentially more reliable, indicator, the number of treatment machines (MV units) per 10 000 radiotherapy candidates. The variation between countries is much less than if the number of machines are simply related to the number of inhabitants (see Figure 98)

Figure 98 – Waterfall plot showing the number of MV radiotherapy machines per million inhabitants (left) or per 10 000 candidates for radiotherapy (right)



Based on Grau et al. (2014)[591] and Borras et al. (2016)[568]

Figure 99 – Waterfall plot showing the percentage of patients receiving radiotherapy relative to the optimal utilization

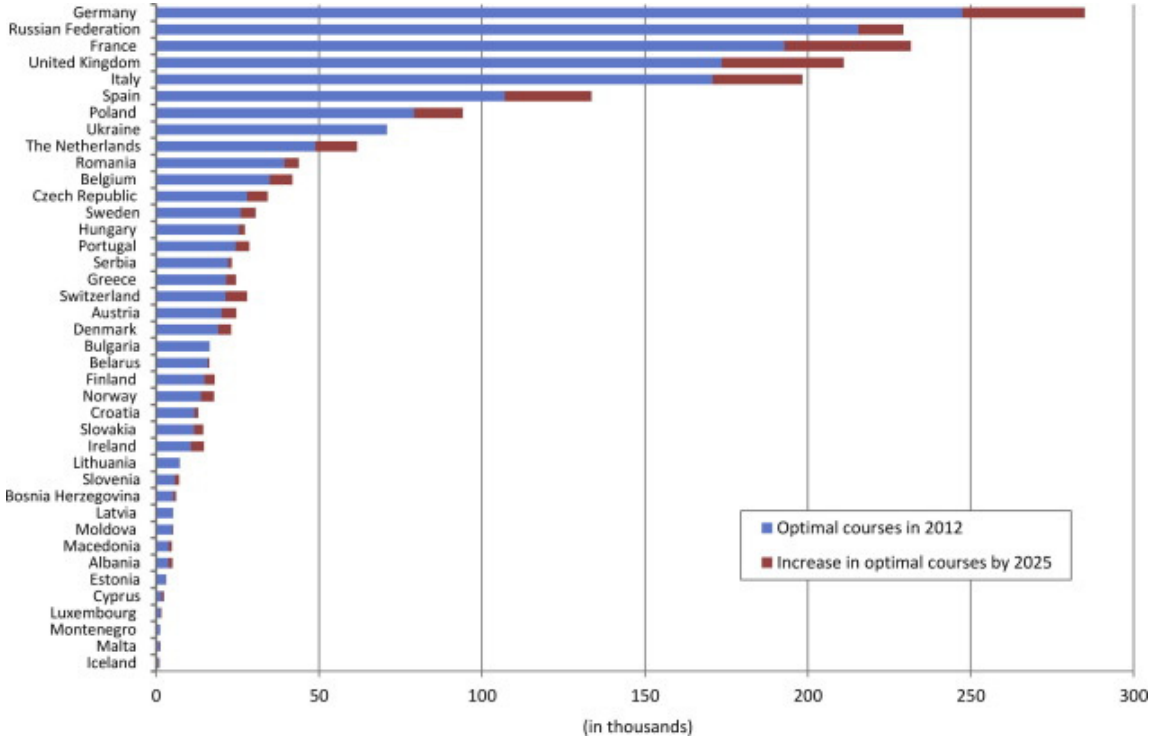


Source: Borras et al. (2016)[568]

The absolute number of new cancer patients with an indication for radiotherapy was significantly lower than the optimal, as predicted from the evidence-based estimates. On average, only 69% of the optimal utilization was observed (Figure 99). The utilization rate in Belgium (80% of OUP) ranges among the highest in Europe. Nevertheless, understanding and closing the gap poses a major challenge for the radiotherapy community as well as policy makers when planning the resources.

Finally, the need for radiotherapy by 2025 has been calculated, using the GLOBOCAN database, taking demographic and cancer incidence factors into account for each country. The highest expected relative increase from 2012 to 2025 in treatment courses is prostate cancer (24%) while lymphoma (13%), head and neck (12%) and breast cancer (10%) were below the average. Overall, a 16% expected increase in the optimal number of radiotherapy treatment courses is estimated for Europe. For Belgium, the forecast is an increase by 20%, from 35 000 to 42 000 annual courses (Figure 100).

Figure 100 – Optimal number of courses of radiotherapy in 2012 and estimated absolute increase in optimal number of courses by 2025



Source: Borras et al. (2016)[568]

The following sections describe the planning and organisation of radiotherapy services in the five selected European countries.

7.4.2 England

Author: Peter Hoskin, Mount Vernon Hospital, Middlesex, England

England is one of four countries in the United Kingdom and has by far the largest population with almost 55 million, Scotland has 5 million, Wales 3 million and Northern Ireland 1.8 million. In England all inhabitants are provided free health care through the National Health Service (NHS). NHS England is funded through central government funding from national taxation. Cancer services including radiotherapy are commissioned centrally through NHS England.

There are 49 radiotherapy departments in England, developed historically based in major hospitals across the country. These are divided across academic centres, major general hospitals and there are three large freestanding cancer centres. Satellites to deliver radiotherapy locally have been established from a small number of centres (6): there are no legal restrictions but in general the establishment of a satellite is not considered as cost-effective. There are also a small number of non-governmental private providers, predominantly concentrated around the South East part of England, typically one or two linear accelerator departments and in central London there are two private Cyberknife centres. Two NHS proton centres are being developed, one in London and the other in Manchester due to open for treatment in 2017/18. Currently a small number of approved patients are sent abroad for proton therapy.

There are approximately 265 linear accelerators functioning in England equivalent to 5.1 per million population. The average linear accelerator workload in 2012 was 6 800 attendances per year (compared to the term 'fraction', the term 'attendance' refers also to the case where some patients may have more than one fraction e.g. a primary site and nodal boost as two different plans) and between 2005 and 2011 there was a 13% increase in radiotherapy fractions. This has continued to rise and in 2016 a total of 1 838 555 fractions were delivered, an increase of 3.5% on the previous year. There are no cobalt machines remaining in the UK. There is concern that the linear accelerator complement in the UK is aging with 13% over 10 years old in 2013. The mechanism for funding of new machines is not well defined, typically dependent upon individual providers providing financial solutions for purchase or leasing of equipment. The UK government has recognised this problem and undertaken to provide a substantial financial package for replacement of aging machines over the next five years.

Radiotherapy is commissioned through a central mechanism which is currently under review with a proposal that there will be a three-tier structure for the designation of radiotherapy centres with larger centres undertaking all major and complex treatment and smaller centres providing a limited range of routine treatments for common cancers. At this stage, the proposal is a consultation document and the definition of large centre is not clear cut yet, especially if it is linked to the case load or also the ability to deliver complex comprehensive care to rare tumours as well as common sites. There are national targets for the delivery of cancer care; patients referred as suspected cancer cases must receive their first treatment within 62 days of referral and others within 31 days of the decision to treat. This can distort priorities in local departments when scheduling patients. A target for implementation of IMRT has been set and in 2012 98% of centres were delivering IMRT for radical radiotherapy. In 2016 an average of 25% of radiotherapy episodes are delivered by IMRT. SBRT has been subject to restricted access through a commissioning framework which limits its use to primary lung cancer and oligometastases in 17 accredited centres only. The limitation to 17 centres was pre-defined, and the definition of which centres should be allowed to deliver SBRT was based on a tender process against specific criteria. Similarly, SRS for brain metastases and other CNS lesions has been limited to access through 18 designated centres for SRS.

The national radiotherapy data set collects all radiotherapy activity through downloads from the record and verify system of each radiotherapy provider monthly. Submission of this data is mandatory in England and it is currently analysed by Public Health England alongside cancer registry, hospital activity and chemotherapy activity datasets.

Radiotherapy in England is undertaken by Clinical Oncologists who are specialised in both chemotherapy and radiotherapy. There is no recognition of the specialty radiation oncology. Entry into training occurs typically after two or three years general medical training following graduation during which the candidate must gain membership of the Royal College of Physicians (MRCP), a post graduate qualification by examination in general

medicine. The training programme is for five years undertaken under the auspices of the Royal College of Radiologists who define the curriculum, training requirements and deliver examinations which lead to the award of Fellowship of the Royal College of Radiologists (FRCR) after successful completion. Regulation of training is through the General Medical Council (GMC) who approve the curriculum and assessment procedures.

The number of whole time equivalent clinical oncologists has risen by 4% every year for the past 5 years however this is balanced by an increasing number working part time, currently 23% of the workforce, and an ongoing number of posts unfilled for > 1 year. Currently there are 691 posts filled in England. There are concerns that almost one fifth will have reached retirement age in the next 5 years heralding a potential crisis in medical manpower.

In most regions, a hub and spoke arrangement exists for the delivery of radiotherapy with clinical oncologists from the radiotherapy centre visiting surrounding hospitals where patients are seen in outreach clinics. In many of these peripheral units, clinical oncologists will be undertaking chemotherapy in these hospitals as well as their main centre. Specialist MDTs covering all tumour sites attended by site specialised clinical oncologists are now a mandatory component of the pathway.

Medical physicists train in radiotherapy physics following a first degree in physics with a formal programme leading to registration through a Masters programme. This is followed for selected candidates by a five-year higher specialist training programme at a doctorate level. Radiographers (RTTs) undertake a degree course in therapeutic radiography during which they are seconded to radiotherapy departments for practical training. There were 3 800 radiographers in post in 2012. Their career path enables progression towards a consultant radiographer post in which they can function independently within specific areas of practice.

All radiotherapy centres are expected to take part in national research trials for which there is a national funding stream. A national radiotherapy quality assurance team overseas radiotherapy QA for patients in such trials.

In summary the strengths of the English system rest on its centralisation within a national health service free to all citizens at the point of delivery. Weaknesses relate to funding constraints, lack of a unified equipment replacement programme and a slow mechanism for national approval of new techniques.

7.4.3 France

Author: Nicolas Pourel, Institut Sainte Catherine, Avignon, France

France has a territory of 551 500 km², a population of 66.7 million inhabitants and a resource of 171 radiotherapy departments, including 89 (52.1%) public (of which 42 academic centres), and 82 (47.9%) private centres.

Until 2007, the Health authorities had to approve every new linear accelerator installation. Since then, this regulatory system has changed: a unique radiotherapy authorization per centre is now granted, based on quantitative and qualitative criteria defined by the French National Cancer Institute (INCa). A minimum number of two linear accelerators per centre and a minimum of 600 treated patients per year are the two essential criteria requested (except for centres located in remote areas of the French national territory), defined by INCa using a very pragmatic approach, taking into consideration the big territory to cover and ensure accessibility to patients. However, after mostly ten years of application (more or less respected), this system must now evolve in order to integrate more demanding qualitative (and maybe quantitative also) criteria in particular regarding the appropriateness of use of innovative technologies, such as SBRT (ongoing discussions).

In January 2016, the following distribution of 481 linear accelerators was observed: one machine for 8% of centres, two for 50%, three for 26% and four to eight for 16%.

Sub-specialization among radiation oncologists (one or two areas of expertise per physician) is common for academic and large centres, less frequent for centres with only two machines. About 30% of radiation oncologists have a part time activity of medical oncology with a mean of about 30%.

About 200 000 treatments for 187 000 patients are delivered annually, yielding to more than 4M radiotherapy fractions. Since 2007, there was an annual increase of 3% per year in terms of radiotherapy courses.

The reimbursement system differs from public to private practice. For public centres, billing is based on the number of sessions with a growing value of sessions depending on complexity of the technique used to treat the patient. For private centres, tariffs are based on a complex and widely outdated system, correlated to maximum delivered dose, field size, control imaging and many other parameters. Discussions are currently ongoing to move to a unique system with tariffs for a whole treatment course, correlated to the cost of procedure, based on the complexity of technique used to treat the patient (SBRT vs IMRT vs 3D-CRT), corrected by fractionation (conventional vs moderate hypofractionation vs extreme hypofractionation (SBRT)), by other specifications (4D, re-irradiation, IGRT, etc.) and by some patients' comorbidities. The total amount of reimbursements for radiotherapy nationwide was about 900M€ for 2015. This cost is covered almost totally by the public insurance system ('Sécurité Sociale', where transport costs are also fully covered on a separate budget line, but the total amount of these costs for the 'Sécurité Sociale' is not clearly available for the whole country) without expenses for the patients.

Over the 2006-2016 decade, the total number of machines has increased of 45%. Almost all linear accelerators are now equipped with a multileaf collimator and an electronic portal imaging devices. About 70% of machines are now equipped with IGRT imaging systems. Stereotactic (body or cranial) radiotherapy, respiratory gating or 4D techniques are currently in use in about one out of three centres. IMRT is widely used for head and neck and pelvic tumours in 88% of the 171 French centres.

There are no more Cobalt units since 2008 (except 2 Gammaknife® units). There are still 12 orthovoltage units for skin tumours. Most departments have a simulation CT-scan within the department. However, the availability of MRI and/or PET-CT is limited for many RT centres. The number of centres practicing brachytherapy has gradually decreased to 32 (19%) over the years and the adequate coverage of the needs is questionable.

From 2006 to 2016, the total number of radiation oncologists has increased of 15% with an average of 3.8 full time equivalent (FTE) radiation oncologists by centre nowadays, an average of about 300 patients per FTE radiation oncologist (medical oncology activity excluded). Over the same period, the total number of medical physicists has increased of 65% with an average of 3.36 FTE per centre and 1.19 FTE per machine. For treatment planning, physicists are assisted by dosimetrists (whose profession will soon be specifically regulated by law): there are 417 FTE dosimetrists with an average of 500 treatments per FTE dosimetrist. Furthermore, 2 250 radiation therapists are dedicated to patients' treatment.

The training capacity of radiation oncology specialists is not regulated at a national level. It depends on the number of students selected after the first year of medical studies (Numerus Clausus nationwide defined) and on the number of students recruited each year in the 'Oncology' pathway of each University Hospital. Until recently, there was no predefined quota of radiation oncologists as compared to medical oncologists within the 'Oncology' pathway but it tends to be 50%. The number of fellows ('Internes') in training for radiation oncology has increased over the last years to around 260, corresponding to 45-60 graduating annually. By contrast, the total number of medical physicists graduating annually is regulated at the national level and limited to 40.

7.4.4 Ireland

Author: Mary Coffey, Trinity College Dublin, Ireland

Ireland (excluding Northern Ireland) has a population of 4.5 million with 63% living in an urban setting. There are 12 radiotherapy departments with a total of 32 linear accelerators. Of these 31% are equipped for IGRT and IMRT. Of the 12 departments, 5 are public and linked to academic hospitals with the remaining seven are sited in the private sector. One of the five public centres is in the west of the country, with 3 accelerators, and one in the south, with 4 accelerators, with the remaining three departments linked as a network serving the Dublin region with a population of approx. 1.7 million, with 12 accelerators. Administration of the Dublin network is centralized which includes patient booking etc. The networks are linked through a teleconference system and peer review meetings are held with participation of all three centres. Six of the private centres have two linear accelerators and the seventh two linear accelerators and one Cyberknife.

A transformation in the radiotherapy services in Ireland was brought out by the report of an expert working group published in 2003 on the Development of Radiation Oncology Services in Ireland[592], that is still the main reference document At the time of the establishment of the expert group there were six linear accelerators and two Cobalt 60 units in the public sector and two linear accelerators in two private centres sited in Dublin. As part of its remit the group defined the minimum size of a public centre at 4 linear accelerators. To define the size, a review of the literature was performed; in addition the group considered the spectrum of sites to be treated and the ability to transfer patients between units if necessary. Finally, it was considered that such a size allows economies of scale. It also established an interim National Radiation Oncology Coordinating Group (NROCG). In considering ways to meet the immediate treatment requirements of patients it had been suggested that the Department of Health and Children would fund public patients to receive treatment in the private centres. The NROCG drew up a series of essential requirements that private departments should meet to qualify including the need to have at least 2 linear accelerators per department to provide continuity of care.

In parallel with the increased equipment recommendations the expert group identified the need to increase the numbers of students in education at all levels. Submissions were made to increase the number of radiation oncology registrars and the number of students recruited into the radiation therapist (RTT) degree programme to ensure that staffing levels would be sufficient for the expanded service thus providing as seamless a transition as possible. The intake into the three education programmes is restricted and reflects service requirement for the radiation oncologists. There is greater flexibility for the medical physicists which is a postgraduate course and is limited primarily by clinical training placements. For the RTTs the education programme offered is an honours science degree which enables graduates to pursue other career options if wished. As with medical physics, the intake is restricted by access to clinical placements.

Staffing levels are consistent across the public sector and follow the guidelines defined in the expert report. The recommendations were for 8-12 radiation oncologists per million population which equated to a caseload of 200-350 new patients per consultant. RTT staffing levels were historically based on numbers per unit and negotiations have been ongoing to move to activity based staffing. Medical physicist numbers were based on the EFOMP recommendations. The current staffing levels as per the HERO data are one radiation oncologist per 250 new patients, one medical physicist per 125 patient course and one RTT per 25 radiotherapy courses. In the Dublin network treatment planning is carried out by the RTTs and in all centres the RTTs have diversified into other roles and responsibilities both technical and psychosocial in nature.

Reimbursement for radiotherapy varies across the sectors. As the SLRON is a stand-alone radiotherapy service it is funded independently. The departments in the West and South of the country receive their funding as part of the overall hospital budget and treatment in the private centres is funded primarily through personal health insurance. In the public sector, there is no differentiation in the level of funding based on the type of technique or the number of fractions, the block grant covers all activities within the department. In the private centres funding is negotiated individually with the health insurers and varies from department to department. The funding information is not available publicly.

In 2006, the second national cancer strategy advocated a comprehensive cancer control programme and in 2007 The National Cancer Control Programme (NCCP) was established to ensure that all elements of the cancer policy were delivered to the maximum possible extent. The NCCP have published national evidence-based clinical guidelines for the treatment of common cancers which include radiotherapy and are the result of extensive review by multidisciplinary groups, using the available literature from the Netherlands, Australia and Canada to support the arguments. The focus of the radiotherapy strategy group was the definition of criteria that can be used to plan the radiotherapy services and resulted in the Hollywood report.[592] All future developments in cancer care are under the responsibility of the NCCP, using those recommendations and expanded on them.

All departments have quality assurance and quality control programmes in place with a designated quality officer in place in some centres. Incident reporting is required under legislation and the Health Service Executive, Medical Exposure Radiation Unit is responsible for ensuring that such systems are in place, for incident investigation and clinical audit of radiotherapy departments.

In summary the restructuring of the radiotherapy services in Ireland has been successful in terms of conforming to recommendations and guidelines. The publication of guidelines on site-specific management is largely implemented and the centralisation of the centres in Dublin has led to uniformity of care. Weaknesses relate to the failure to integrate all centres in the country together and in the large public/private divide that now exists. The evolution over the past decade has been enormous and the establishment of the National Cancer Control Programme with representation of all professional groups has strengthened forward planning assuring further development is based on needs assessment and current evidence, based on the data from the Cancer Registry: staffing levels, new technology and equipment requirements are evaluated.

7.4.5 The Netherlands

Author: Ben Slotman, VU University Medical Centre, Amsterdam, the Netherlands

The Netherlands has 16.8 million inhabitants and there are 21 radiotherapy departments, including 8 at academic centres, 1 as national cancer institute and the remainder either as part of a large hospital or as free standing facilities, close to a hospital. All radiotherapy is part of the standard care for which all Dutch citizens have an insurance. There is no 'private' radiotherapy.

Until the turn of the century, the government had to approve every request for placement of every new linear accelerator. At that time, there were long waiting lists for radiotherapy, and after much discussion in the late 1990's the government made money available for improvement of radiotherapy infrastructure, and an increase in training capacity for personnel. In addition, a reimbursement system was implemented, which considered not only number of treatments but also the intensity and costs of different treatments. A few years later, the government no longer had to approve each decision on additional equipment, but only regulated the number of departments. The decision to leave to the centres the definition of how many machines are needed, is based on the ownership of the financial risk: centres still needed approval for extra teletherapy production by the insurance companies, so the financial risk was completely at the centre.

About 5 years ago, the government left decisions to start a department completely to the 'market'. At that time, the Dutch Society of Radiation Oncology (NVRO) developed guidelines for size and quality of radiotherapy departments and defined that a department should have at least 4 linear accelerators. At the same time, many requests came from hospitals who wanted to start their own radiotherapy department. Because of the minimum requirement of 4 machines, a system of main departments with one or more satellites was introduced. A satellite should have at least 2 linear accelerators, the same quality system as in the main centre and all treatment planning should be performed in the main centre.

The minimum size of a department of 4 machines was based on the subspecialisation among radiation oncologists. Most radiation oncologists nowadays only have two areas of expertise. To cover all these areas, at least 8 radiation oncologists are required. Based on a generally agreed norm that became the standard in the Netherlands, this resembles (8x200-250 new patients per doctor) a department with a size of 4 linear accelerators (400-500 patients per machine). To guarantee continuity and sufficient size of a satellite centre, it was decided that a satellite should have a minimum of 2 machines. Depending on patient load and the distance to the main centre, centres may decide to install a CT simulator in the satellite centre.

The reimbursement system which was introduced in the late nineties had a weighting system, where a treatment which at that time was considered standard (e.g. tangential fields for breast cancer) was considered a standard treatment with weight factor 1, whereas simple palliative treatment in a known patient had a weight factor of 0.3 and more intensive 3D conformal radiotherapy had a weight factor of 1.7. The fourth category at that time included more intense treatments like IMRT and SBRT with a weight factor of 2.7. Combining the number of treatment series and the weight factor led to a better correlation with the actual workload. When techniques like IMRT and SBRT became part of the routine practice in most radiotherapy departments, the weight factors were adjusted.

The weighting system was also used to prognosticate the required number of machines and personnel. We have demonstrated over the decades that prognostication made by the NVRO, which was based on data from the Dutch Cancer Society of expected cancer incidence, was very accurate.[570] This has been extremely helpful to keep a close correlation between supply and demand.

Currently there are eight different classifications for external beam radiotherapy, which are related to the actual costs of these procedures. These include two standard (either with standard (A1) or very long (A2) treatment delivery time), total body radiotherapy (A3), 3D radiotherapy (A4), IMRT with expensive imaging (A5), radiotherapy with breathing control/gating (A6), and two for stereotactic radiotherapy without (A7) or with (A8) expensive imaging. The 'imaging' in these definitions refers to the costs which the department has to make for additional MR or PET-scans required for treatment planning. In 2015, 28% was classified as A1, 5% as A2-3, 43% as A4 (either delivered as conformal radiotherapy or IMRT), 10% A5, 7% A6 and 8% A7-8. The costs of the products vary per department and are based on the cost calculations within each centre and negotiations with insurance companies.

Between 2000 and 2010, there was an annual increase of 3 to 4% per year in radiotherapy treatments, equipment and personnel. The number of machines per department increased to an average of 6 linear accelerators in 2010 with on average 10 FTE radiation oncologists, 5 FTE medical physicists and 45 FTE technologists. It is important to realize that in the Netherlands, physicists often have physics assistants who perform quality assurance and that treatment planning is generally done by the technologists.

From 1998 – 2010, the number of linear accelerators almost doubled (67 – 120). Since 2006, almost all linear accelerators were equipped with multileaf collimators and electronic portal imaging devices. In 2010, cone beam CT scans were already available on about 40% of the machines. Currently they are present on virtually all machines. There are no Cobalt units in the Netherlands. Eight departments still use orthovoltage units for skin tumours. Most departments have 1 or 2 CT scanners within the department. There is ample access to MRI and PET scanning, but often outside of the radiotherapy department. The number of brachytherapy remote afterloaders has gradually decreased over the years and in 2010 there were 27 afterloaders (5 LDR, 8 PDR and 14 HDR).

The total number of (non-weighted) treatment series per MV-machine was 426, per radiation oncologist 242, per clinical physicist 482 and per technologist 53 (data 2015). In 2015, there we 238 FTE radiation oncologists, 119 FTE clinical physicists and 1 075 FTE technologists. The training capacity of radiation oncologists and clinical physicists is regulated at a national level and the number of residents in training for radiation oncologists was 97 FTE. There were 24 FTE clinical physicists in training.

7.4.6 Denmark

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Denmark has 5.6 million inhabitants and there are seven radiotherapy departments, all organized at academic centres, and a total of 53 linear accelerators. One centre has two satellites, with two and four accelerators, respectively. In 2018, a national centre for proton therapy will open in Aarhus, with three gantry rooms, and capable of serving all Denmark.

The median size of a Danish radiotherapy department is seven linear accelerators (range 4-12). Establishment of a new radiotherapy department requires approval by the Danish Health Authority. The recommended minimum size is four machines, primarily because less machines in a department would lead to suboptimal use of the simulator and administrative staff. The main argument for this recommendation is economies of scale for especially equipment costs, as one simulator is estimated to be able to serve four megavoltage machines. Other arguments include staffing and subspecialisation among oncologists. The two satellites are completely integrated with the academic centre, with central triage and shared staff and treatment techniques. From 2005 – 2010, the number of linear accelerators almost doubled, and now all Danish linear accelerators are equipped with multileaf collimators, electronic portal imaging and in room/on-board kV imaging. There are no Cobalt units in Denmark. Most departments have one or two CT scanners. The large departments also have their own MR and PET/CT scanner.

The high degree of centralization is a consequence of two decades of central planning from (formerly the National Board of Health) under Ministry of Health, who is responsible for planning and approval of specialized treatments at all Danish hospitals, for most diseases. Within cancer, the developments over the last 20 years have been much influenced by the Cancer Control Plans. The first plan was launched in 2000, and contained a detailed list of problems and shortcomings within radiotherapy, as well as a national plan for expansion of radiotherapy services in a centralized way. The principles laid out have been followed since. The second cancer plan in 2005 resulted in a large sum for new radiotherapy equipment, which were installed from 2006-2008. This expansion of services finally led to abolishment of the long waiting lists, which had caused much frustration among patients, professionals and politician for a decade.

Between 2002 and 2011, there was a total increase of 81% in annual number of radiotherapy fractions, with an annual increase of 6% per year. During the last five years, a much lower (0-2%) annual increase has been seen. From the HERO epidemiological forecasts, it is expected that the need for radiotherapy in Denmark will increase by 20% from 2012 to 2025.

The staffing of Danish radiotherapy departments is complex and differs from many other European countries. The physicians are trained as clinical oncologists, and work in tumour site defined teams, which is responsible for both medical and radiation oncology services. Most of the RTTs working at the linear accelerators are nurses with a one-year licensed training in radiotherapy. The RTTs are delivering day-to-day care of the patients, but more complex handling of morbidity during and after treatment is done at the ambulatory outpatient clinics. Very few patients are hospitalized. The medical physicists are also performing most of the dose planning, except simple routine plans (breast, prostate, palliative). The training capacity for clinical oncologists (residents) is regulated at a national level and the number of new residents in training for clinical oncology is 24 per year. The number of training positions for other staff is not centrally regulated.

All radiotherapy services are an integrated part of clinical oncology, which is tax-paid and delivered free of charge to all Danish citizens. There is no private radiation oncology in Denmark. The hospital is reimbursed based on activity codes (DRG coding), allowing for some degree of differentiation between simple or complex planning and treatments, image guidance, stereotactic procedures and brachytherapy, and taking number of fractions into consideration. When techniques like IMRT and SBRT became part of the routine practice in most radiotherapy departments, the DRG reimbursement were adjusted.

In 2007, an important decision to have national integrated cancer pathways (fast track) was taken by the Danish government and supported by the Danish Regions. The aim was to remove waiting times for diagnosis and treatment of all cancer types. Clinical guidelines with cancer pathways with manual-like clinical guidelines as well as time-standards for all steps in

clinical processing, flow-chart and organizational schedule have been developed, including the steps involved in radiotherapy planning. By January 2009 these integrated cancer pathways were implemented in the Danish health care system and are now monitored centrally in the national hospital patient registry.

7.4.7 Summary and conclusion

The five selected countries represent different organizational models of radiotherapy planning used in Western and Norther Europe. Most countries have national instruments for planning and implementation for infrastructural investments and service provision. In one end of the spectrum, Denmark and the Netherlands have a long history of national radiotherapy planning, and today have very centralized services with large departments, and the highest percentage of machines equipped to perform state-of-the-art treatments (IGRT, IMRT). The same evolution has now started in France, where the centres have been smaller but are now regulated, and the equipment status is improving. In England, the government is now providing a substantial financial package for replacement of aging machines. In Ireland, investment needs have resulted in more than half of the current capacity now being in small stand-alone private clinics, despite cancer plan recommendation of at least four accelerators per department; and less than half of the machines are equipped for modern radiotherapy (IGRT and IMRT).

In conclusion, radiotherapy services in the top benchmark countries are a result of long-term planning within the public health system and based on substantial input from the professionals in a multidisciplinary oncology framework.

8 MATERNITY SERVICES

8.1 Introduction

Maternity services in Belgium occupy an important place in the hospital landscape given the vital role they play in a crucial period in the life of most Belgian people (98.8% of births in Belgium takes place in the hospital[593]). Maternity services can be seen as an example of a care assignment that is best delivered in the proximity of the patient: a high patient volume combined with accessibility requirements. On the other hand, there are also regular reports about an overcapacity of maternity services (beds and services) in Belgium. Also in the reform plans of the minister, maternity services are the prime example to rationalise hospital supply.

In Belgium there are two levels of maternity services: the general maternity services and the ‘maternal intensive care’ departments (MIC-beds). In this report the focus is on maternity services in general, a detailed evaluation of MIC-beds and specific care for high-risk pregnancies is out of scope. Where relevant, results are presented for maternity services with and without MIC-beds separately. Except stated otherwise M-beds refer globally to maternity services, that is both beds in the general maternity service and beds in the MIC department. Also the delivery/labour room, and the neonatal function are out of scope.

Box 30 – Types of deliveries

Throughout this chapter, the following definitions are used:

Normal delivery is defined as a full-term vaginal delivery of a single healthy infant (with cephalic presentation), without any complications antepartum, during the delivery and postpartum, requiring minimal or no assistance.

Vaginal delivery includes normal deliveries as well as all other vaginal deliveries presenting complications or requiring assistance. In the APR-DRG classification it corresponds to APR-DRG 541 'Vaginal Delivery with Sterilization and/or Dilatation and Curettage', APR-DRG 542 'Vaginal Delivery with Complicating Procedure except Sterilisation and/or Dilatation and Curettage' and APR-DRG 560 'Vaginal Delivery'

C-section (or caesarean) delivery includes both elective and emergency caesarean sections. In the APR-DRG classification it corresponds to APR-DRG 540 'Caesarean Delivery'.

8.2 Organisation of maternity services in Belgium

8.2.1 Current organisation and legislation

In Belgium, levels of perinatal care are defined by several Royal Decrees specifying general provisions and architectonic, functional and organisational standards of maternity service (M-service), neonatal care (N*-function), maternal intensive care (MIC) and neonatal intensive care (NIC). For clarity, relevant hospital services, and their corresponding indices, are summarised in Table 103 and the divisions of hospital activities are briefly presented in Box 31.

In what follows, the unit of analysis is the maternity service, understood as a hospital site with M-beds, rather than the hospital level. A hospital can have several maternity services, located on different sites. Also, each maternity service can be divided in several maternity wards, depending on the internal organisation. Analyses on the ward level are out of scope for the present study.

Table 103 – Index for hospital services

Type	Name	Index	Programming criterion	Minimum number of beds
Hospital service	Maternity	M	32 M-beds for 1 000 births	10(*)
Hospital service	Neonatal intensive care	NIC (N)	6 NIC-beds for 1 000 births	15
Hospital service	Paediatrics	E	37 E-beds for 1 000 births	15
Hospital department	Maternal intensive care	MIC		8
Hospital function	Local neonatology	N*		
Hospital function	Regional perinatology	P*		
Programme of care	Programme of care for children			

(*) Article 5 of the Royal Decree (RD) of 12 October 1993[594] states '(…) can never have as a consequence that the capacity of maternity beds (index M) (…) created in a region or municipality (...) falls below the minimum level of 10 (…) beds'. Source: Crommelynck et al. (2013)[595], art 1 of RD of 21 March 1977[596], art 5 of RD of 12 October 1993[594], art 3 of RD of 20 August 1996 [597], art 14 of RD of 30 January 1989[598], art 8 of RD of 20 August 1996[599]

Box 31 – Organisation of hospital care activity

Hospital care activity is organised in services, functions and departments. For some specific groups of patients, programmes of care are also organised.

Hospital services: each hospital includes several services of care (maternity, surgery, paediatrics, etc.). Beds in these services are identified by an index (letter(s) possibly followed by a number).

The notion of **hospital department** (*'section'* / *'afdeling'*) is not properly defined in the law, but generally refers to part of a hospital service.

A **hospital function** aims to provide transversal care across services and departments.

Programmes of care are designed as an organisational framework allowing to implement clinical pathways.

To meet the notion of '**basic hospital'**, the hospital must have at least 150 licensed beds and include at least a service of surgery and a service of internal medicine. It must also supply the following activities: anaesthesiology, radiology, basic activities in clinical biology, functional rehabilitation and basic activity in hospital pharmacy, as well as a basic care programme in oncology.

Source: Crommelynck et al. (2013)[595]

Interdependencies between maternity and other services

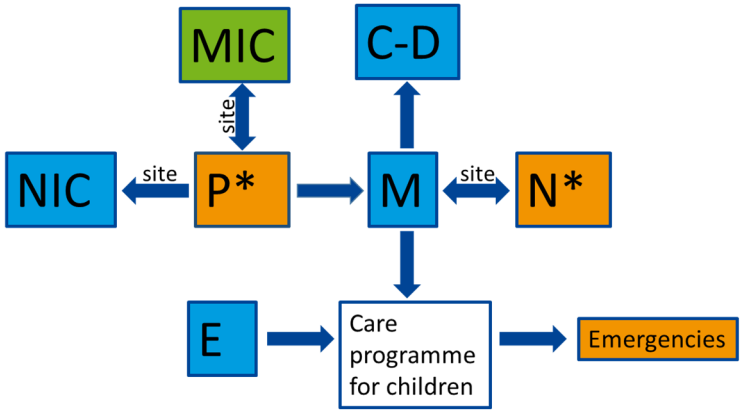
Maternity services (M-service) cannot exist as isolated entities as there are legal interdependencies with other services (Figure 101). In particular, the maternity must belong to a hospital that includes:

- at least a department where surgery and internal medicine are practiced (services C and D) (RD of 21 January 1998, art. 3)[600]
- a licensed neonatal care function (function N*) (RD of 20 August 1996, art. 1 and RD of 2 April 2014, art. 1)[601, 602]
- a licensed care programme for children (RD of 2 April 2014, art. 1)[602].

Reference centres for high-risk pregnancies and neonatal care

The regional perinatal care function (P*-function) consists of a department for high-risk pregnancies (MIC, see Box 32) and a licensed service of neonatal intensive care (NIC), on the same hospital site. Both MIC and NIC units are subject to particular standards. Hospitals with a P*-function act as a reference centre. Indeed, each hospital with a P*-function has to make collaboration agreements with hospitals with an M/N*-function, in order to cover a catchment area of at least 5 000 deliveries per P*- function per year (RD of 20 August 1996, art 6).[599]

Figure 101 – Interdependencies between maternity and other services in the Belgian law



Note: Hospital services are depicted in blue, hospital functions in orange and hospital departments in green. Each arrow stands for '… belongs to a hospital that also includes…', for instance, a maternity service must belong to a hospital that also includes a care programme for children. If the concerned services must be co-located on the same site, it is mentioned above the arrow. Except otherwise stated, the requirements are defined at the hospital level.
The Royal Decree regulating the care programme for children was suspended in December 2016. Care for children is therefore organised by a previous decree (13 July 2006)[603]. Under this RD, each care programme for children must have at least

15 E-beds, making the above link between paediatric service (E) and care programme for children bidirectional.
Sources: art 2 of RD of 30 January 1989[598], art 1 and 20 of RD of 20 August 1996[601], art N5 and art N6 of RD of 23 October 1964[604], art 8 of RD of 2 April 2014[605] and RD of 20 August 1996[599]

Box 32 – MIC-units: main messages of a previous evaluation performed by KCE

KCE made an evaluation (i.e. do MIC-units take up their role as reference centre; are the additional financial means adequately used; are MIC-units equally spread across the territory) of MIC-units in 2008.[606] It is beyond the scope of the current study to perform an update of this evaluation. Nevertheless, it is important to summarize the main findings in view of an update in the near future.

The concept of MIC was introduced in Belgium in 1996 in a Royal Decree as 'a department of the maternity service (index M). This department is dedicated to 'intensive monitoring' of high-risk pregnancies. The department also accommodates (…) patients of which the foetus might require neonatal intensive care and patients who will need highly specialised postpartum care'[599] Maternity services with MIC-beds are supposed to act as a reference centre for at least 5 000 deliveries. Nevertheless, the Royal Decree does not describe the licensing requirements nor the precise objective of these services in detail.

Based on an evaluation of the 17 maternity services with MIC-beds in 2008 the following main messages could be formulated:

Terminology:

The terminology 'Maternal Intensive Care' is confusing since it does not concern 'intensive care'. It is better to use 'maternal intermediate care' instead;

Reference centre:

Only a small minority of pregnant women (±1%) is transferred to another hospital. In case of transfers in the prenatal phase (60%) the majority (±75%) is transferred to a maternity service with MIC-beds. Yet the number of transfers per MIC-bed is limited ranging from 0.5 to 12.8 transfers per MIC bed per year (the transfer rates are higher when the MIC-services are located in a university hospital).

Maternity services with MIC-beds have, in general, a higher concentration of pre-term births; still births; …

Women identified at risk (flagged as candidates for MIC-care based on criteria identified in Minimal Hospital Data (MZG – RHM) and billing data) have a higher rate of severe pre-term births (<32 weeks of pregnancy): 8.8% compared to 1.5% for all pregnancies. The majority of these severe pre-term births (80%) of women at risk take place in hospitals with a MIC but large geographical differences exist (e.g. only 50% in the province of Namur).

Allocation of additional budget:

There are indications that the proportion of women at risk on the total number of women admitted to maternity services with MIC-beds is lower than the proportion of MIC-beds on the total number of M-beds in these hospitals;

Geographical accessibility:

Only 40% of the women at risk is admitted in a MIC-bed;

The higher the number of maternity services with MIC-beds in the proximity, the higher the probability that women at risk are admitted in a MIC-bed (e.g. in the region of Brussels and Liège, where a high number of maternity services has MIC-beds, 60% of women at risk are admitted in a MIC-bed while this is only 15-18% in the provinces of Namur, West-Vlaanderen and Luxembourg).

Based on this evaluation it was recommended to improve and support (e.g. through financial incentives) the referral policies of women at risk; to re-evaluate the required capacity of MIC-beds; to improve the geographical distribution.

In light of the current reforms it seems worthwhile to update this evaluation of MIC-services more in-depth to arrive with policy recommendations that are relevant in the context of the changing hospital landscape.

Maternal and neonatal referrals are organised through the RD of 20 August 1996.[599] and rely on P*-functions as reference centres. Each P*-function collaborates with maternities in order to cover a catchment area of at least 5 000 deliveries per year. The heads of departments of both services should meet twice a year in a structured consultation organised by the P*-function (art. 6). A transport team should be stand by in case of a neonatal transfer (art. 5), and consultation is required with the referral hospitals with regard to conditions for maternal and neonatal transfer (art 5).

In 2007, a retrospective study[607] using 2004 data found that 90.3% (56/62) of the surveyed M-services and 93.5% (58/62) of the surveyed N*-functions report having an agreement with a P* function. According to the heads of departments of M-services and N*-functions, most of the obstetricians/gynaecologists (83.9% or 47/56) and paediatricians (94.8% or 55/58) in service comply with this written agreement. When asked if the agreement contains criteria for maternal or neonatal transfer, only 50% (28/56) mention criteria for in utero transfer, 32.1% (18/56) criteria for maternal transfer in postpartum and 56.9% (33/58) criteria for neonatal transfer. In this retrospective study, rates of transfers were shown to be 90 in utero transfers per 10 000 deliveries, 28 maternal transfers per 10 000 deliveries and 143 neonatal transfers per 10 000 deliveries.

Standards applicable to maternity services: a large fixed cost

Specific standards (buildings, staff, functioning, etc.) applicable to maternity services are defined in art. N5 of the Royal Decree of 23 October 1964 and further modifications.[604] In particular, in maternity services there can be at most two beds per room and a sufficient number of single bed rooms must be available. The maternity service comprises at least one unit of care. Per unit of care (or for two contiguous units), the following must be available: a room for midwifes, a room for examination and treatment, a room for nurses, a room for doctors, a room for care material, a room for laundry, a room for storage, a kitchen (even if a central kitchen exists), a living room, a bathroom, a storage space for staff belongings, separate toilets for staff and visitors, and a space dedicated to learning, group discussion and conversation.

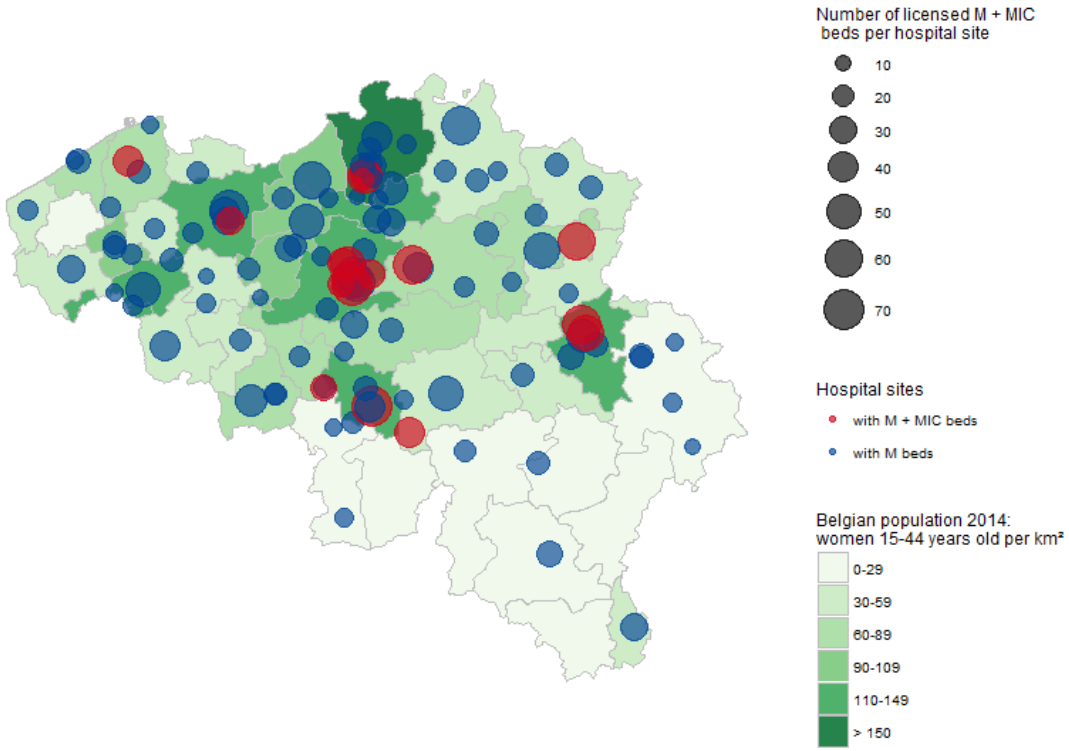
The management of the maternity service is ensured by an acknowledged physician specialised in gynaecology and obstetrics, working exclusively in the hospital. At all times, a gynaecologist-obstetrician, a specialist in anaesthesiology and a paediatrician must be available on call. Each unit of care must have at least one chief midwife (possibly a chief nurse) and enough midwives to ensure 24-hour permanence.

The maternity service must have a milk kitchen (including two separate rooms, one for cleaning, and the other for preparation of baby bottles) and a childbirth area. The latter consists of two delivery rooms, a labour room (where deliveries could take place in case of need) and several additional rooms for patients and staff. The area must be sufficiently equipped, according to the state of science, to guaranty safety of the mother and her child. In the childbirth area, daily activities are carried out under the supervision of the chief midwife and there are enough midwives to ensure 24-hour permanence. In addition, a paediatrician is available at all time.

A high density of maternity services

Figure 102 depicts the geographical distribution of maternity services in Belgium in 2014. Larger maternity services (in terms of number of beds) are represented by a larger circle. Services with a MIC department are identified in red. There are 111 maternity services in Belgium (64 in Flanders, 36 in Wallonia and 11 in Brussels). At the hospital level, 98 out of 103 hospitals have a maternity service. Among them, 18 also have a MIC department (7 in Flanders, 5 in Wallonia and 6 in Brussels).

Figure 102 – Geographic distribution of the M-beds in the hospital sites in Belgium, December 2014



The total capacity of licensed maternity beds in Belgium is 3 176 beds (of which 168 are MIC-beds). This corresponds to 1.5 beds per 1 000 women aged 15-44 (see Table 104) or 25.5 beds per 1 000 births. The latter is far below the programming norm of 32 M-beds per 1 000 births which has been defined in order to ensure geographical access and to control costs. However this programming rule dates back to the 1970's[596] when the length of stay (and thus the required capacity) was much longer than it is today, and is no longer adapted to the current reality. In 1982, a moratorium was introduced on the number of hospital beds. It still applies today, implying that any new bed results in the closure of another hospital bed.

In addition, a regional difference can be observed with a higher ratio in Brussels (1.73 beds per 1 000 women aged 15-44) than in the rest of the country. Yet, when the ratio is calculated as number of M-beds per 1 000 births, the ratio in Brussels (i.e. 24.5 compared to 25.7 in Flanders and Wallonia) is lower due to a higher number of births in Brussels.

Table 104 – Hospital and sites with M-beds in Belgium, December 2014

	Brussels	Flemish region	Walloon region	Belgium
Hospitals with M-beds (total number of hospitals*)	10 (12)	55 (55)	33 (37)	98 (103)
Hospital sites with M-beds (total number of hospital sites*)	11 (18)	64 (81)	36 (55)	111 (154)
Number of M-beds (except MIC-beds)	403	1 658	947	3 008
Number of MIC-beds	50	70	48	168
Number of M-beds (including MIC-beds)	453	1 728	995	3 176
Number of M-beds (including MIC) per 1 000 females aged 15-44	1.73	1.47	1.47	1.50
Number of M-beds (including MIC) per 1 000 births	24.47	25.71	25.72	25.53

** with at least one C, D, H, E or M-bed.*
Sources: FOD VVVL - SPF SPSCAE (2014); for MIC-beds: FOD VVVL - SPF SPSCAE (2016).

The size of maternity services mostly exceeds the minimum number of licensed beds: most maternity services have between 16 and 24 beds

Each maternity (M-service) must have at least 10 beds (RD of 12 October 1993, art. 5).[594] Most of the maternity services have more than the minimum required number of beds. Only three of them have 10 beds, the biggest has 70 beds, and the median is 24 (see Table 105). Maternity services are bigger (in terms of number of beds) in Brussels than in the other regions: only two services (among the 11 in Brussels) have less than 25 beds, and the median number of beds in Brussels is 40.

Table 105 – Size of maternity services, December 2014

	Brussels	Flemish region	Walloon region	Belgium
Number of maternity services* with ≤ 15 maternity beds	1	15	7	23
Number of maternity services* from 16 to 24 maternity beds	1	24	13	38
Number of maternity services* with 25 to 40 maternity beds	4	15	10	29
Number of maternity services* with ≥ 40 maternity beds	5	10	6	21
Median number of maternity beds per maternity service*	40	22.5	23.5	24

**Hospital sites with M-beds.*
Source: FOD VVVL - SPF SPSCAE (2014)

The minimum activity on maternity services is set at 400 deliveries per year

The annual number of deliveries must be at least 400 on average during three consecutive years (RD of 30 January 1989, art. 17).[598] This minimum threshold does not have to be met in the following cases (RD of 30 January 1989, art. 18 and RD of 21 January 1998, art. 16):[598, 600]

- in the area where the service is established, the closest similar service is located at a distance of at least 25 km;
- the service is established in a municipality of at least 20 000 inhabitants where the closest similar service is located at a distance of at least 15 km;
- the closest maternity service in the same Community ('*Communauté*' / '*Gemeenschap*') is located at a distance of at least 50 km.

In 2014, 8 maternity services performed less than 400 deliveries (see section 8.2.2.2). Although the minimum activity level stated in the law is defined as an average over three consecutive years, the annual data give us a good approximation of the number of services that do reach the threshold.

The Belgian law also stated that if the occupation rate is below 70% on average during three consecutive years, the number of beds should be reduced in consequence (articles 16 and 20 of the RD of 30 January 1989[598]). Although the occupation rate is below this threshold for a large number of maternities in Belgium (see section 8.2.2.4), this reduction did not take place in reality. Indeed, the application of the concerned articles of the RD has been suspended from 2000 onwards (article 21 of the RD of 30 January 1989[598]).

Defining licensing norms became a competency of the Federated entities after the 6th State Reform

Since 1 July 2014, the federated authorities have the power to define the licensing norms. However, these norms must respect the organic legislation, the federal programming criteria and the federal power to regulate the practice of medicine. The federated entities cannot impose licensing norms unilaterally. In case they affect the federal healthcare budget, the norm can be rejected. This implies that proactive consultation between the federal and federated entities will take place in case the federated entities decide to define/change licensing norms.[20]

Importance of maternity services within the hospitals

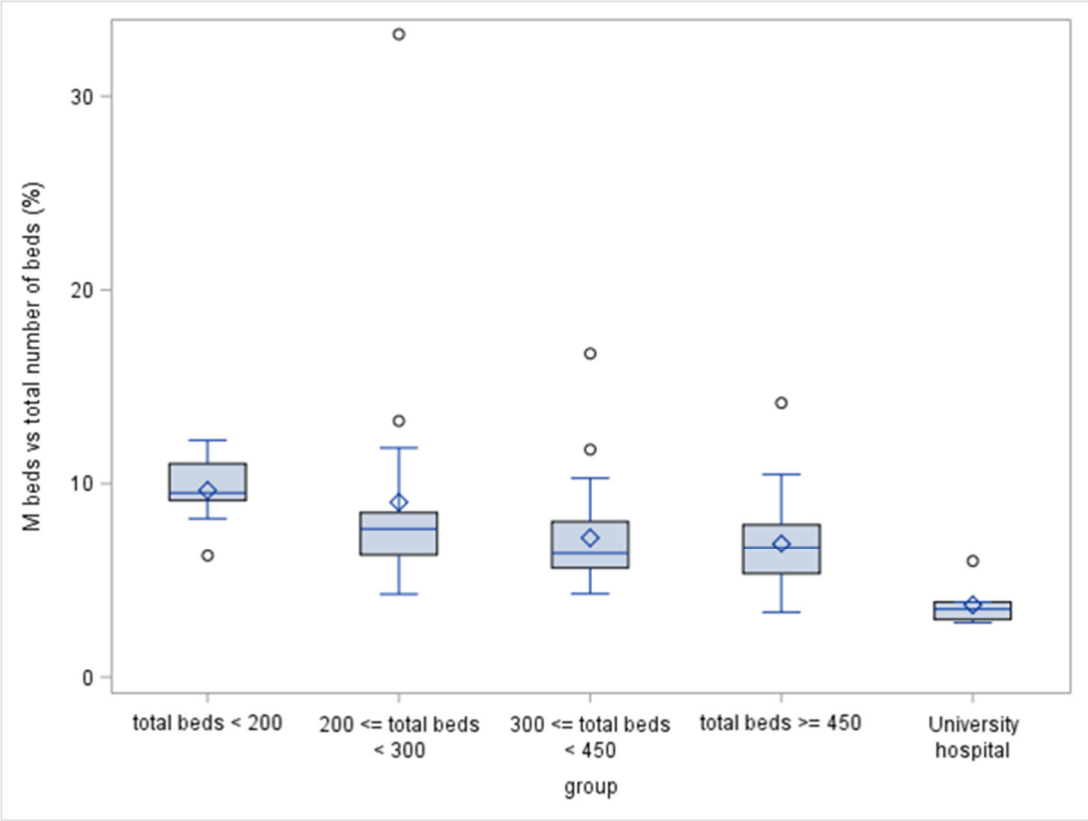
Within the hospitals, the maternity beds represent between 2.79% and 33.20% of the total number of licensed beds, the median being 6.79%. The relative proportion of maternity beds is more important for smaller hospitals. As shown in Table 106 and Figure 103, maternity services represent a larger part of small hospitals (median share of 9.52% in hospitals with less than 200 beds) and a smaller part for university hospitals (median share of 3.49%).

Table 106 – Proportion of M-beds among the total number of licenced beds in Belgium (2014)

Hospital size	N	Min	p25	Median	p75	Max
Total beds < 200	11	6.25	9.14	9.52	11.03	12.24
200 <= total beds < 300	21	4.26	6.28	7.67	8.51	33.20
300 <= total beds < 450	19	4.28	5.61	6.37	8.04	16.72
Total beds >= 450	40	3.33	5.32	6.69	7.88	14.17
University hospitals	7	2.79	2.96	3.49	3.85	5.96

Note: considered hospitals (98) are hospitals that do have M-beds.
Source: FOD VVVL - SPF SPSCAE (2014)

Figure 103 – Proportion of M-beds among the total number of licensed beds in Belgium (2014)

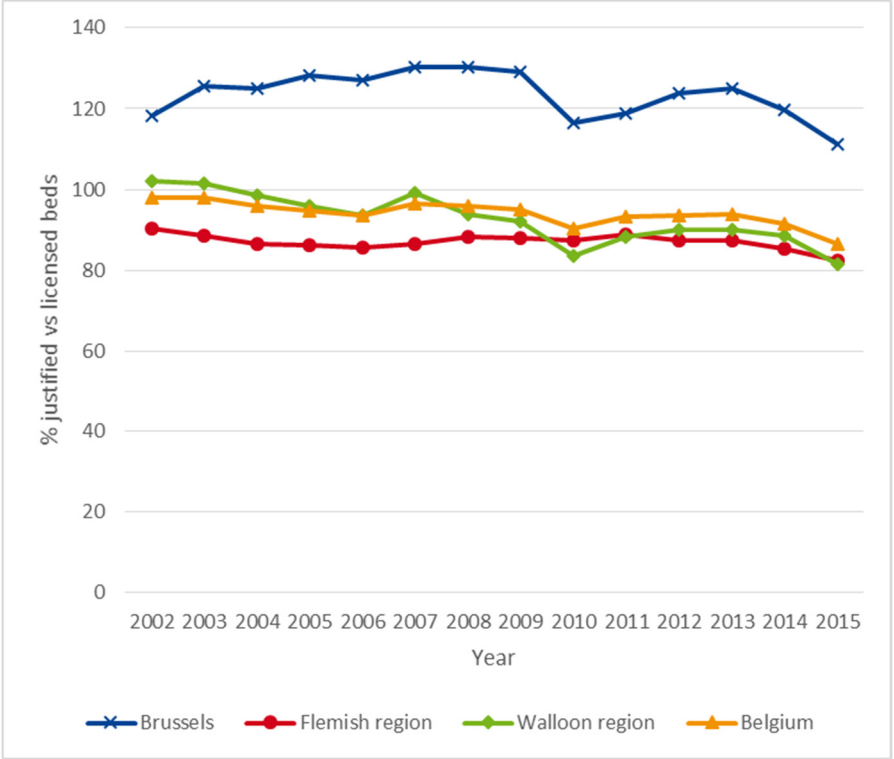


Note: considered hospitals (98) are hospitals that do have M-beds.
The large proportion of M-beds (33.20%) for one hospital is explained by the fact that this hospital actually is part of a bigger organisation, with two different license numbers. If we exclude this particular case, the maximum proportion of M-beds among the total number of licensed beds is 16.72%.
Source: FOD VVVL - SPF SPSCAE (2014)

Gap between justified and licensed beds, except in Brussels

Figure 104 compares the number of licensed and justified (justified beds are a central concept in the calculation of the hospital budget for Belgian hospitals) M-beds for the period 2002-2015 for Belgium as well as for Flanders, Wallonia and Brussels. There are strong differences between Brussels and the other regions. While there is an important gap between justified and licensed beds in Wallonia and Flanders, indicating a certain degree of overcapacity of licensed beds, the opposite is true in Brussels, the number of justified beds being 10% (in 2015) higher than the number of licensed beds.

Figure 104 – Comparison of the number of justified and licensed M-beds for Belgium and the three regions per bed type, 2002-2015



Source: FOD VVVL - SPF SPSCAE & KCE (For 2012 and 2013, data from FOD VVVL - SPF SPSCAE were available by hospital and aggregated. We chose to work with the data by hospital, since the two sources were not congruent)

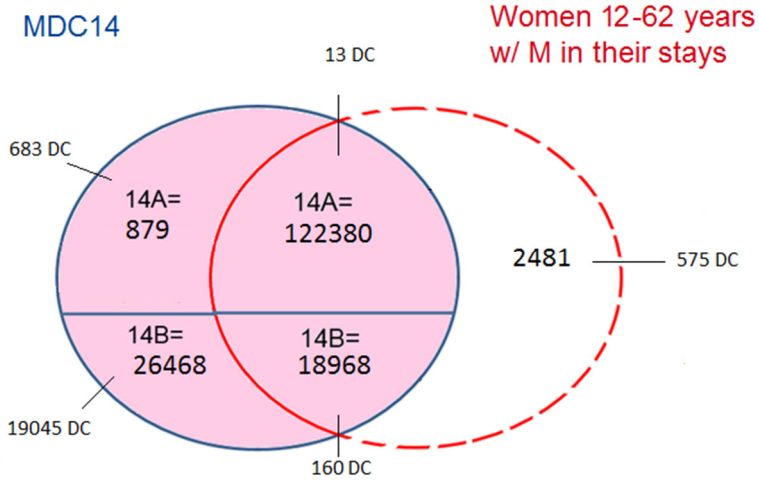
Among women admitted in an M-bed for a delivery[kk] in Wallonia and Flanders, the vast majority resides in the same region (97.6% in Wallonia, 97.9% in Flanders). In Brussels, only 75.5% of the women admitted in an M-bed for a delivery live in the region, 17% come from Flanders, 7.1% from Wallonia and 0.4% from abroad.

8.2.2 *Maternity services activity profile*

8.2.2.1 *Selection of data and indicators*

In this section we describe the activity profile of Belgian maternity services. The description is based on the Minimal Hospital Data (MZG – RHM) for the year 2014. We select women aged 12-62 with a stay in a maternity service (M-bed). However, to have a complete picture of maternity care activity, we also include women whose principal diagnosis is related to maternity care, even if they did not stay in an M-bed. In particular, we include all stays classified in the Major Diagnostic Category (MDC) 14 'Pregnancy, Childbirth and Puerperium'. These stays can be further divided between deliveries (called further MDC 14 A, if the APR-DRG concerns a delivery, namely APR-DRG 540 'Caesarean Delivery', 541 'Vaginal Delivery with Sterilization and/or Dilatation and Curettage', 542 'Vaginal Delivery with Complicating Procedure except Sterilisation and/or Dilatation and Curettage' and 560 'Vaginal Delivery') and other related diagnostic related groups (called further MDC 14 B, if the APR-DRG does not concern a delivery but the pregnancy or the puerperium, i.e. APR-DRGs 544-6 or 561-566). This selection procedure is illustrated by Figure 105.

Figure 105 – Selection criteria (number of stays)



Note: DC = Day care; blue circle = stays classified in MDC 14; red circle = women aged 12-62 with a stay in a maternity service (M-bed); MDC 14 A = deliveries (APR-DRGs 540, 541, 542 or 560); MDC 14 B = pregnancy or puerperium (APR-DRGs 544-6 or 561-566).

We found 168 695 stays for which MDC 14 has been assigned in 2014: 123 259 stays (73.1%) with deliveries and 45 436 stays (26.9%) with another APR-DRG in MDC 14. Of all deliveries, 122 380 stays (99.3%) were spent in a maternity service (M-bed). Of all the stays without deliveries in MDC 14, 18 968 (41.7%) were spent in a maternity service. The majority of the stays without deliveries (26 468 stays; 58.3%) were thus spent outside bed index M. Most of these admissions occurred in a day-care setting. A few deliveries did not occur in an M-bed, also mostly in a day-care setting.

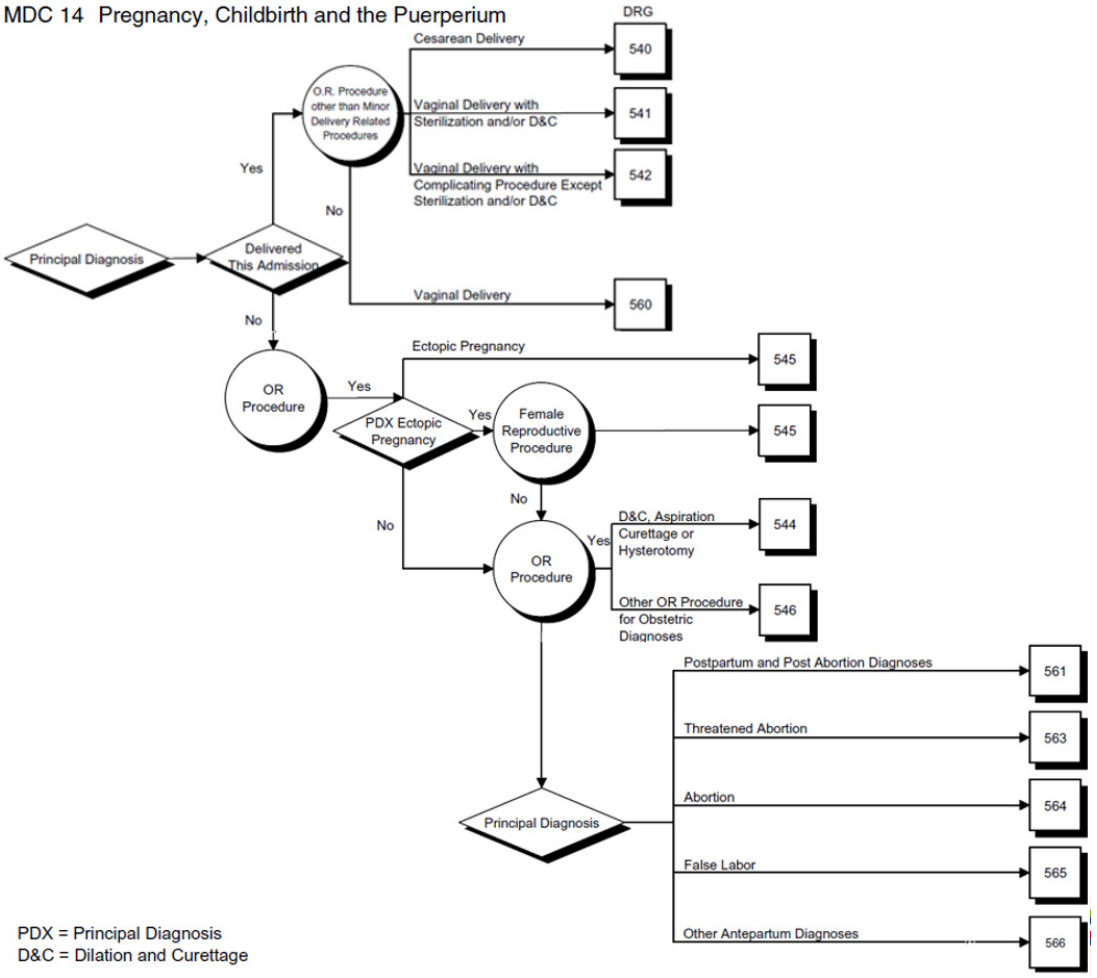
[kk] See section 8.2.2.1 for details about the data selection.

In total 143 829 stays were spent (at least for some time) in an M-bed; including 2 481 stays (1.7%) with a MDC different from MDC14.

In an attempt to describe the activity profile of maternity services in Belgium, we can focus on different types of activities: activity in M-beds, deliveries, or activities related to pregnancy. Depending on the indicator we want to analyse, one or another of these categories may be more relevant:

- **Activity in M-beds**. There were 143 829 hospital stays (inpatient and day care) for which the patient spent at least some time in an M-bed. More details can be found in the Data Manual (available upon request). Among these stays, 141 348 concerned MDC 14 (with only 173 in day care). The vast majority (122 380) concerned deliveries (i.e. what we call MDC 14 A) and 18 968 concerned other diagnoses related to pregnancy (MDC 14 B). Finally, 2 481 stays (of which 575 in day care) in an M-bed where not related to MDC 14. In section 8.2.2.4, we use the number of days spent in M-beds to analyse the occupancy rate of M-services (Figure 118, Figure 119, Figure 120, Figure 121 and Figure 122). The MZG – RHM files allow to determine the time spent by a patient in a specific unit, but not to identify the specific bed index when the unit contains different bed indices. Therefore, it was not possible to isolate the activity in MIC-beds as subpart of the activity in all M-beds.
- **Deliveries**. Deliveries are defined as stays for which one of the four following APR-DRGs is recorded: 540, 541, 542 and 560. We use 'MDC 14 A' to label this group of hospital stays. In 2014, there were 123 259 stays in this category. Most of them (122 563) were inpatient stays, but a small subgroup (696) concerned day-care stays. In section 8.2.2.2 we analyse deliveries (both inpatient and day care) in Belgian hospitals more in details (in particular, Figure 107, Figure 108 and Figure 112). For some figures (Figure 109 and Figure 111), we restrict ourselves to deliveries taking place in an M-bed (also inpatient and day care). In section 8.2.2.2, we focus on the average length of stay for hospital inpatient stays with a delivery (Table 107, Figure 113, Figure 114, Figure 115, Figure 116 and Figure 117).
- **Activity related to pregnancy**. This activity corresponds to the 168 695 stays for which MDC 14 (A or B) has been assigned. For most of these stays (141 348) at least some time is spent in an M-bed. Amongst the stays outside M-beds (27 347), very few (879) were related to deliveries (MDC 14 A). Most of them (26 468, including 19 045 in day care) concerned other diagnosis related to pregnancy (MDC 14 B). A detailed analysis of the stays of MDC 14 B performed in- or outside an M-service is beyond the scope of the current study. However, where relevant a distinction is made between activity related to deliveries (i.e. MDC 14A) and other activities (Figure 122 and Figure 123).

Figure 106 – MDC 14 Pregnancy, Childbirth and Puerperium



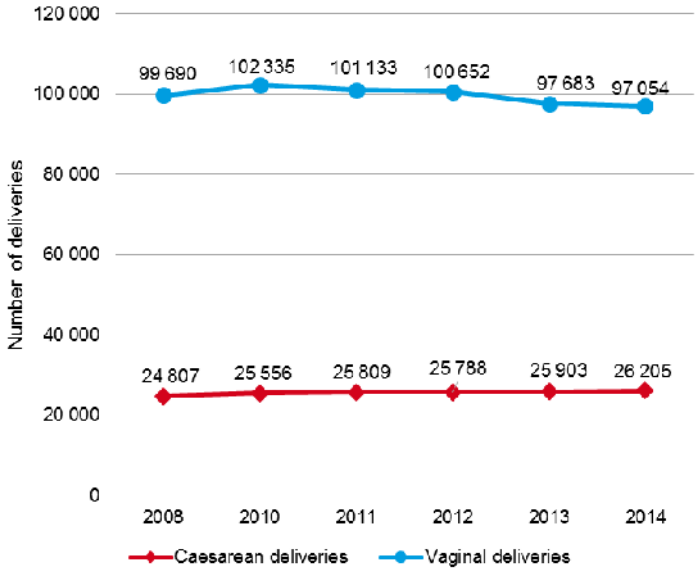
Source: adapted from 3M™ APR DRG Classification System Version 28.0 (effective 10/01/2010) Definitions Manual Volume 1, 2010, 3M Health Information Systems, Wallingford CT, U.S.A.

8.2.2.2 *Deliveries in Belgian hospitals*

The number of deliveries in Belgian hospitals is relatively stable over time

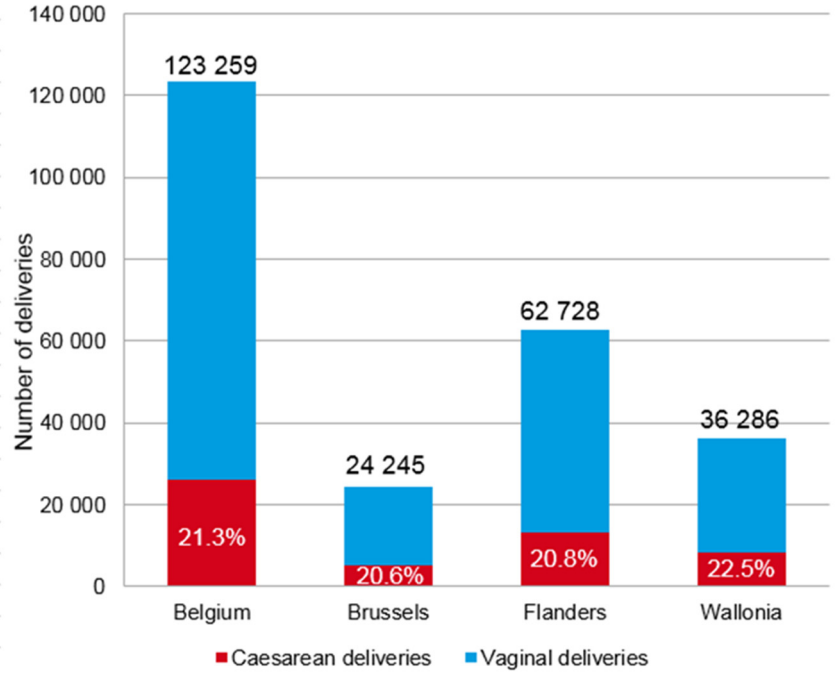
There were 123 259 deliveries (97 054 vaginal deliveries and 26 205 C-sections) in Belgium in 2014. This number is quite stable over time, with a slight increase of C-sections compensated by a decrease in vaginal deliveries (see Figure 107). Most of the deliveries (51%) take place in the Flemish region (see Figure 108). Also note that the rate of C-sections is a bit higher in the Walloon region (22.5%) than in other parts of the country (20.8% in the Flemish region and 20.6% in the Brussels region).

Figure 107 – Number of deliveries in Belgium, 2008-2014



Deliveries in Inpatient and day-care settings.Source: Minimal Hospital Data (MZG – RHM).

Figure 108 – Number of deliveries per region in Belgium, 2014

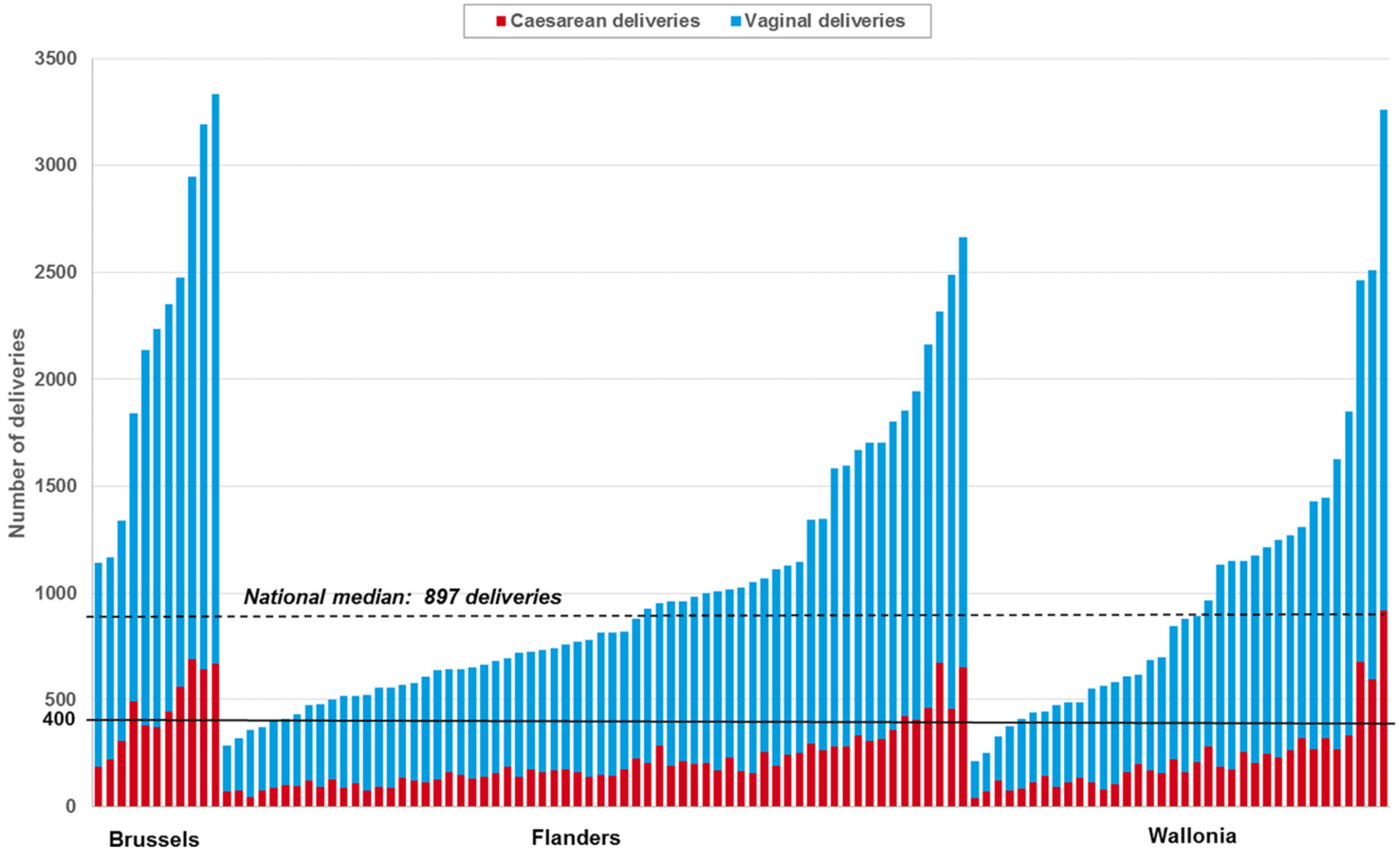


Deliveries in Inpatient and day-care settings.
Source: Minimal Hospital Data (MZG – RHM).

There is a large variability across Belgian hospitals in terms of number of deliveries per maternity service

In Belgium, most deliveries take place in the hospital. Among the 111 maternity services (hospital sites) described above, the median number of deliveries per site is 897 but varies widely (from 212 to 3 333) between sites and between regions. The 11 maternity services in the Brussels region had a larger number of deliveries per site (median of 2 236 deliveries) compared to the other regions. In Wallonia, the median number of deliveries was 864.5 (36 hospital sites) while this is even lower in Flanders: 800 (64 hospital sites). Figure 109 depicts this number of deliveries per maternity service.

Figure 109 – Number of deliveries per maternity service in Belgium, 2014



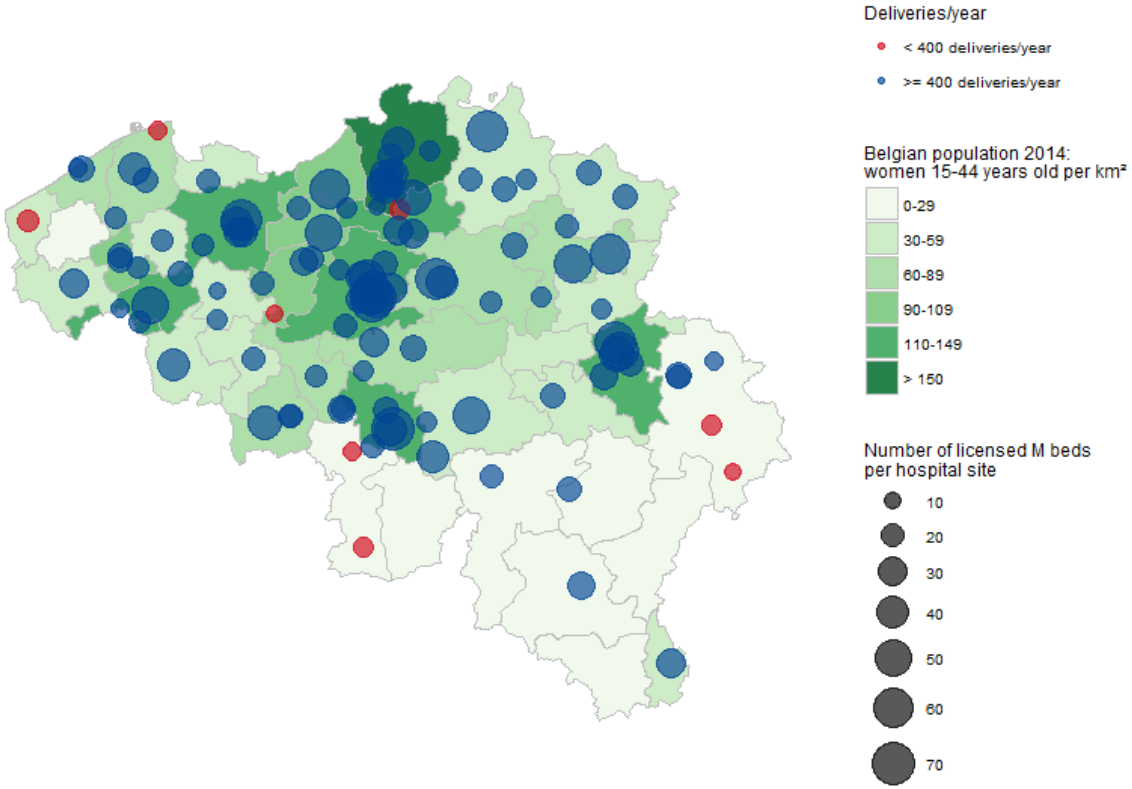
Deliveries in M-beds (Inpatient and day-care settings). If we had taken into account, for the 111 hospital sites, also deliveries occurring in a bed that is not an M-bed (number of additional stays: 871), the national median number of deliveries per site would have been 907. Source: Minimal Hospital Data (MZG – RHM).

Two maternity services operate below the legal minimum number of deliveries

Eight services had less than 400 deliveries in 2014 (see Figure 109). They are identified by the red dots in Figure 110. Although the minimum activity level stated in the law is defined as an average over three consecutive years, the annual data give us a good approximation of the number of maternity services that do not reach the threshold. Two of these maternity services are located in municipalities of more than 20 000 inhabitants where the closest similar service is located at a distance of at least 15 km (respectively 35 km and 15 km). The six others are located in municipalities of less than 20 000 inhabitants. For four of them, the closest similar service is located at a distance of more than 25 km (precisely, 26 km, 26 km, 31 km and 39 km). But, for two maternity services, the exception criteria that would allow them to perform less than 400 annual deliveries are not met: the distance to the closest similar service is less than 25 km (respectively 7 and 14 km). These maternity services performed respectively 321 and 330 deliveries in 2014.

Note that the notion of distance is not defined in the law. We choose to take the most conservative hypothesis (travel distance by road). If we had used distance as the crow flies, the above distances would have been 6 and 8 km. Moreover, three additional maternity services would have been considered as outside the exception criteria: one in a municipality of more than 20 000 inhabitants but located at 11 km of the closest similar service, and two located in smaller municipalities and, both at 18 km of the closest other maternity service.

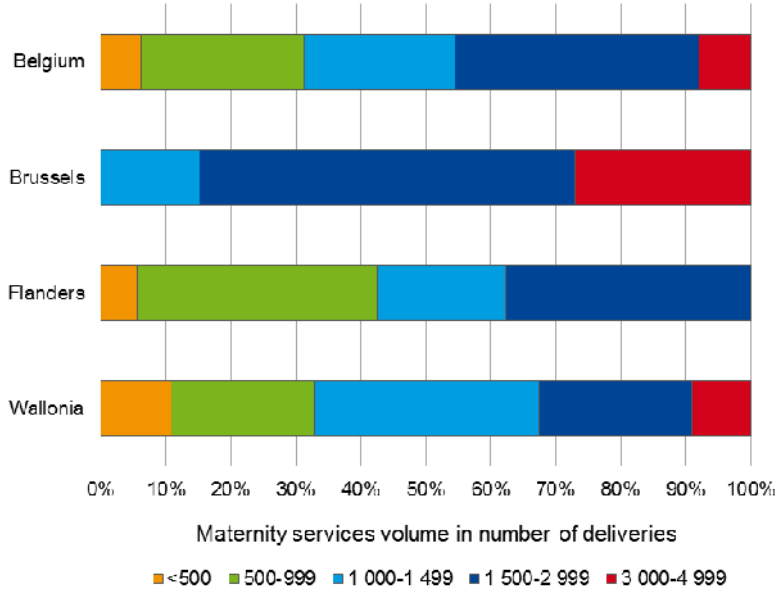
Figure 110 – Maternity services in Belgium with less than 400 deliveries in 2014



The vast majority of deliveries are performed in maternity services with at least 1 000 deliveries per year but large regional differences exist

In 2014, almost 70% of the deliveries in Belgium occurred in a maternity service performing more than 1 000 deliveries per year, and around 45% in a service performing more than 1 500 deliveries (see Figure 111). However, these numbers vary widely among regions. In Flanders more than 40% of the deliveries occurred in a service performing less than 1 000 deliveries. Moreover, no service in that region performed more than 3 000 deliveries per year. In Brussels, on the contrary, no service performed less than 1 000 deliveries per year.

Figure 111 – Distribution of deliveries by maternity service volume in Belgium and its three regions, 2014

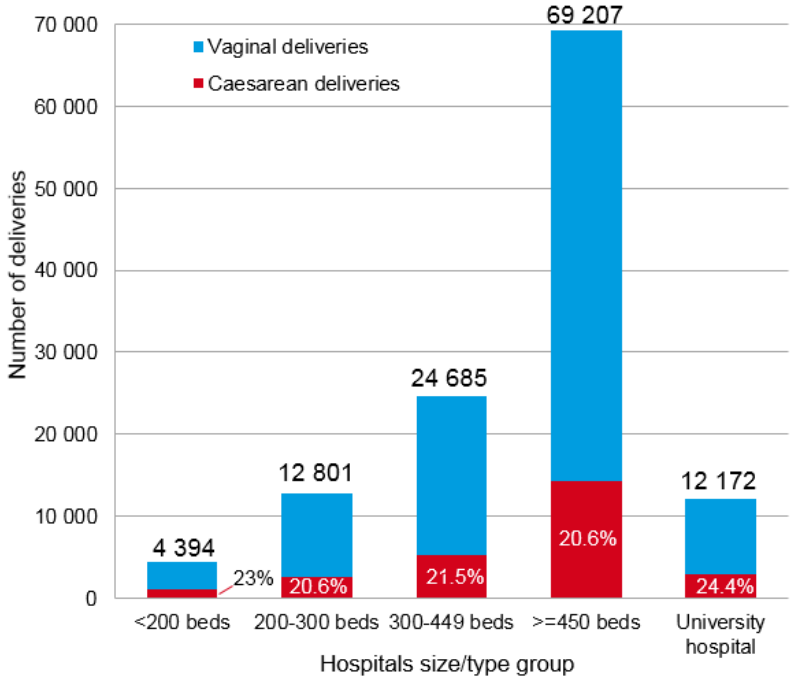


Deliveries in M-beds (Inpatient and day-care settings). Source: Minimal Hospital Data (MZG – RHM).

Most deliveries are performed in hospitals with 450 beds or more

From Figure 112 it can be observed that most of the deliveries in Belgium in 2014 occurred in a hospital that counts more than 450 (M and non-M) beds. Also, the vast majority of deliveries (68%) occurred in maternity services without MIC department. As one may expect, the rate of C-sections is lower in these maternity services (20.4%) than in those with a MIC department (23.3%).

Figure 112 – Number of deliveries per type/size of hospital in Belgium, 2014



Deliveries in inpatient and day-care settings. Source: Minimal Hospital Data (MZG – RHM).

8.2.2.3 *Length of stay for hospital stays with a delivery*

The average length of stay is (slowly) decreasing for vaginal and caesarean deliveries

In 2014, the average length of stay in Belgium in 2014 was 4.1 days for a vaginal delivery and 6.1 days for a C-section. Variations between regions are small (see Table 107). The average length of stay for a delivery is decreasing over time (Figure 113). In 2003, the average length of stay for a vaginal delivery was 5 days, while it was 7.8 days for a C-sections. The average length has been reduced by respectively 16% and 20% in 10 years. This decreasing trend is consistent with what is observed in other countries even if the average length of stay in Belgium is still above the EU average (see section 8.4.1, in particular Figure 138).

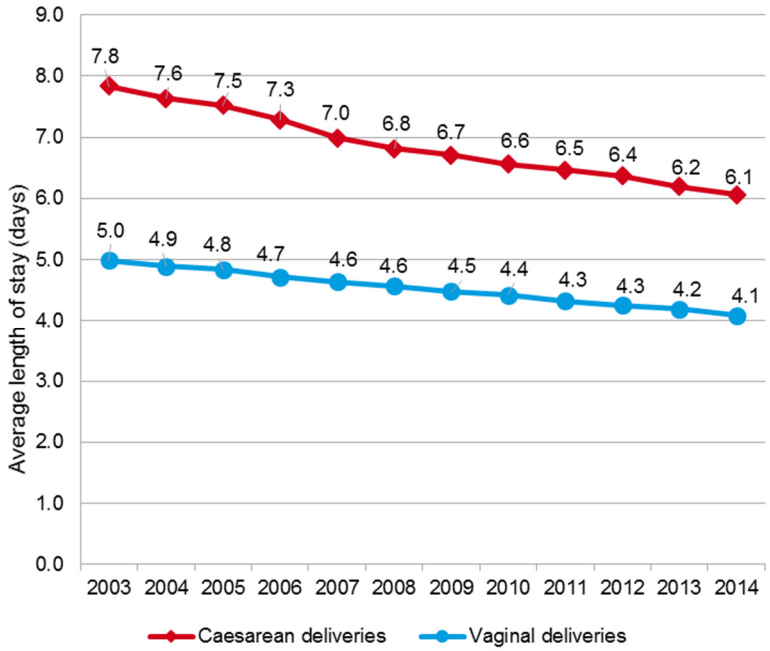
The length of stay is expected to further reduce in the coming years (see also Chapter 1 and section 8.3.2). Indeed, in the context of the Action Plan for a reform of the Belgian hospital payment system (April 2015)[1], the minister of Social Affairs and Public Health supports seven pilot projects, with a duration of two years, to optimise the organisation of care before, during and after the hospital stay.[608]

Table 107 – Average length of stay (in days) for a delivery in the three regions of Belgium, 2014

	Caesarean	Vaginal
Brussels	6.3	4.2
Flanders	6.1	4.0
Wallonia	5.8	4.2

Deliveries in inpatient setting. Source: Minimal Hospital Data (MZG – RHM).

Figure 113 – Evolution of the average length of stay (in days) for a delivery in Belgium, 2003-2014

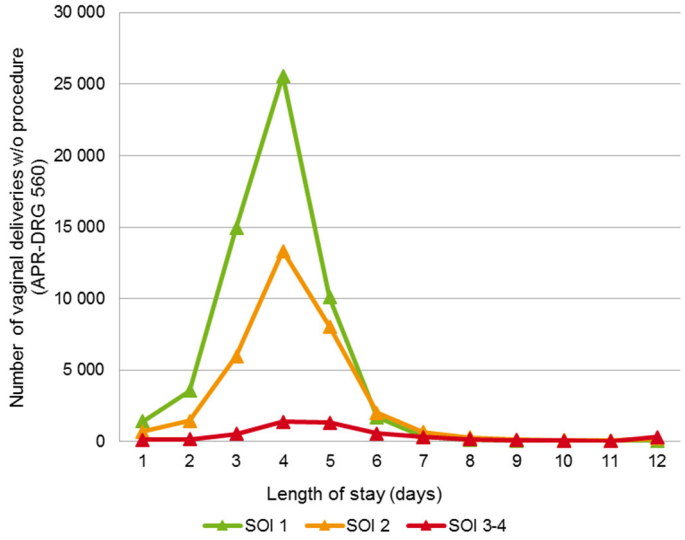


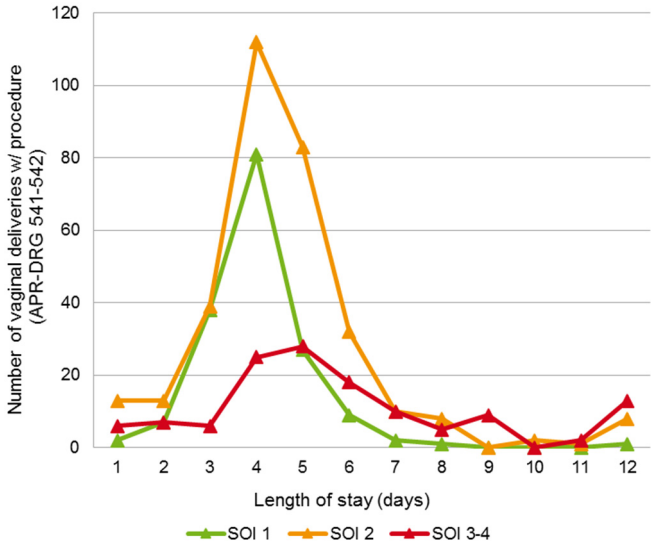
Deliveries in inpatient setting. Source: Minimal Hospital Data (MZG – RHM).

The distribution of length of stay is concentrated around 4 days for vaginal deliveries and 5-6 days for caesareans, for the lowest levels of severity

Figure 114 and Figure 115 show the distribution of length of stay per level of severity. The left panel of Figure 114 shows the case of vaginal deliveries without procedure. They represent more than 99% of the vaginal deliveries in the three regions of Belgium in 2014. For these deliveries, the large majority of stays lasted 4 days, at least for levels of severity 1 and 2. The picture is less clear for vaginal deliveries with procedure (right panel of Figure 114), even if the same peak appears at 4 days for levels of severity 1 and 2. For C-sections (Figure 115), the large majority of stays lasted 5 or 6 days, at least for levels of severity 1 and 2. For all types of deliveries, the distribution of length of stays is way more scattered for levels of severity 3 and 4. Also, the distribution of length of stay do not vary importantly across regions.

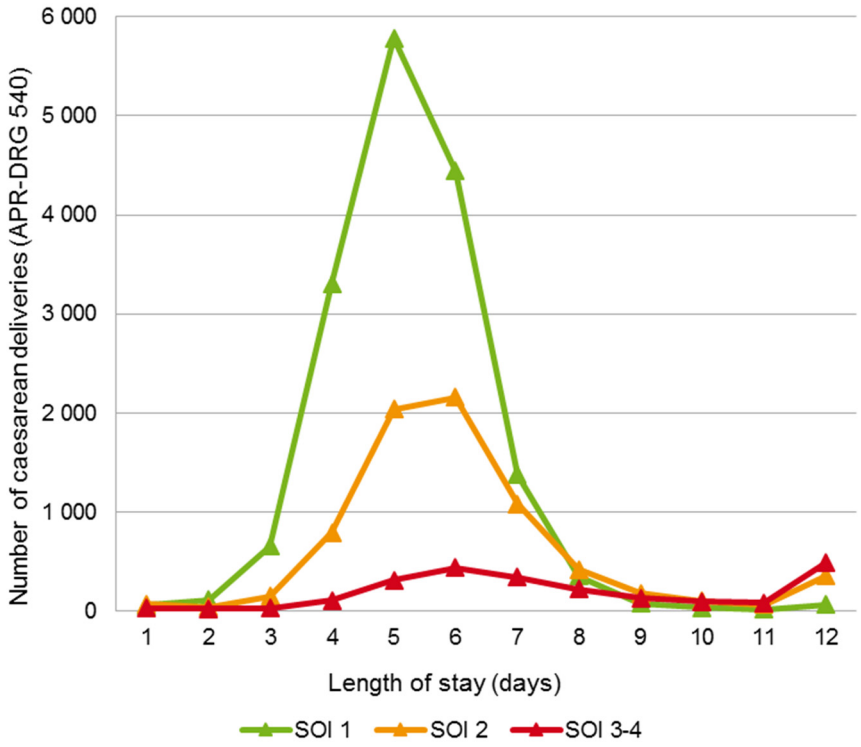
Figure 114 – Distribution of length of stay (in days) for vaginal deliveries per level of severity in Belgium, 2014





Deliveries in inpatient setting. Source: Minimal Hospital Data (MZG – RHM).

Figure 115 – Distribution of length of stay (in days) for C-section deliveries per level of severity in Belgium, 2014



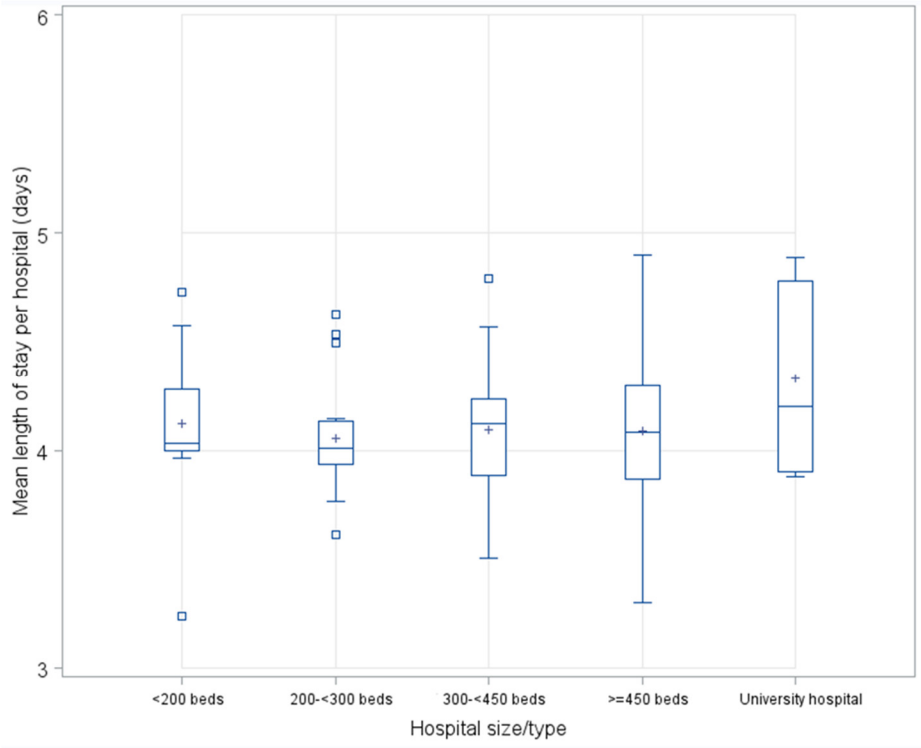
Deliveries in inpatient setting. Source: Minimal Hospital Data (MZG – RHM).

The variability in length of stay between hospitals is relatively low

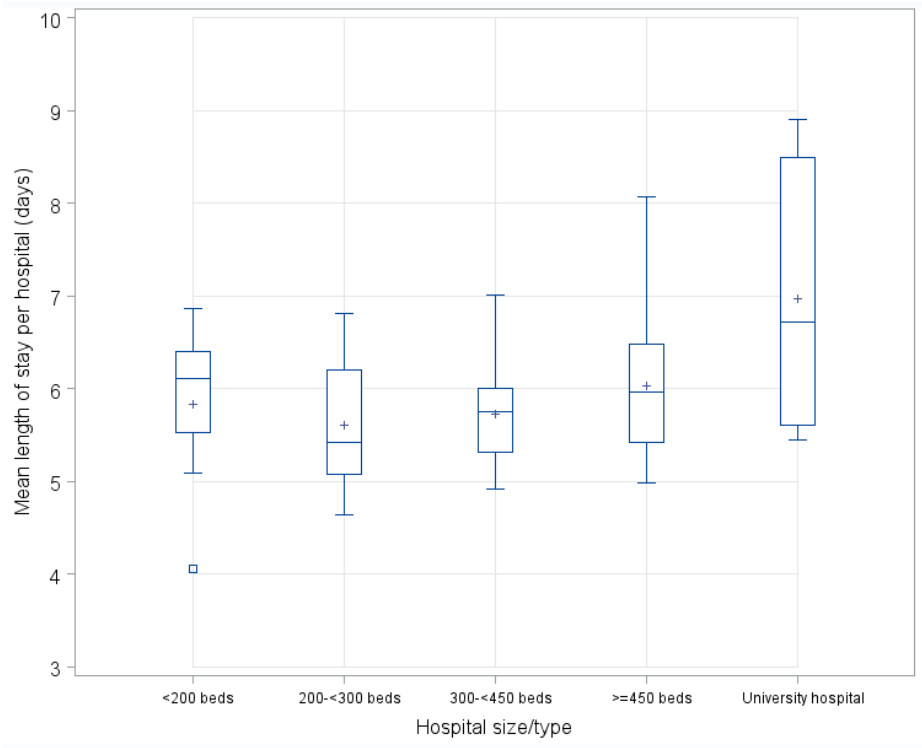
The distribution of average length of stay per hospital type/size is shown in Figure 116 for vaginal deliveries and for C-sections. The same is done for maternity services with and without MIC department in Figure 117. Globally, length of stay for a delivery is longer in university hospitals as well as in maternity services with a MIC department.

Figure 116 – Distribution of average length of stay for a delivery per hospital type/size in Belgium, 2014

(a) Vaginal deliveries



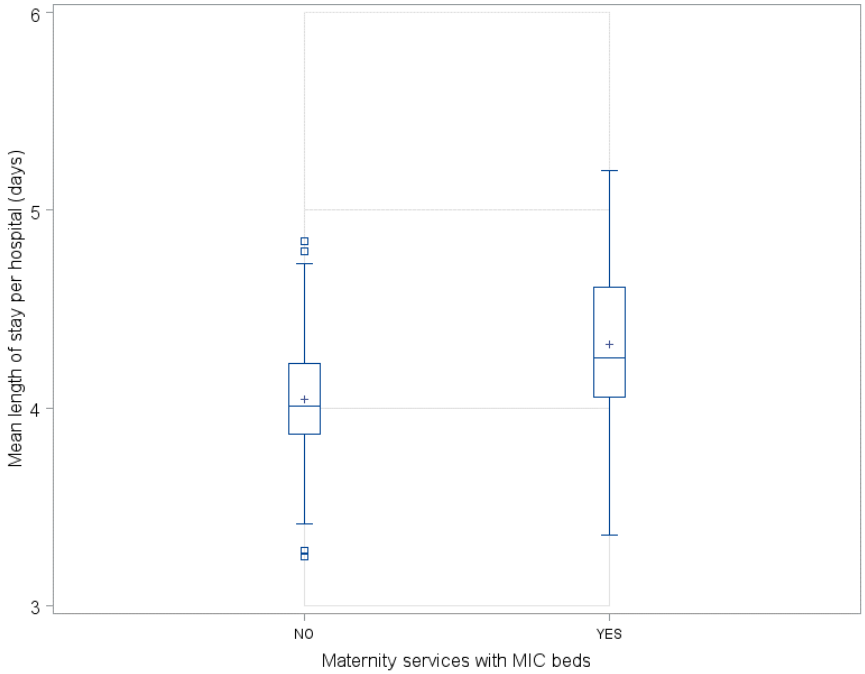
(b) C-sections



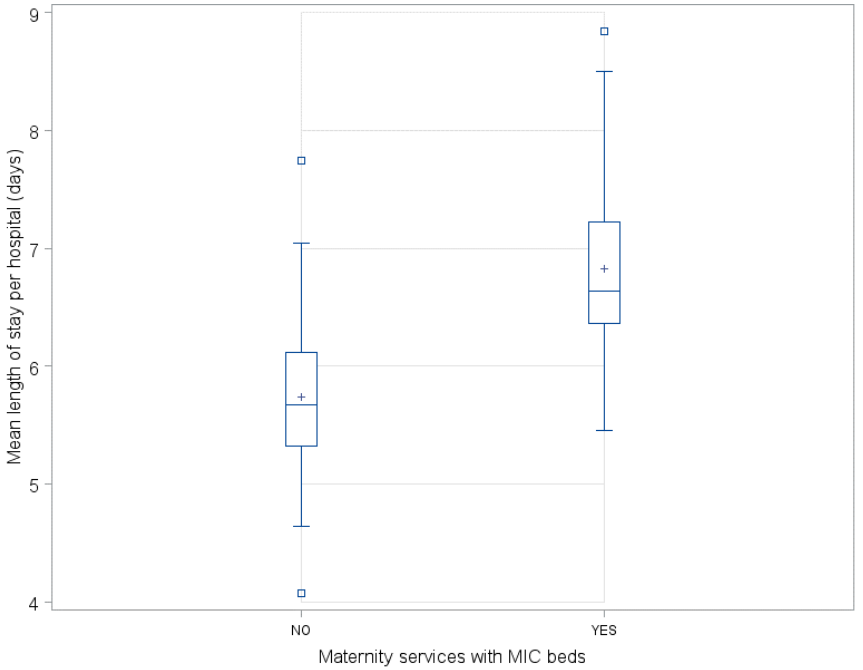
Deliveries in inpatient setting. Source: Minimal Hospital Data (MZG – RHM).

Figure 117 – Distribution of average length of stay for a delivery for maternity service with or without MIC department, 2014

(a) Vaginal deliveries



(b) C-sections



Deliveries in M-bed (inpatient setting). Source: Minimal Hospital Data (MZG – RHM).

8.2.2.4 Occupancy rate of M-services

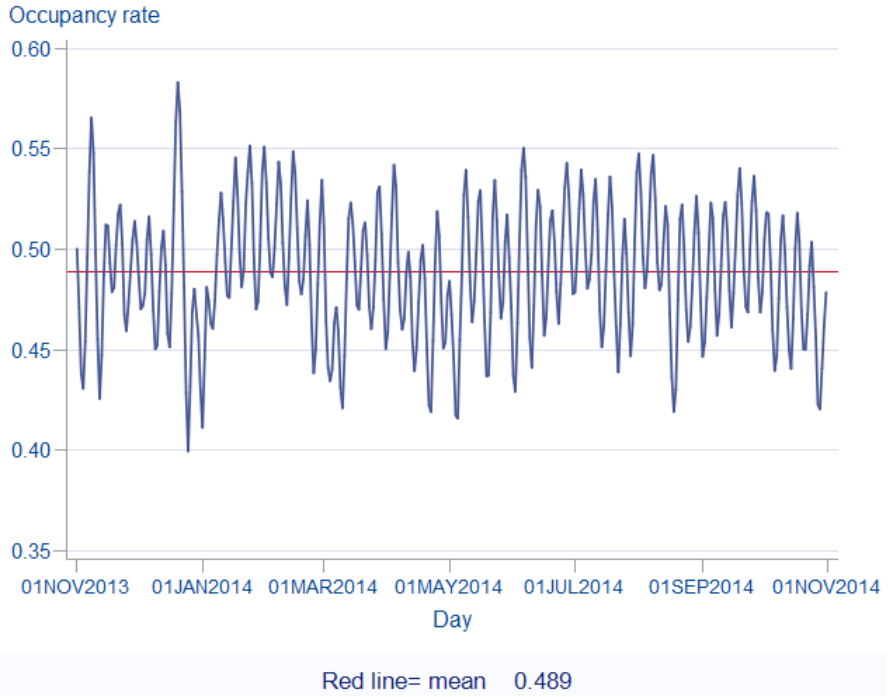
A daily occupancy rate is calculated as the number of M-beds effectively occupied that day (nursing days) divided by the number of licensed M-beds available that same day. This ratio is expressed as a percentage and can be higher than 100% when several patients occupy a bed on the same day. Note that the number of licensed M-beds can be larger than the number of beds actually used in the maternity service (operational beds).

As hospital stays are registered in MZG – RHM per year of discharge, data for 2014 include some stays admitted in 2013 and discharged in 2014 but do not include stays admitted in 2014 and discharged in 2015. Therefore, to calculate the occupancy rate on a full year, we started the calculation on 1 November 2013 and stopped it on 31 October 2014.

The average national occupancy rate is below 50%

Figure 118 shows the national daily occupancy rate of maternity services between November 2013 and October 2014. The average occupancy rate over the year is 48.9%, the median is 48.8%, the minimum being 39.9% and the maximum 58.3%.

Figure 118 – National occupancy rate of maternity services per day in Belgium, November 2013 - October 2014



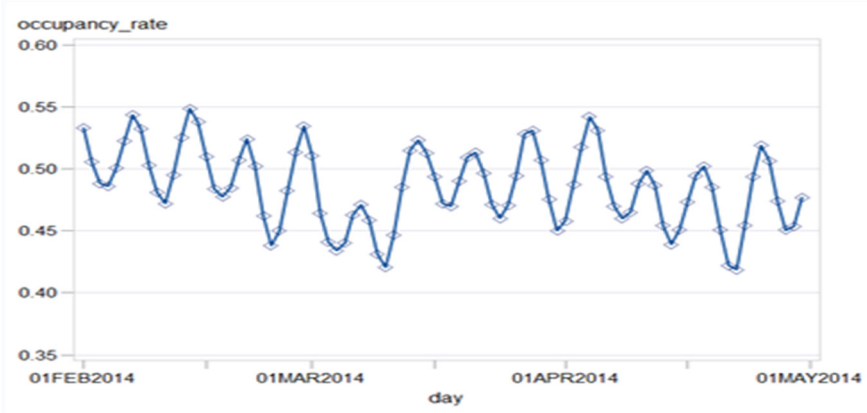
Activity in M-beds (inpatient and day-care settings). Source: Minimal Hospital Data (MZG – RHM).

Peak days are rare compared to days with very low occupancy rate

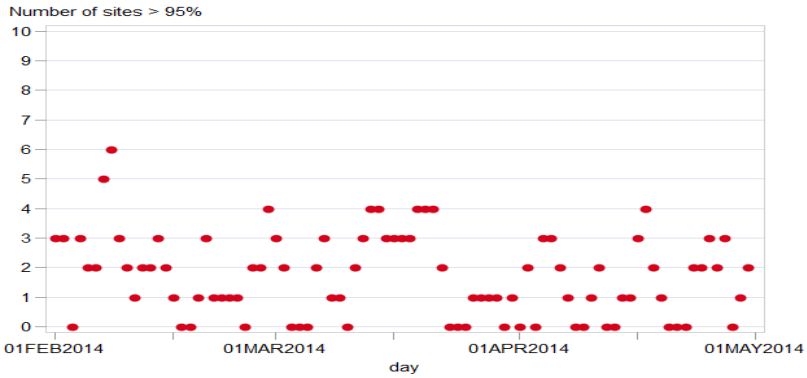
On a typical day of the year, much more maternity services work with very low occupancy rates than with very high. Figure 119 shows, for each day of the period 1 February – 1 May 2014, the number of maternity services with a daily occupancy rate above 95% (upper panel), the national average occupancy rate (centre panel) and the number of maternity services with a daily occupancy rate lower than 30% (lower panel). For instance, on February 1st, the national average occupancy rate was 53.30%, but 18 maternity services had an occupancy rate below 30% and only 3 had an occupancy rate above 95%. Similar patterns are observed for other quarters of the year. Over the entire period November 2013 – October 2014, the maximum number of maternity services with a daily occupancy rate above 95% on the same day was 9 (on 20 and 21 December 2013). On the other hand, each day 10 maternity services or more had an occupancy rate below 30%.

Figure 119 – Number of maternity services with high and low occupancy rate, per day, 1 February 2014 – 1 May 2014

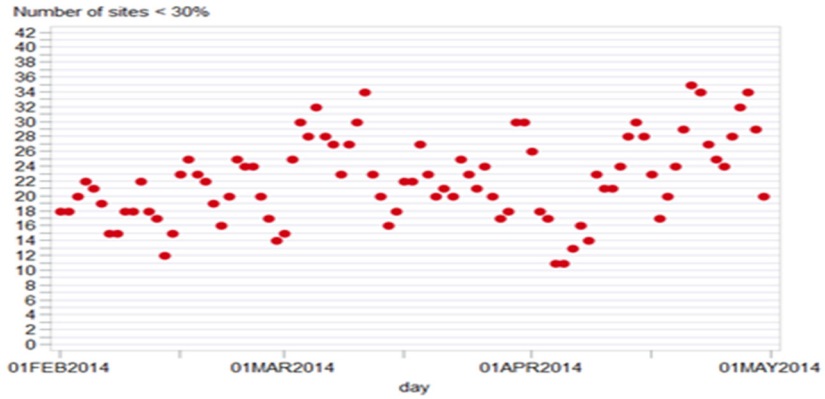
Occupancy rate Belgian M-services



Number of maternity services per day that exceed a 95% occupancy rate



Number of maternity services per day below a 30% occupancy rate



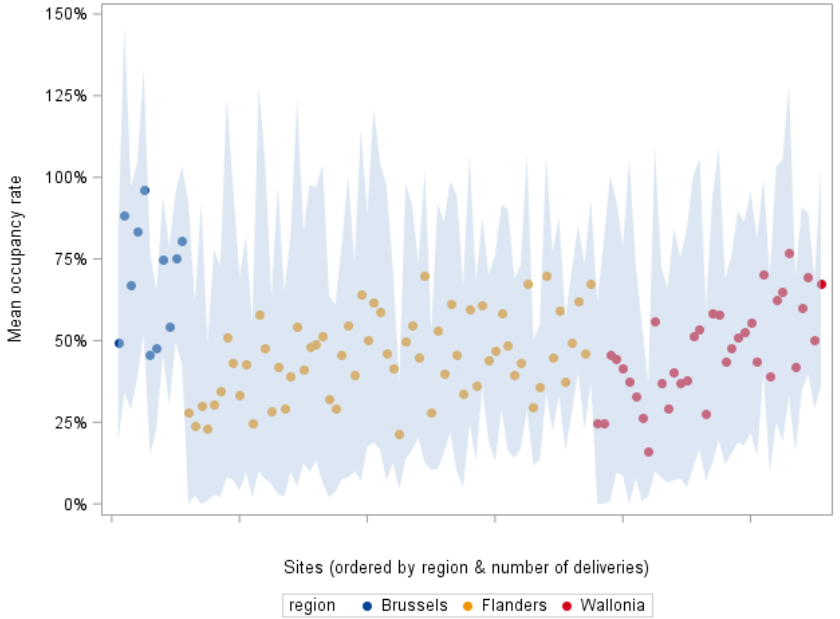
Activity in M-beds (inpatient and day-care settings). Source: Minimal Hospital Data (MZG – RHM).

The average occupancy rate per maternity service varies between 16% and 96% with manifest higher occupancy rates in Brussels

Figure 120 shows the annual (1 November 2013 – 31 October 2014) occupancy rate of each maternity service in Belgium. As one can see, the average occupancy rate is higher for maternity services in Brussels (on average 69.33% for maternity services in Brussels) than in the other regions (45.07% on average for maternity services in Flanders, 46.60% in Wallonia and 47.97% for Belgium). In Wallonia, the maternity service with the lowest annual occupancy rate has a rate of 15.93%. The highest annual occupancy rate in that region is 76.75%, and the median is 45.01%. Flanders exhibits comparable results (minimum 21.41%, maximum 70.01%, median 45.17%). In Brussels, however, even the hospital with the lowest occupancy rate exhibits a rate of 45.75%. The highest is 96.37% and the median is 74.85% in that region.

The average occupancy rate is, of course, not the best metric to assess the capacity in a domain that is subject to activity peaks (high number of deliveries on a particular day). Therefore, also the higher and lower peaks are depicted (i.e. the blue band) in Figure 120. It can be observed that this fluctuates between nearly 0% and 150%. Yet, for most maternity services, the number of days with occupancy rates above 95% is limited (i.e. for 92% of the maternity services in Flanders and Wallonia, this happens less than 10 days a year). In Brussels, the situation is different since only 7 out of 11 hospitals (63.64%) have less than 10 peak days a year. The remaining 4 maternity services in Brussels have more than 30 peak days a year, the highest number of peak days culminating at almost 200 days.

Figure 120 – Average annual occupancy rate (1 November 2013 – 31 October 2014) for each maternity service in Belgium



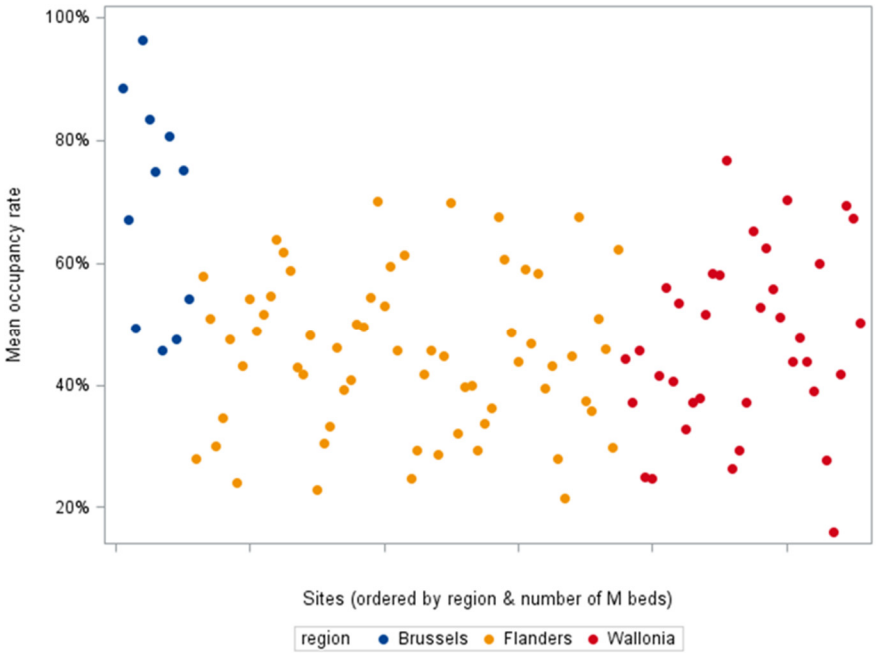
Activity in M-beds (inpatient and day-care settings). Source: Minimal Hospital Data (MZG – RHM).

While there is variation in the occupancy rates across maternity services, this cannot be related to the size (in terms of number of M-beds) of the services, as one can see on the left panel of Figure 121. It cannot be said that large maternity services have systematically low occupancy rate or vice-versa. However it is true that large maternity services (in terms of number of M-beds) perform more deliveries than lower size services. This is true in each of the three regions of Belgium (right panel of Figure 121). In addition, the maternity services depicted in Figure 120 are ranked (per region) according to the number of deliveries. From the maternity services in Flanders and Wallonia an association between number of deliveries and

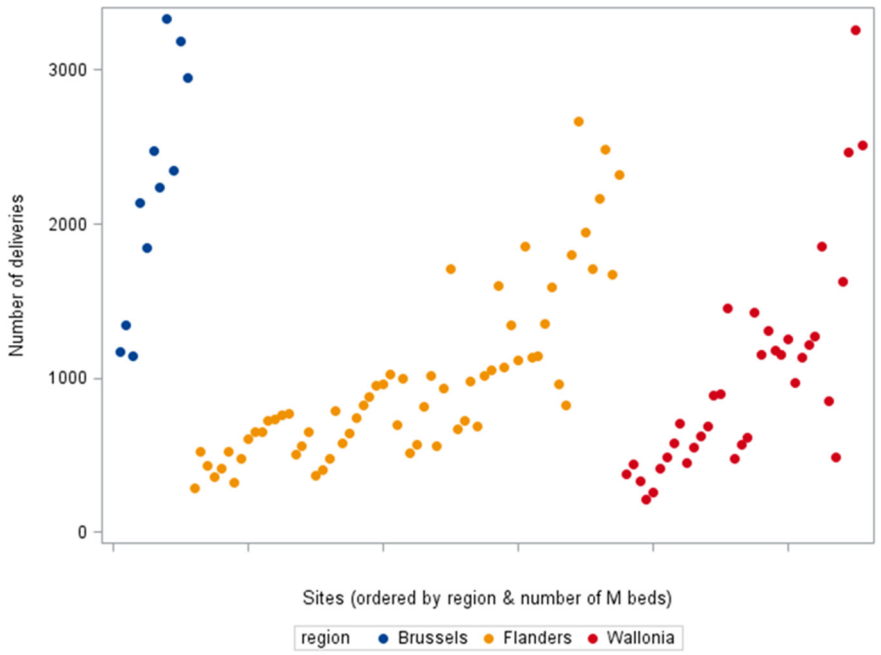
occupancy rates can be observed: the higher the number of deliveries, the higher the average occupancy rates (without necessarily resulting in higher peak occupancy rates).

Figure 121 – Average annual occupancy rate and number of deliveries for each maternity service in Belgium, ordered by region and number of M-beds

(a) Average (annual Nov 2013- Oct 2014) occupancy rate



(b) Number of deliveries (2014)

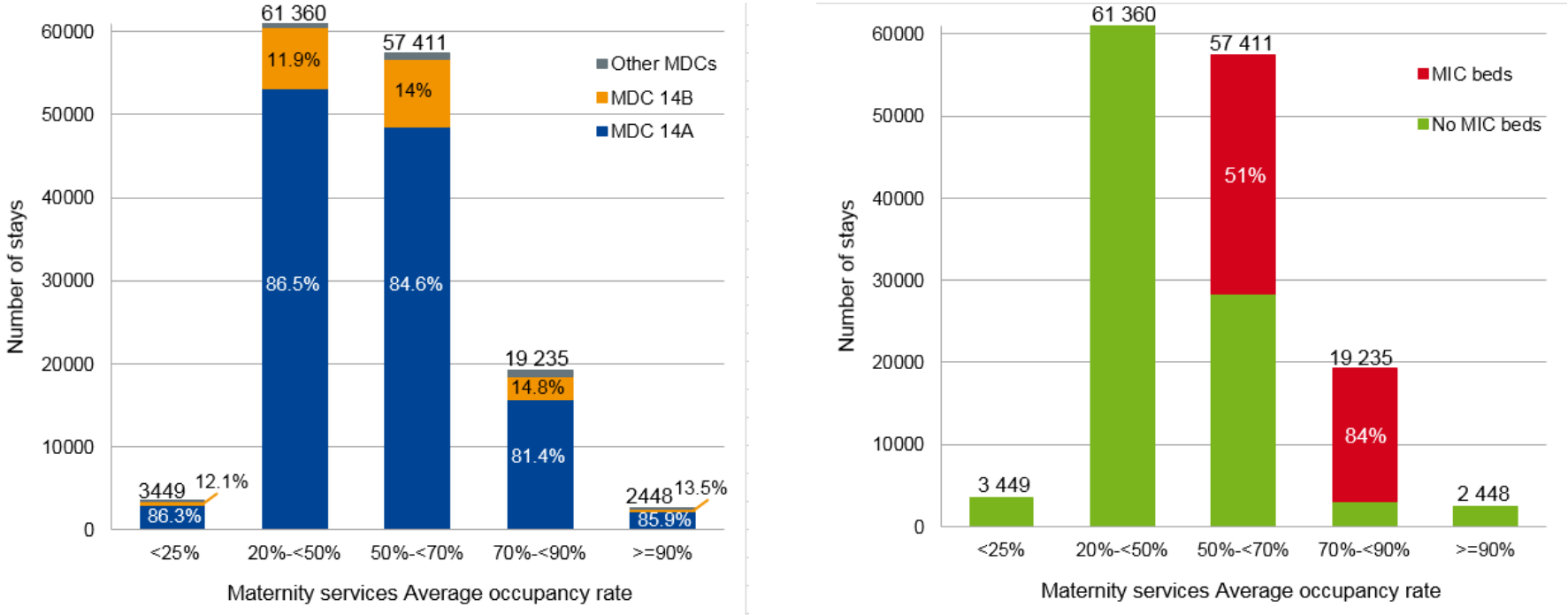


(a) Activity in M-beds (inpatient and day-care settings), (b) deliveries in M-beds (inpatient and day-care settings). Source: Minimal Hospital Data (MZG – RHM).

Services with MIC-department have higher occupancy rates

When looking at the types of stays in maternity services with different average occupancy rates (Figure 122), we see that the proportion of stays that are related to pregnancy but not to deliveries is more or less the same in all groups of maternity services. It means that low occupancy rate cannot be explained by a different percentage of deliveries with respect of other stays. However, stays in maternity services with high average occupancy rates are also mostly stays in maternity services with a MIC-department. In particular, 84% of the stays in maternity services with average occupancy rate between 70% and 90% occurred in a maternity that has a MIC-department.

Figure 122 – Distribution of stays in maternity service with different average occupancy rates in Belgium, in 2014



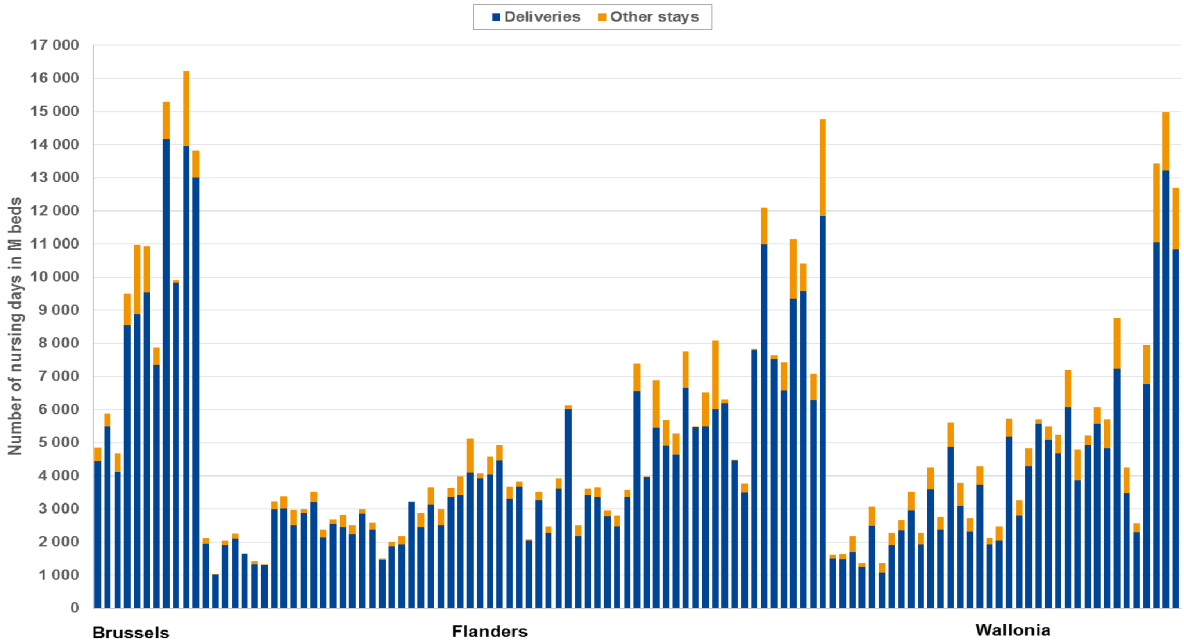
Activity in M-beds (inpatient and day-care settings). Note: average occupancy rates are calculated on the period November 2013 – October 2014. Source: Minimal Hospital Data (MZG – RHM).

8.2.2.5 *Pregnancy related activity*

A detailed analysis of pregnancy related activities that are not deliveries (MDC 14 B) performed in- or outside an M-service is beyond the scope of the current study. However the relative importance of these stays with and without delivery in maternity services is of interest. Indeed, in planning capacity for maternity services it is relevant to look at activities beyond deliveries. In particular, if these activities are concentrated in some maternity services, this may explain a low volume of deliveries per bed because the M-beds are occupied by patients with other pregnancy related issues. Figure 123 shows that the stays unrelated to deliveries are not particularly concentrated in particular maternity services but spread across all services.

The figure shows, for each maternity service in Belgium, the number of nursing days in M-beds that are related to deliveries or not. Nursing days unrelated to deliveries include mostly days recorded in MDC 14 B and some days recording in other MDCs, outside MDC 14. Maternity services are ordered by region and by number of M-beds. Further analysis shows that nursing days unrelated to deliveries are more or less equally spread across maternity services of different sizes (in terms of number of M-beds).

Figure 123 – Activity related and unrelated to deliveries in maternity services in Belgium, 2014



Source: Minimal Hospital Data (MZG – RHM).

8.2.3 Geographic distribution

High density of maternity services and maternity beds

As we observe in Figure 124, maternity services are spread across the country, with a higher density of services where population (women 15-44) density is higher. In some areas, particularly in Flanders, several maternity services, with an important number of licensed M-beds, are located close to one another, although the number of deliveries per licensed bed is quite low.

The situation of Brussels (Figure 125) is different. All eleven maternity services in that region perform at least 50 deliveries per M-bed per year. This is consistent with the observation we made above (see Figure 109) that the maternity services in Brussels have a larger number of deliveries (median of 2 236 deliveries) compared to the other regions (the Belgian median being 897 deliveries per maternity service).

Figure 124 – Geographic distribution of deliveries per bed in maternity services in Belgium, 2014

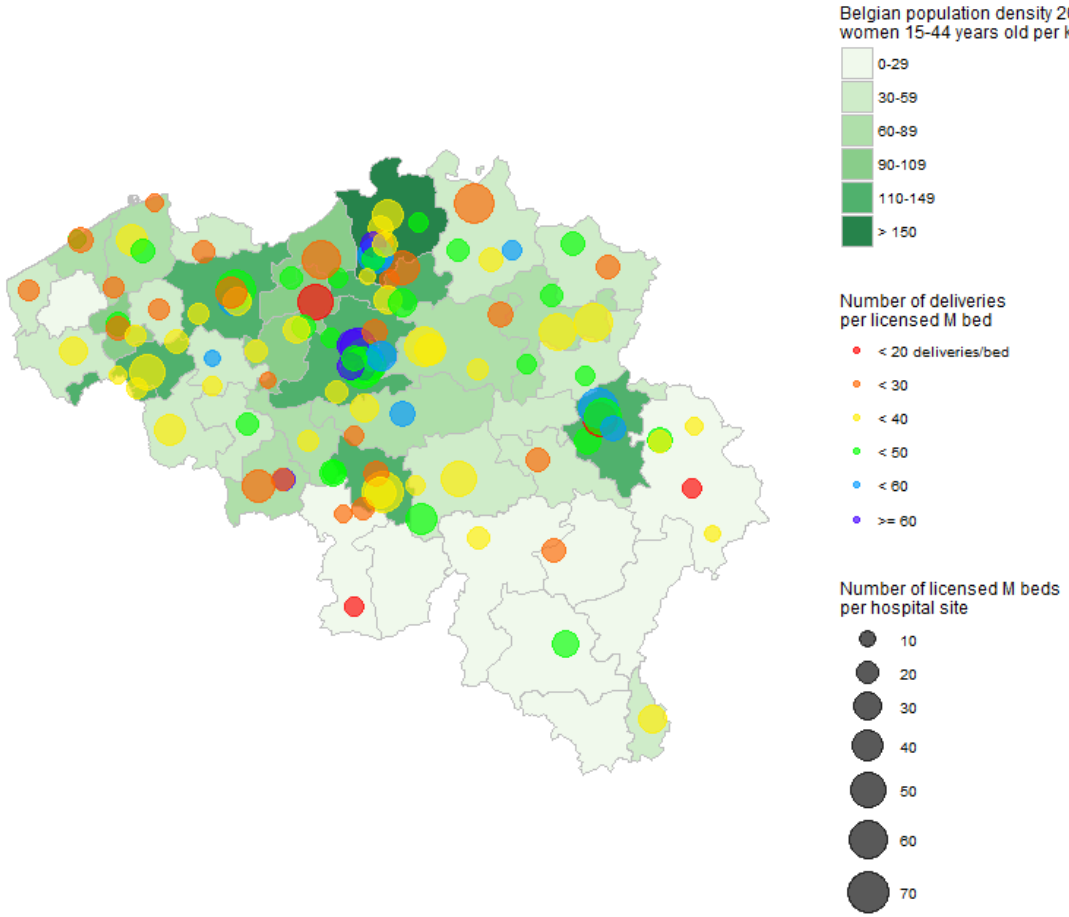
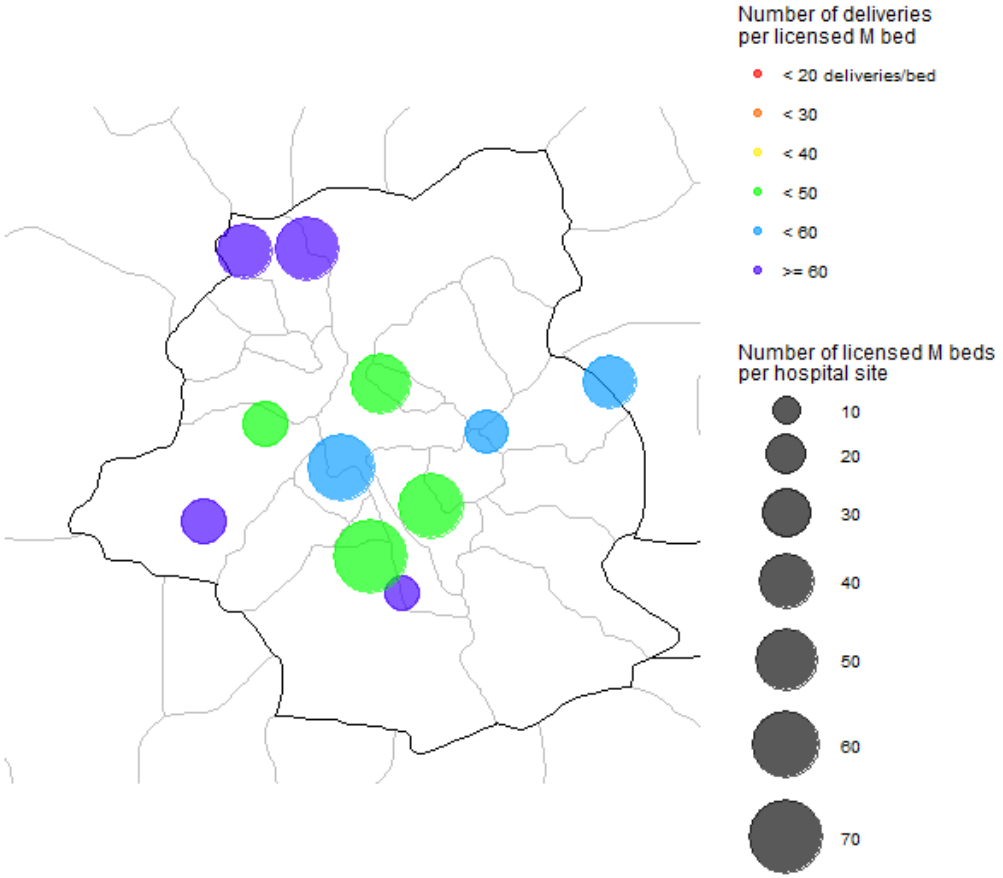


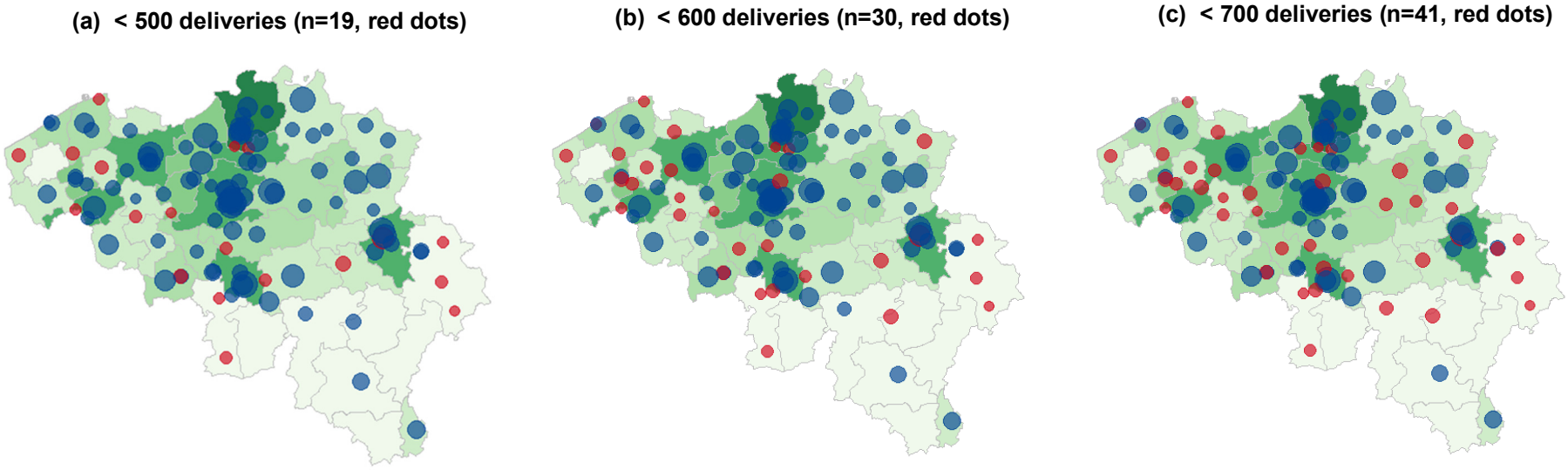
Figure 125 – Geographic distribution of deliveries per bed in maternity services in Brussels, 2014



Small maternity services are not always geographically isolated

In Figure 126, the red dots identify maternity services with less than 500, 600 or 700 deliveries per year. Amongst the 111 maternity services, there are respectively 19, 30 and 41 services in these categories. Figure 126 confirms that the maternity services that have a small number of deliveries are not necessarily geographically isolated. Some are located in the vicinity of other services. As already stated (see Figure 111), Flanders has a large number of relatively small maternities.

Figure 126 – Maternity services in Belgium with less than 500, 600 and 700 deliveries in 2014



Note: the size of the dot represents the number of licensed M-beds; the background colour represents population (women 15-44) density (darker corresponding to higher density).

Maternity services with a low number of deliveries operate under full capacity

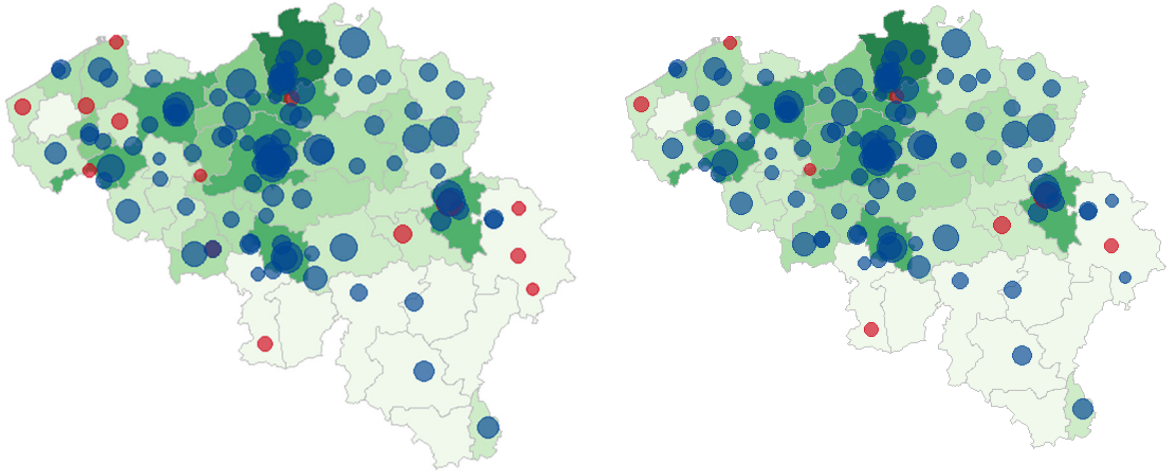
Among the 19 maternity services that performed less than 500 deliveries in 2014, 14 have a daily occupancy rate that is below 30% during more than 90 days of the year. These services are identified by the red dots on panel (a) of Figure 127.

There are even eight services that have a daily occupancy rate below 20% more than 90 days of the year (panel (b) of Figure 127). Again, although some of these services are geographically isolated, it is obviously not the case for all of them.

Figure 127 – Maternity services in Belgium with less than 500 deliveries in 2014 and over 90 days with bed occupancy rate below 30% or 20%

(a) < 500 deliveries and over 90 days with bed occupancy rate < 30% (n=14, red dots)

(b) < 500 deliveries and over 90 days with bed occupancy rate < 20% (n=8, red dots)



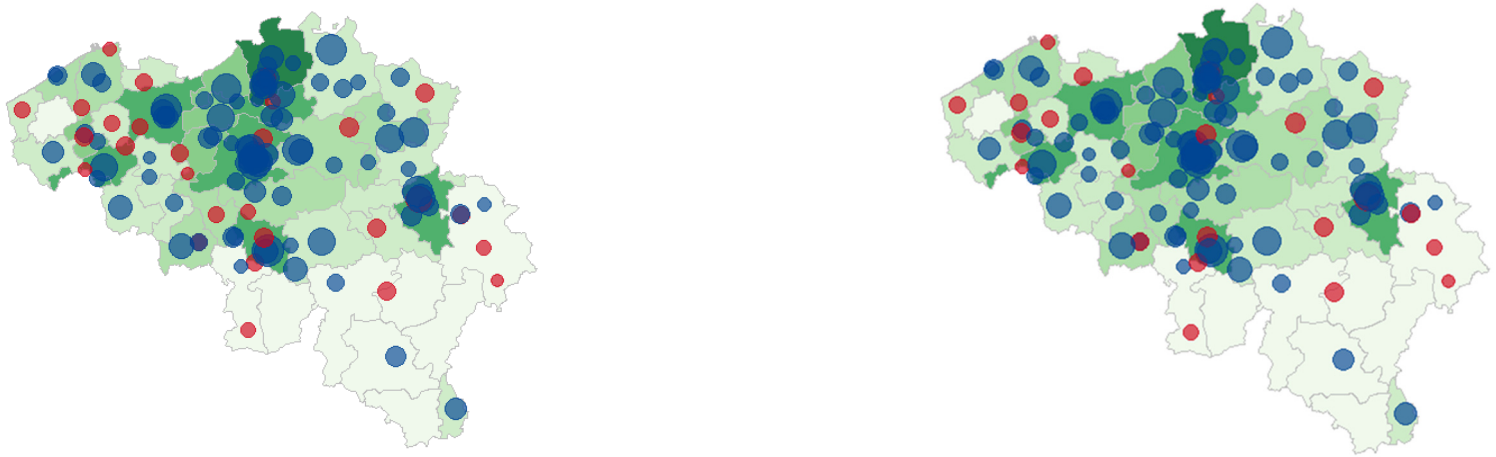
Note: the size of the dot represents the number of licensed M-beds; the background colour represents population (women 15-44) density (darker corresponding to higher density). Daily occupancy rates are calculated in the period November 2013 – October 2014.

Figure 128 identifies maternity services with less than 700 deliveries that have a low daily occupancy rate (below 30% or even 20%) at least 20 days of the year but not a single day of the year with an occupancy rate above 95%. For these maternity services, the low occupancy rate during some periods is not compensated by a high occupancy rate in other periods. This would have justified the necessity to have a fairly important number of M-beds to face peak activity periods. As we observe in Figure 128, this is not the case, at least for a number of maternity services. Moreover, these maternity services with low occupancy rate (that is not justified by an activity peak in other periods) are not necessarily geographically isolated. Most of them are located close to (an)other maternity service(s).

Figure 128 – Maternity services in Belgium with less than 700 deliveries in 2014, no day with bed occupancy above 95% and over 20 days with bed occupancy rate below 30% or 20%

(a) < 700 deliveries, over 20 days with bed occupancy rate < 30% and no day with bed occupancy rate ≥ 95% (n=28, red dots)

(b) < 700 deliveries, over 20 days with bed occupancy rate < 20% and no day with bed occupancy rate ≥ 95% (n=23, red dots)

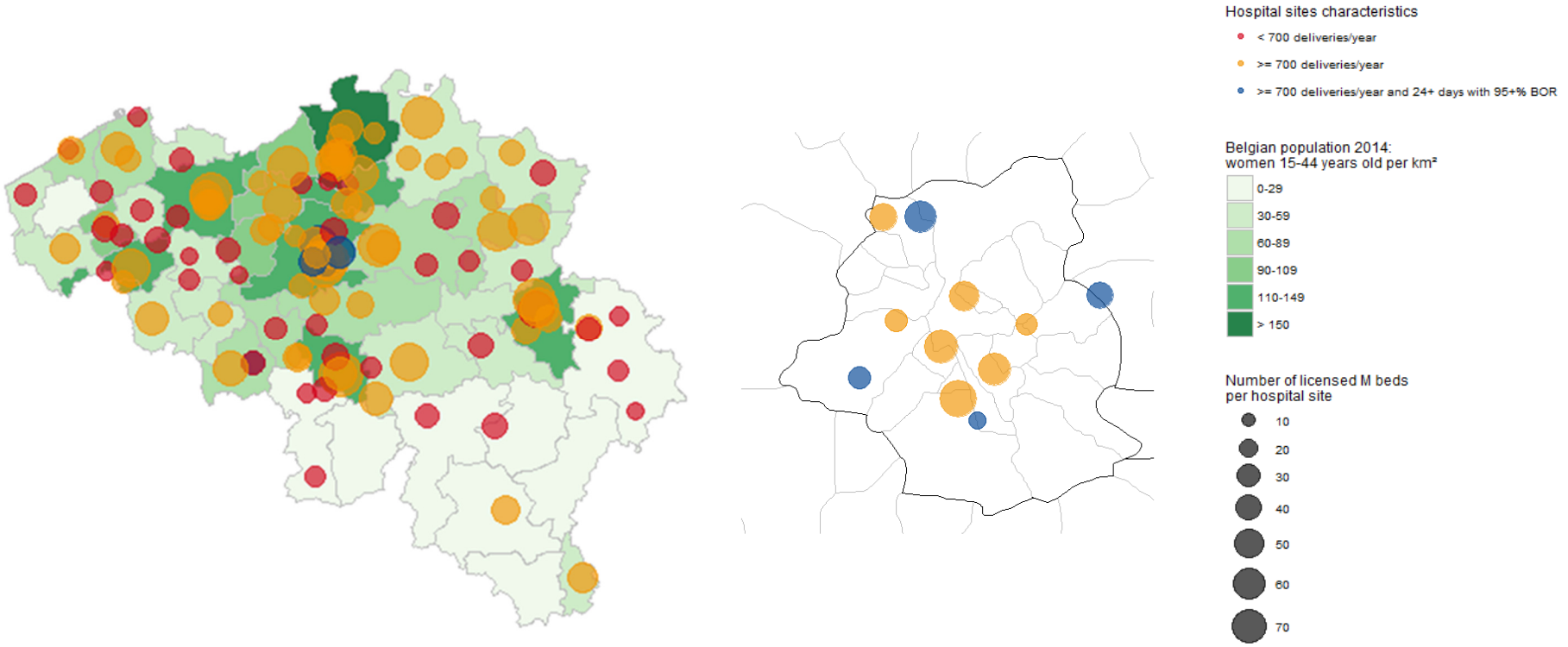


Note: the size of the dot represents the number of licensed M-beds; the background colour represents population (women 15-44) density (darker corresponding to higher density). Daily occupancy rates are calculated in the period November 2013 – October 2014.

Low activity volume maternity services cohabit with high volume ones although there is no capacity issue, except in Brussels

Following our previous analysis, we categorise maternity services according to their volume of activity: less than 700 deliveries per year or 700 or more deliveries per year. For maternity services with 700 or more annual deliveries, we further distinguish services facing capacity issues (24 days or more with occupancy rate equal or higher than 95%) from the others. Figure 129 shows the different categories of maternity services in Belgium and in Brussels. Overall, maternity services with low and high volume of activity are spread all over the country. Low volume maternity services that are not geographically isolated from the others are mostly located in Flanders. High volume maternity services facing capacity issues are mainly located in Brussels.

Figure 129 – Maternity services in Belgium and Brussels categorised by volume of activity and capacity issues, 2014



Note: occupancy rates are calculated on the period November 2013 – October 2014.

8.3 Estimation of (future) needs

The following section presents results from our projection model that are specific to maternity services and provides estimates for the (future) need for M-beds. Method, data and assumptions used are detailed in Chapter 1.

8.3.1 Current situation

Based on the observed (2014) number of inpatient days in M-beds, we calculate the need for M-beds. The normative occupancy rate of 70%, which is used to determine the number of justified beds, is applied. Given this occupancy rate, we estimate the need for M-beds at 2 545 beds, which is 19.87% less than the number (3 176) of licensed M-beds in 2014.

8.3.2 Baseline forecast

Number of deliveries

The number of deliveries is expected to increase in the coming years due to an increasing population trend. Table 108 presents the projected evolution of new-borns from 2014 to 2025. Remark that in the projection model, the number of deliveries is not directly determined by the number of new-borns, but indirectly by the evolution in women of child-bearing age and the trend evolution in the admission rates for vaginal and Caesarean deliveries. This because the mother is considered the primary patient requiring hospital care rather than the new-born child.

Table 108 – Projected number of new-borns (2014-2025)

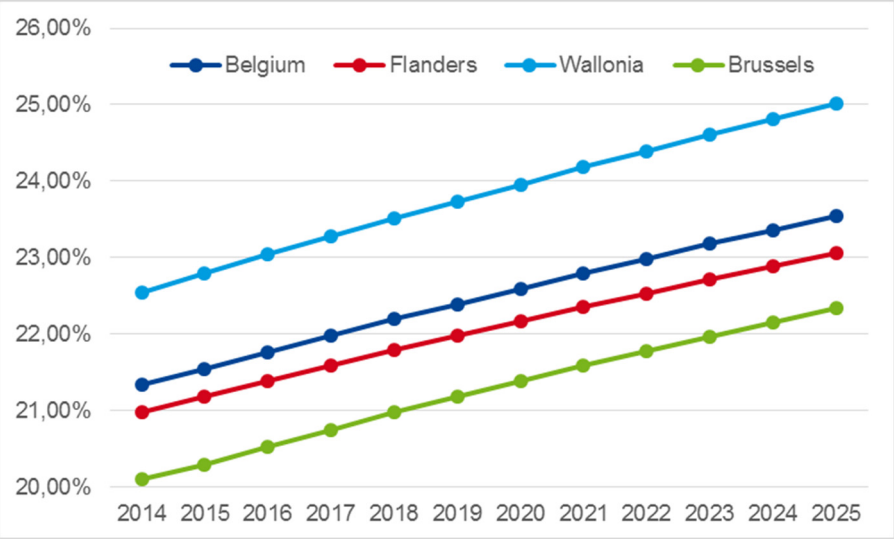
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Flanders	67 350	65 780	66 132	67 623	69 239	70 981	72 865	72 896	72 794	72 637	72 451	72 209
Rel. evolution Flanders (2014 = 100)	100.0	97.7	98.2	100.4	102.8	105.4	108.2	108.2	108.1	107.9	107.6	107.2
Wallonia	38 766	38 037	38 620	39 432	40 280	41 155	42 092	42 074	42 020	41 965	41 935	41 882
Rel. evolution Wallonia (2014 = 100)	100.0	98.1	99.6	101.7	103.9	106.2	108.6	108.5	108.4	108.3	108.2	108.0
Brussels	18 207	17 976	18 282	18 763	19 254	19 749	20 287	20 300	20 290	20 288	20 301	20 315
Rel. evolution Brussels (2014 = 100)	100.0	98.7	100.4	103.1	105.8	108.5	111.4	111.5	111.4	111.4	111.5	111.6

Note: population in year t = cross-section of statistics Belgium on January 1 of year t+1, e.g. population 2014 = observed population on January 1, 2015. Source: Vandresse et al. (2017)[7]

Type of deliveries

Based on the past evolution in medical practices in Belgium, we forecast a shift towards more C-section in comparison to the number of vaginal deliveries. Figure 130 shows the forecasted evolution of the rate of C-sections in Belgium and its three regions.

Figure 130 – Forecasted evolution of the rate of C-sections in Belgium and its three regions (2014-2025)

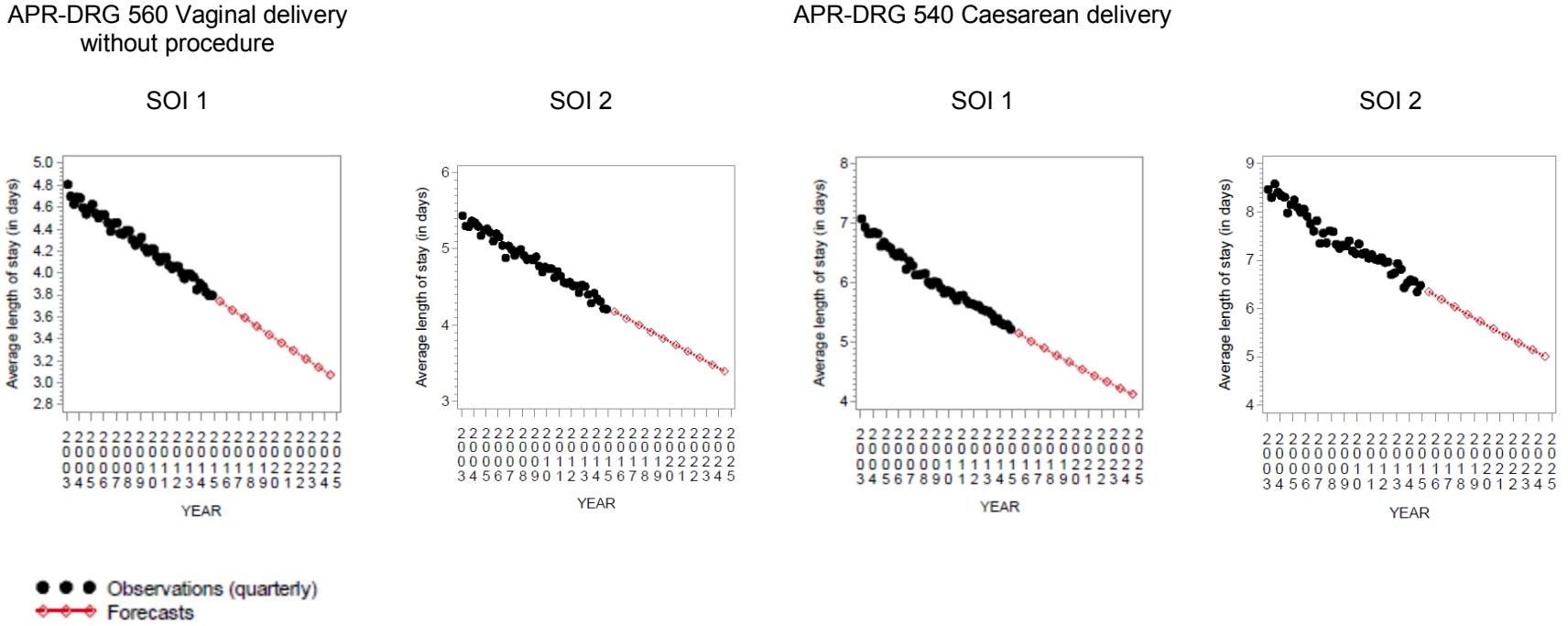


Note: rate of C-sections is defined as the number of C-sections deliveries (APR-DRG 540) divided by the total number of deliveries (vaginal: APR-DRGs 560, 541 and 542; and C-section: APR-DRG 540).

Average length of stay

Forecasts for the average length of stay (ALOS), generated by the projection model based on past and current medical practices in Belgium, are shown, for vaginal delivery without procedures (APR-DRG 560) and for C-section (APR-DRG 540) in Figure 131. Only results for severity of illness level (SOI) 1 are presented here. Results for other levels of SOI are to be found in the online appendix. A reduction in ALOS is projected for vaginal as well as C-section deliveries. In APR-DRG 560, the ALOS declines from 3.8 days in 2014 to 3 days in 2025 for SOI 1 and from 4.3 days to 3.3 days for SOI 2. C-section stays (APR-DRG 540) are lengthier and are projected to shorten from 5.3 days in 2014 to 4 days for SOI 1 and from 6.5 days to 4.9 days for SOI 2.

Figure 131 – ALOS trend analysis for caesarean deliveries and vaginal delivery without procedure (APR-DRG 560 and 540) (2003-2025)



Note: Only results for SOI 1 and 2 are presented.

Results

The baseline forecast results from the projection model are presented in Table 109. The projections indicate that the normative need for M-beds could be reduced by 17.0% (432 beds) between 2014 and 2025. Compared to the number of licensed beds in 2014, an even stronger reduction is possible.

Table 109 – Baseline forecast results for inpatient stays and days

	Licensed beds 2014	2014	2020	2025	Abs. difference 2014-2025	Abs. difference Licensed-2025	Rel. difference 2014-2025
Total inpatient stays		1 851 612	1 958 563	2 072 756	221 144		11.9%
MDC 14		148 793	152 415	155 217	6 424		4.3%
APR-DRG 540		26 144	28 400	30 130	3 986		15.2%
APR-DRG 541		346	337	323	-23		-6.6%
APR-DRG 542		272	260	249	-23		-8.5%
APR-DRG 560		95 801	96 687	97 268	1 467		1.5%
Total inpatient days		12 906 895	12 446 613	12 268 831	-638 064		-4.9%
MDC 14		636 202	578 984	529 911	-106 291		-16.7%
APR-DRG 540		158 551	148 570	138 679	-19 872		-12.5%
APR-DRG 541		1 793	1 532	1 339	-454		-25.3%
APR-DRG 542		1 438	1 235	1 087	-351		-24.4%
APR-DRG 560		391 268	350 357	316 330	-74 938		-19.2%
M-beds	3 176	2 545	2313	2 113	-432	-1 063	-17.0%

8.3.3 Alternative scenario

As an alternative to using trend forecasts for ALOS, generated by the projection model and based on historic evolutions in hospital maternity services, we can apply international benchmarks in ALOS as future targets. Indeed, we observe that the length of stay for a delivery in Belgium is still long compared to some other countries (see Figure 138).

In this section, we evaluate the potential effects of an accelerated reduction in ALOS for vaginal deliveries (APR-DRG 560) and Caesarean deliveries (APR-DRG 540) for SOI 1 and 2 conform to international benchmarks. Two data sources are used for the comparison. First, the observed ALOS in 2016 in the US state Texas.[67] The figures are very recent and use the same classification system as in Belgium, which are important advantages. The second point of comparison are data on ALOS from the Healthcare cost and utilization project (HCUP) of the US agency for healthcare research and quality (AHRQ).[68] The information relates to the year 2014 and is arranged using a different classification system, which is also based on diagnosis related groups. The following benchmarks are applied:

- APR-DRG 560, SOI 1: an ALOS of 2 days in 2025
- APR-DRG 560, SOI 2: an ALOS of 2.5 days in 2025
- APR-DRG 540, SOI 1: an ALOS of 3 days in 2025
- APR-DRG 540, SOI 2: an ALOS of 4 days in 2025

The accelerated reduction in ALOS is gradually introduced in the model over the period 2018 to 2025, i.e. until 2017 the projected evolution in ALOS is followed and between 2018 and 2025 a linear evolution towards the benchmark value is assumed. Forecasted ALOS are shown in Figure 132 for vaginal deliveries and in Figure 133 for caesarean deliveries.

Figure 132 – ALOS trend analysis for APR-DRG 560 (vaginal delivery), baseline and alternative scenario (2003-2025)

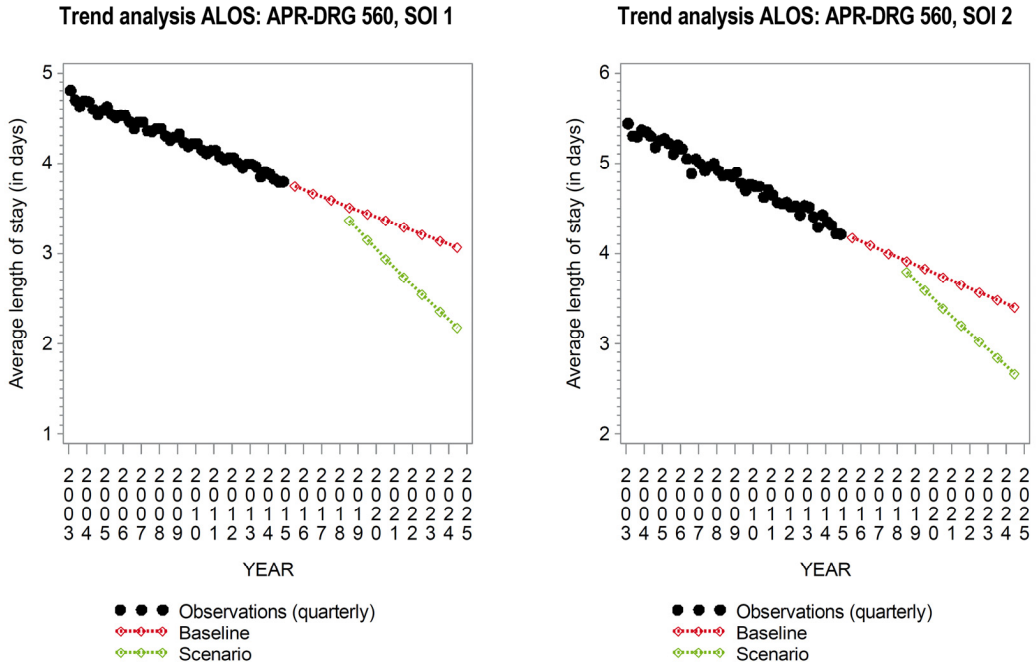
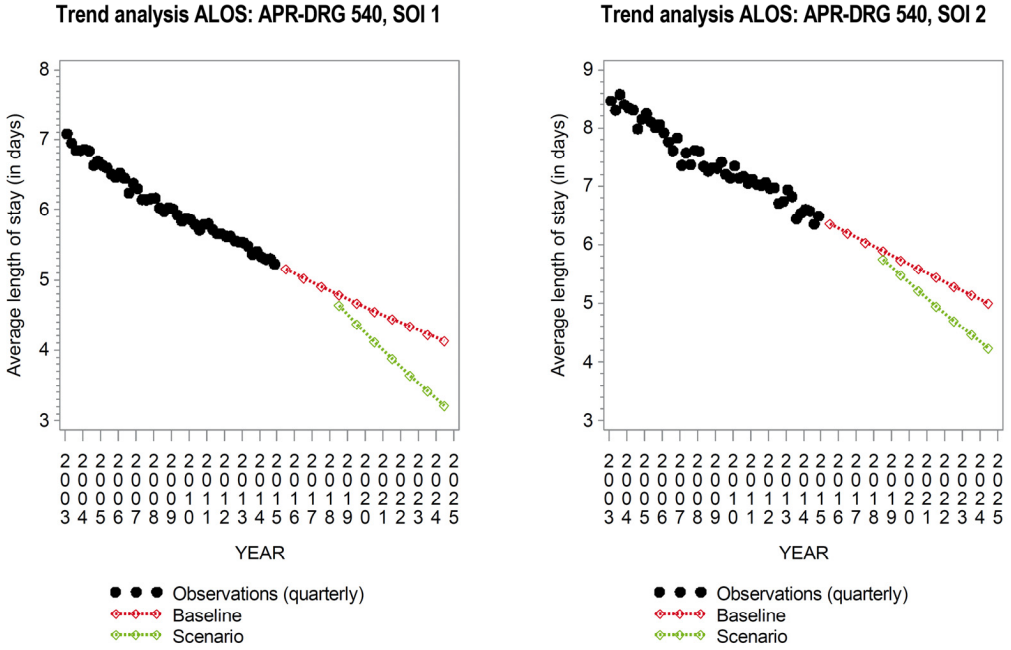


Figure 133 – ALOS trend analysis for APR-DRG 540 (caesarean delivery), baseline and alternative scenario (2003-2025)



Results from the projection model, based on this alternative scenario, are presented in Table 110 and compared with the baseline results in Table 109. Accounting for a bigger reduction in the length of stay matching international benchmarks, lead to a further decrease of 425 M-beds (about 16.3% of the observed bed need in 2014), on top of the reduction projected in the baseline. The scenario results indicate that the normative need for M-beds would decrease from 2 545 in 2014 to 1 688 in 2025, a reduction of 33.7%.

Table 110 – Alternative scenario forecast results

	Licensed beds 2014	2014	2020	2025	Abs. difference 2014-2025	Abs. difference Licensed-2025	Rel. difference 2014-2025
Scenario results							
MDC 14		636 202	533 000	420 658	-215 544		-33.9%
APR-DRG 540		158 551	137 861	112 050	-46 501		-29.3%
APR-DRG 560		391 268	315 082	233 706	-157 562		-40.3%
M-beds	3 176	2 545	2 134	1 688	-857	-1 488	-33.7%
Difference baseline – scenario							
MDC 14			-45 984	-109 253	-109 253		-17.2%
APR-DRG 540			-10 709	-26 629	-26 629		-16.8%
APR-DRG 560			-35 275	-82 624	-82 624		-21.1%
M-beds			-179	-425	-425	-425	-16.3%

As additional exercise, we also simulate the impact of a reduction of the average length of stay on the occupancy rate. Setting the average length of stay to 3 days for APR-DRG 560 SOI 1, and keeping the other APR-DRG-SOI combinations unchanged, led to a decrease of the average national occupancy rate over the year of almost 5%, with respect to the current situation presented in Figure 118. Results from this simulation exercise are presented in Table 111.

Table 111 – Simulated impact of reduced length of stay on the occupancy rate

	Mean	Min.	25th percentile	Median	75th percentile	Max.
Daily occupancy rate 1 Nov 13 - 31 Oct 14	48.9%	39.9%	46.6%	48.8%	51.4%	58.3%
Simulated daily occupancy rate	44.1%	37.0%	41.7%	44.1%	46.7%	52.6%

Activity in M-beds (inpatient and day-care settings). Simulated rate is based on a shortened length of stay (hypothesized to be 3 days for APR-DRG 540 (SOI 1) and unchanged for others APR-DRG-SOI).
Source: Minimal Hospital Data (MZG – RHM).

8.3.4 Update of programming criteria

In 2014 there are 25.5 licensed beds per 1 000 births (Table 104) which is far below the programming norm of 32 M-beds per 1 000 births. The lower number of licenced M-beds than what could be allowed based on the programming standards, however, contrast with the observed overcapacity of M-beds (see section 8.2.2.4). It can be concluded that the programming standards for M-beds are outdated. In fact they date back to the 1970s[596] when the length of stay (and thus the required capacity) was much longer than it is today and will be in the future.

From Table 109, we observe that the 122 563 deliveries (APR-DRGs 540, 541, 542 and 560) in 2014 resulted in 553 050 nursing days, which corresponds to 4 510 nursing days per 1 000 deliveries. With a normative bed occupancy rate of 70% (equivalent of 255.5 occupied days per bed) this results in a programming standard of 17.7 M-beds per 1 000 births. However, M-beds are also used for non-delivery hospital stays. These stays represent about 10% of the nursing days in 2014 (see section 8.2.2.5). Accounting for that, the programming standard is best increased to 19.4 M-beds per 1 000 births. The first line of Table 112 summarises these results.

Instead of using the currently observed number and distribution of nursing days per APR-DRG-SOI as a basis of the suggested programming norm, we could anticipate the future evolution in medical practice, including reduction of length of stay and increase of C-section rate, by using the forecasted (2025) distribution of nursing days per APR-DRG-SOI. From Table 109, we can see that the 127 970 forecasted deliveries result in 457 435 nursing days, that is 3 570 nursing days per 1 000 deliveries. As shown in the second line of Table 112, this results in a programming standard of 14.0 M-beds per 1 000 births, or 15.4 M-beds per 1 000 births if we account for non-deliveries stays.

Alternatively, the programming standard could be based on the results of the alternative scenario described in section 8.3.3 (Table 110) in which a more important reduction in length of stay is assumed corresponding to international benchmarks. Doing so, the norm would be 10.6 M-beds per 1 000 births, or 11.7 M-beds per 1 000 births when accounting for non-deliveries stays (see the third line of Table 112).

Table 112 – Scenarios for alternative programming standards to determine the number of M-beds for the Belgian territory

Scenario	Number of nursing days per birth	Bed availability based on normative occupancy rate of 70%	Required number of beds per 1 000 births	Accounting for 10% of nursing days for non-delivery related conditions
Based on current practice: number of nursing days per type of delivery (anno 2014)	4.51 nursing days or 4 510 nursing days per 1 000 births	255.5 days per licensed bed	4 510/255.5= **17.7 M-beds per 1 000 births**	17.7+10%= 19.4 M-beds per 1 000 births
Baseline forecast (2025)	3.57 nursing days or 3 570 nursing days per 1 000 births	255.5 days per licensed bed	3 570/255.5= **14.0 M-beds per 1 000 births**	14.0+10%= 15.4 M-beds per 1 000 births
Scenario with shortened length of stay*	2.72 nursing days or 2 720 nursing days per 1 000 births	255.5 days per licensed bed	2 720/255.5= **10.6 M-beds per 1 000 births**	10.6+10%= 11.7 M-beds per 1 000 births

** Shortened length of stay is hypothesized to be 3 days for APR-DRG 540 (SOI 1), 4 days for APR-DRG 540 (SOI 2), 2 days for APR-DRG 560 (SOI 1), 2.5 days for APR-DRG 560 (SOI 2), and unchanged for others APR-DRG-SOI.*

8.4 Organisation of maternity services in a selection of countries

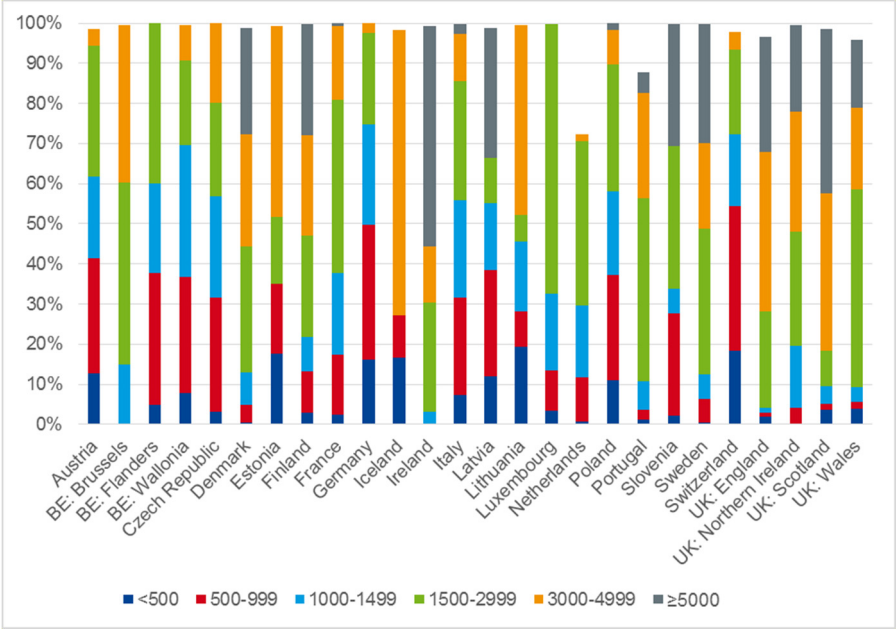
Multiple models of maternity care exist across the world. Some countries concentrate care in large units, whereas others provide care in small ones. While infant and maternal mortality declines almost everywhere, there is variation among countries regarding these outcomes. In this section we first give a general international overview of maternity care organisation and outcomes.

Then, we study more specifically the organisation of maternity services in a selection of countries: France, England and Sweden. These countries have been selected because, as in Belgium, they have a high rate of hospital-based deliveries. For that reason, the Netherlands were not selected, as in 2010 about 16% of all deliveries took place at home and about 11% in a maternity home, outside the hospital.[609] Selected countries also have similar maternal mortality rates but different utilisation patterns (for instance in terms of length of stay).

8.4.1 International overview

Figure 134 shows the distribution of births by maternity service volume in 2010. Overall, few births occurred in services with fewer than 500 births, but considerable variation is observed across countries. In Cyprus, 61.9% of births took place in such small services and in ten other countries, from 10% to 20% of births did. In Flanders and Wallonia, as well as in Germany and Switzerland, over half of all births took place in services with 500-1 499 births, and in six other countries, over a third of births occurred in such services. On the other hand, more than a quarter of births in Denmark, Sweden, and England took place in units with more than 5 000 births, while Slovenia, Latvia, Scotland, and Ireland had even larger proportions of births in units with more than 5 000 births. In 13 countries and in Brussels, more than a third of births took place in units with 3 000 or more births.

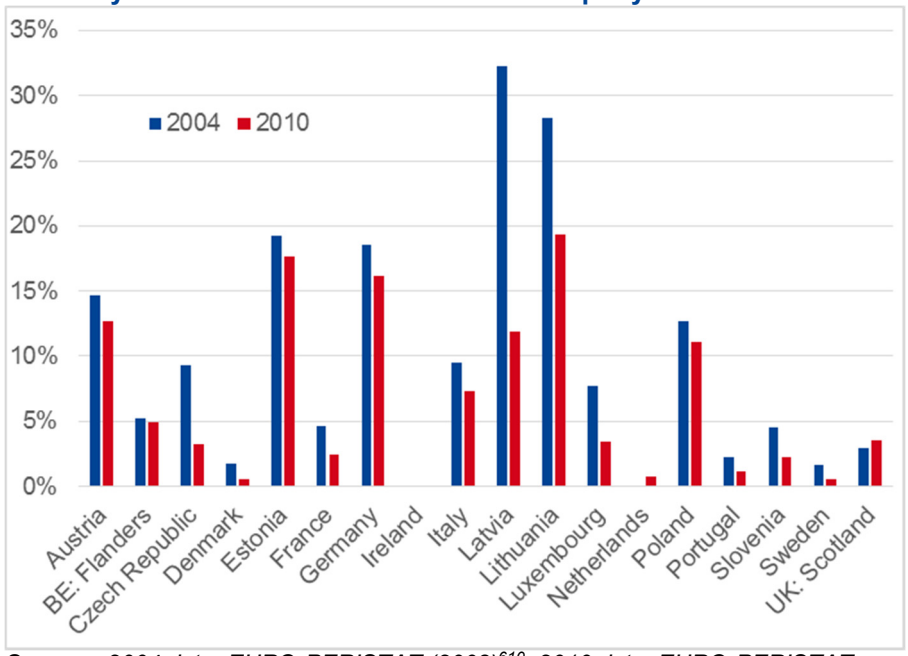
Figure 134 – Distribution of births by maternity unit volume of deliveries, 2010



Note: Not represented births take place at home or in a setting outside hospital such as birth centres or birthing homes.
Source: EURO-PERISTAT (2010)[609]

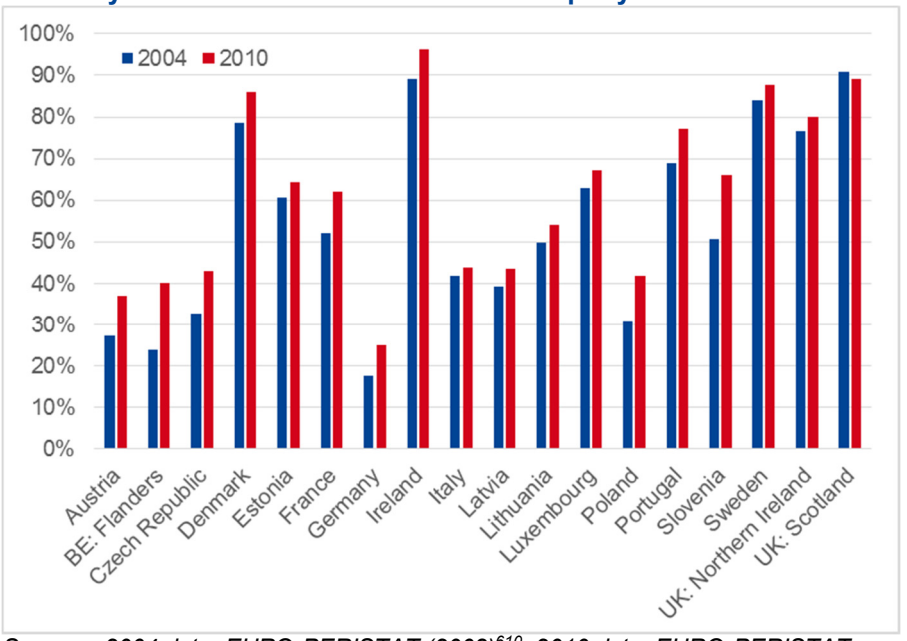
Figure 135, Figure 136 and Figure 137 show changes between 2004 and 2010 in percentage of births occurring in maternity services with respectively fewer than 500 births per year, 1 500 or more births per year and 3 000 or more births per year. In all countries for which data are available, except Scotland, the proportion of births in small maternity services decreases over this period. In Latvia, Lithuania and Luxembourg, the change is substantial in relation to the initial levels. Also, in most countries, the percentage of births in large maternity services rose. In France, Denmark, and Northern Ireland, the change is important.

Figure 135 – Evolution (2004-2010) of the percentage of births in maternity services with fewer than 500 births per year



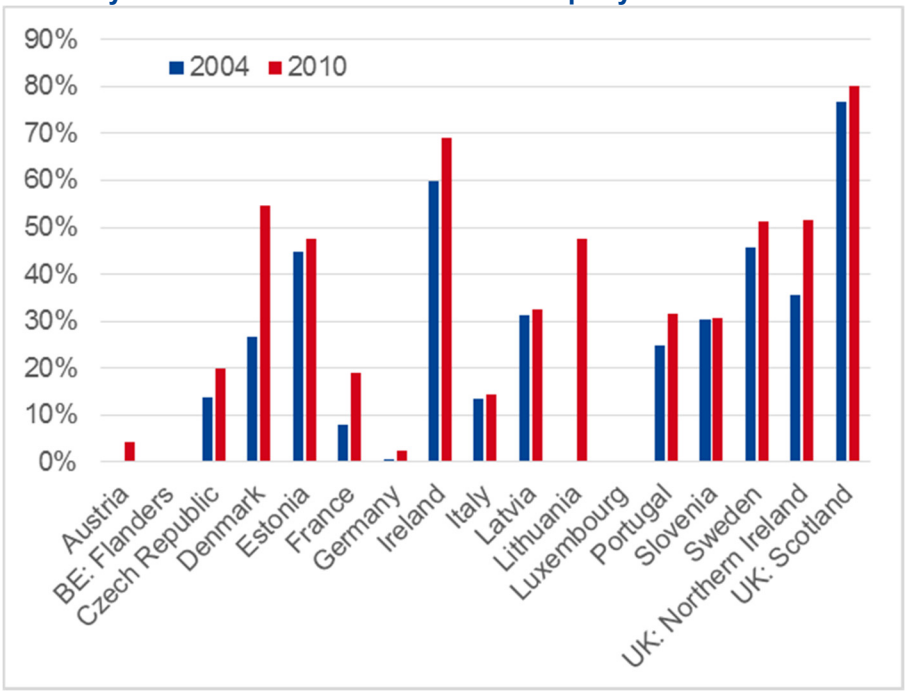
Sources: 2004 data: EURO-PERISTAT (2008)[610], 2010 data: EURO-PERISTAT (2010)[609]

Figure 136 – Evolution (2004-2010) of the percentage of births in maternity services with 1 500 or more births per year



Sources: 2004 data: EURO-PERISTAT (2008)[610], 2010 data: EURO-PERISTAT (2010)[609]

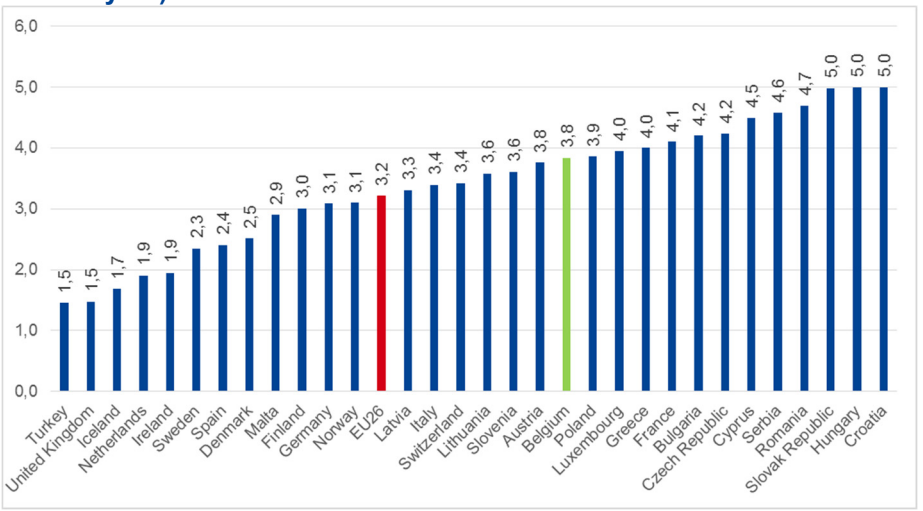
Figure 137 – Evolution (2004-2010) of the percentage of births in maternity services with 3 000 or more births per year



Sources: 2004 data: EURO-PERISTAT (2008)[610], 2010 data: EURO-PERISTAT (2010)[609]

Figure 138 shows that the average length of stay for a normal delivery ranges from less than two days in Turkey, the United Kingdom, Iceland, the Netherlands and Ireland, to five days in Croatia, Hungary and the Slovak Republic. The length of stay in Belgium (3.8 days) and France (4.1) is longer than the EU average (3.2 days) while in the UK (1.5 days) and Sweden (2.3 days) it is shorter than the EU average.

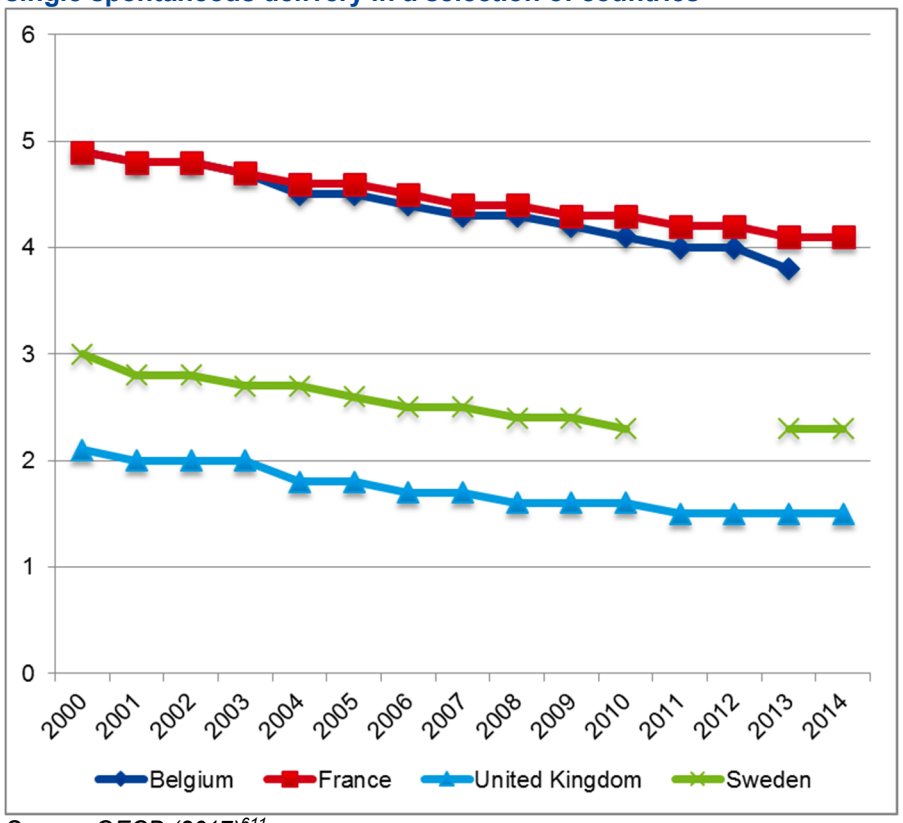
Figure 138 – Average length of stay for normal deliveries, 2014 (or nearest year)



Sources: OECD (2016)[69]

The length of stay for a normal delivery has been reduced in nearly all EU countries, dropping from 5 days in 2000 to 3.2 days in 2014 on average in EU member states.[69] Figure 139 depicts this evolution for the countries we have selected. While starting from the same point, the reduction of the average length of stay for a single spontaneous delivery has been stronger in Belgium than in France. The average length of stay has always been shorter in Sweden and the UK, but also in these countries we observe a decreasing trend.

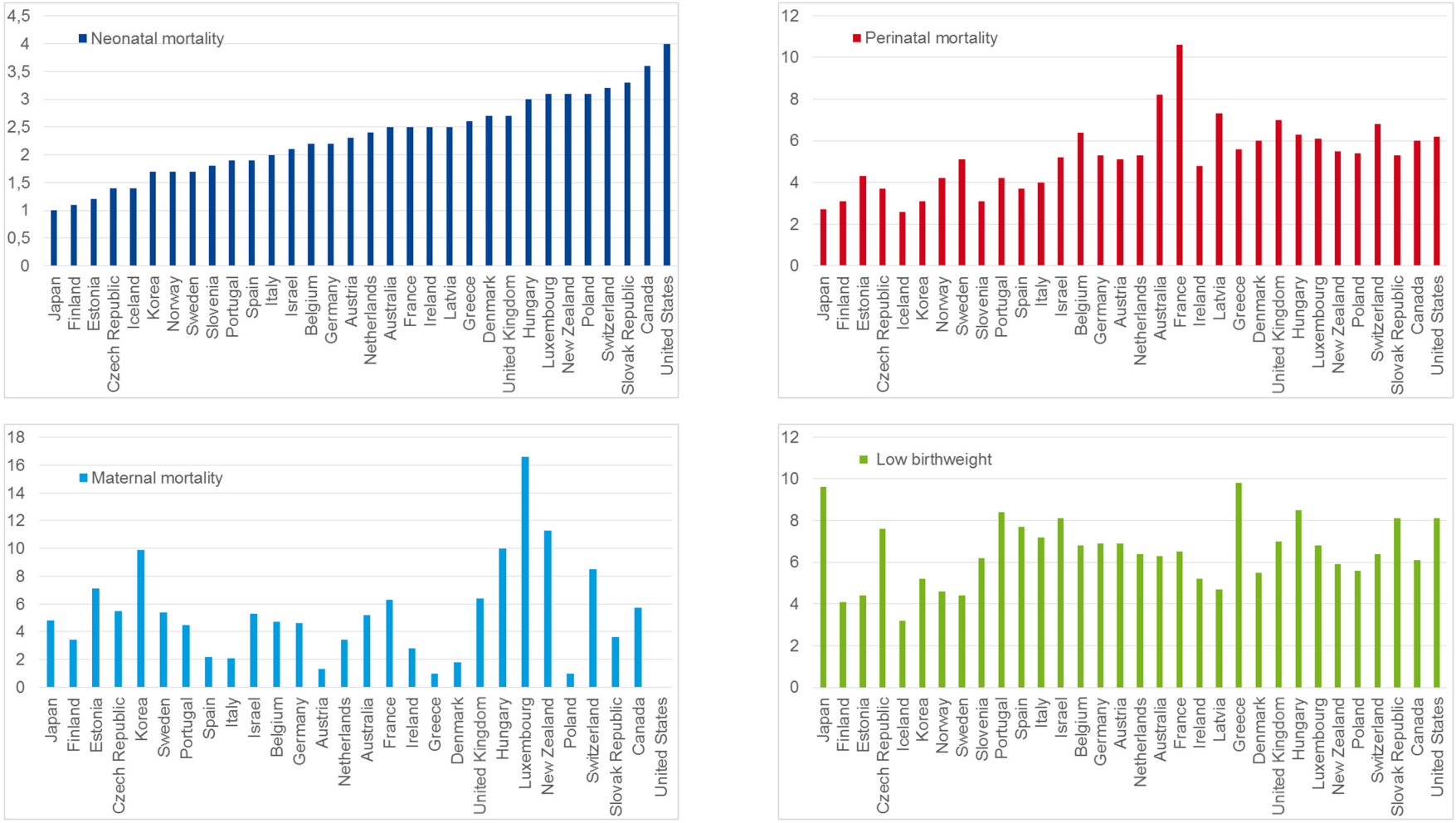
Figure 139 – Evolution (2000-2014) of the average length of stay for a single spontaneous delivery in a selection of countries



Source: OECD (2017)[611]

Outcomes also vary widely between countries. Figure 140 shows the performance of several countries regarding four indicators: neonatal mortality, perinatal mortality, maternal mortality and low birthweight. Countries are ordered according to their ranking for neonatal mortality. Neonatal mortality ranges from 1 death per 1 000 live births in Japan to 4 deaths in the US. Regarding perinatal mortality, Iceland counts 2.6 deaths per 1 000 births, while the indicator is above 7 deaths per 1 000 births in the United Kingdom, Latvia, Australia and France. The widest variation is observed for maternal mortality (from 1 to 16.6 deaths per 100 000 live births). Overall, regarding all outcomes measures, Sweden is amongst the best performers. Maternity outcomes in France are comparable to the ones in Belgium, except perinatal mortality, which is particularly high in France (more than 10 deaths per 1 000 births).

Figure 140 – Maternity outcomes



Note: Neonatal mortality: deaths per 1000 live births, no minimum threshold of gestation period or birthweight, data 2013, except Canada, Slovak Republic and New Zealand (2012) and Ireland (2011); perinatal mortality: deaths per 1000 total births, data 2012, except Canada and Ireland (2011); maternal mortality: deaths per 100 000 live births, data 2012; low birthweight: less than 2500 grams, percentage of total live births, data 2011. Source: OECD (2017)[611]

8.4.2 France

Following the Hospital, Patients, Health and Territories Act ('*Hôpital, patients, santé et territoire*'[II], HPST), 26 Regional Health Agencies ('*Agences Régionales de Santé'*, ARS) were created in April 2010, one in each of the 22 metropolitan regions of France, and 4 in the Overseas departments. This number was reduced to 17 (13 in metropolitan regions and 4 overseas) in January 2016, following a reform of the regional division of France. They are responsible for the territorial organisation of health care supply, with the double objective of reducing inequality in access to care and improving efficiency. They are in charge of designing a Regional Health Project which gives the orientation of the regional policy. It defines the ARS's objectives for several years as well as the methods that will be used to reach them. An important part of it is the Regional Health Organisation Scheme ('*Schéma régional de l'organisation des soins*', SROS) that plans current and future capacity on the basis of a regional analysis. This plan should take into account population needs, effectiveness requirements, and geographic accessibility issues. The minimum list of activities of care that should be included in the plan is defined in the law.[612] One of these activities is perinatal care.[613]

8.4.2.1 Concentration process

The organisation of maternity services in France has followed a long process of concentration, initiated in the seventies. In 1972, the Dienesch Decree[352] stated that a minimum of 15 beds was necessary to run a maternity service. Firstly applicable to private clinics, this restriction has been rapidly extended to the public sector. This measure led to the closure of lots of small private maternity clinics, often run by midwifes, as well as small maternity services in public local hospitals, where responsibility was owned by general practitioners.[329]

With the objective to decrease maternal mortality by 30% and perinatal mortality by 20%[614], a new organisation of the supply of care has been established in 1998 by two decrees known has 'périnatalité' decrees.[354, 615] This reorganisation aimed to improve safety of care, more than to reduce costs.[614] It has been claimed that the organisation of the supply has not been sufficiently designed according to population needs, but rather corresponds to an adaptation of existing structures.[614]

Maternity services were classified in three categories. Type I maternities ensure obstetrics services, type II ensure obstetrics and neonatology services and type III ensure obstetrics, neonatology and neonatal reanimation services. Type II can further be subdivided into the ones without (type IIA) and with (type IIB) a neonatal intensive care unit.[353] The purpose of the classification was to guide pregnant women to the appropriate structure, depending on the risk. Triage and transfers are organised through perinatal health networks (see section 8.4.2.2). Type II and III maternities also ensure a proximity role, hence can operate low-risk deliveries.[614]

Box 33 – Types of maternity services in France

Type I: obstetrics unit without neonatology unit.

Type IIA: obstetrics unit and neonatology unit (without intensive care)

Type IIB: obstetrics unit and neonatology unit (with intensive care)

Type III: obstetrics units, neonatology unit and neonatal reanimation unit.

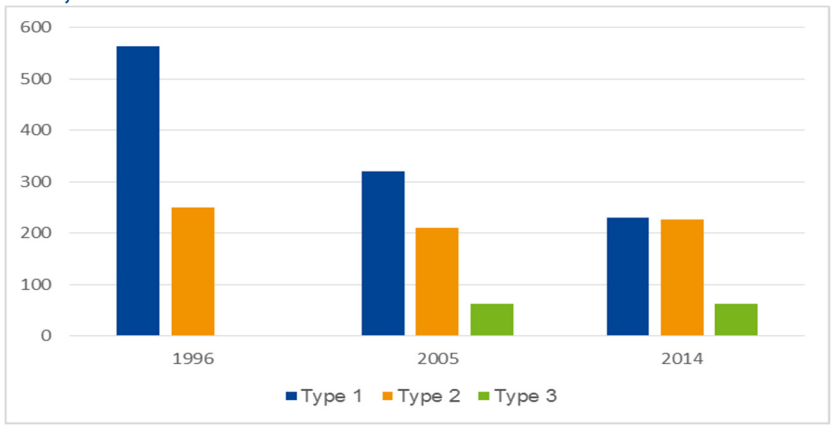
Source: Vanlerenberghe (2015)[614]

II *Loi portant réforme de l'hôpital et relative aux patients, à la santé et aux territoires*, Act n° 2009-879 of 21 July 2009.[314]

The reduction of the number of maternities (especially of type I) has continued since then. From 1 369 in 1984, their number has been reduced to 814 in 1996 and was 518 in 2014[329] (see also Figure 141). In obstetrics units, the number of beds has been almost divided by two in thirty years, while the number of deliveries has been stable. Therefore, utilisation rate increased, from 22 deliveries per bed on average in 1975 to 47 in 2014.[329] At the same time, the average length of stay was reduced from 8 to 5 days.[329]

The main effect of the 1998 policy was the displacement of a number of deliveries towards types II and III maternity services. Indeed, while 43.5% of the deliveries took place in those facilities in 1996, this percentage was 52.3% in 2000.[616] This effect is partially explained by the increase of capacity of types II and III facilities despite the global decrease of the number of beds. In 2014, 71 % of the beds and 76 % of the deliveries were concentrated in types II and III units.[329]

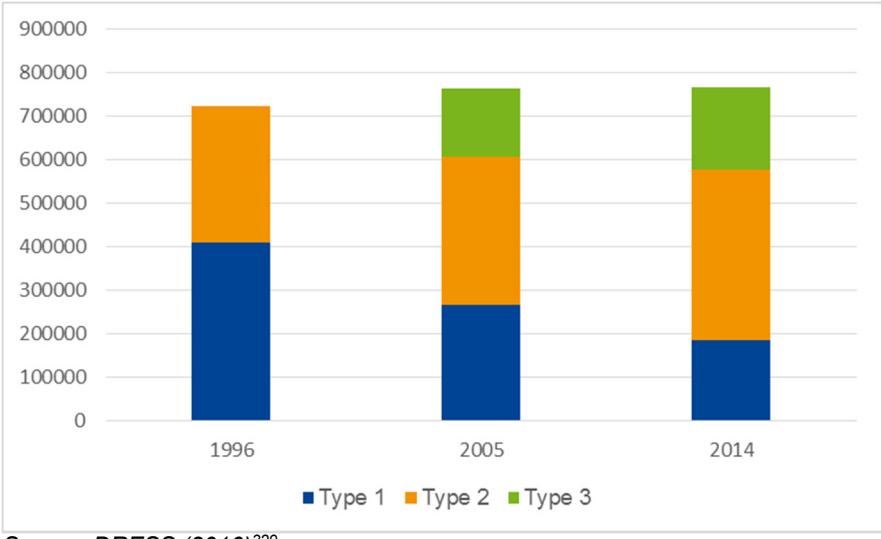
Figure 141 – Number of maternity services in France by category in 1996, 2005 and 2014



Note: Type 1 maternities ensure obstetrics services, type 2 ensure obstetrics and neonatology services and type 3 ensure obstetrics, neonatology and neonatal reanimation services.
Source: DRESS (2016)[329]

Maternity services are now mostly public or private not-for profit. In 2014, 60% of type I maternities were public or private not-for profit against 50% in 2002. Regarding types II and III, this percentage is 80% and 100%.[329] Types II and III maternities concentrate 71% of the beds and 76% of the deliveries, against 43% in 1996 (see Figure 142). On average, type I facilities perform 816 deliveries per year, while type II and III perform respectively 1 724 and 3 076 deliveries per year.[329]

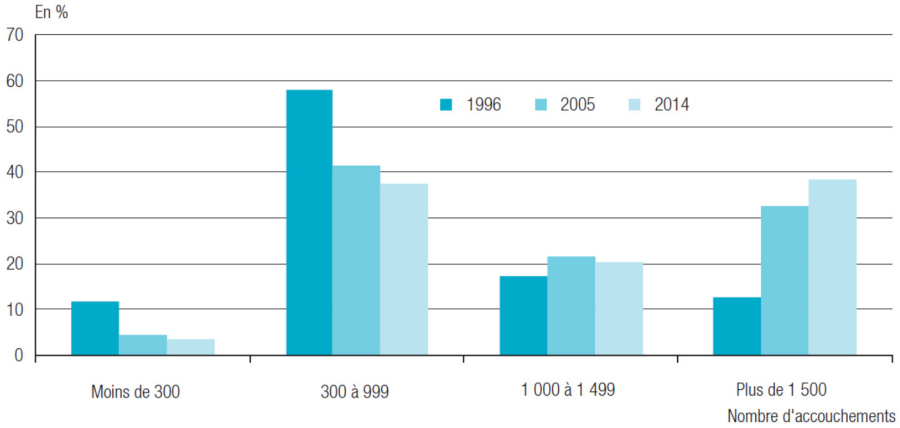
Figure 142 – Number of deliveries by category of maternity services in France, in 1996, 2005 and 2014



Source: DRESS (2016)[329]

In 2014, almost 40% of the facilities performed more than 1 500 deliveries per year, against 13% in 1996. Only 4% of the facilities (= 13 maternity services) performed less than 300 deliveries per year while this was 12% in 1996 (see Figure 143). These 13 maternity services operate below the minimum threshold that was established in 1998 and benefit from a derogation (see section 8.4.2.3).

Figure 143 – Maternity services in France by number of deliveries in 1996, 2005 and 2014



Source: DREES (2016)[329]

8.4.2.2 *Networks*

As the purpose of the 1998 reorganisation was to treat pregnant women in the appropriate structure depending on the risk, the functioning of triage and transfers plays an important role. This is ensured by the perinatal health networks (‘*réseaux de santé périnatalité*’). They regroup health professionals, working within a hospital or not (midwifes, gynaecologists, anaesthetists, paediatricians, GPs, psychologists, etc.), social services, hospitals, and other related structures.[617] One of their missions lies in the identification of risk factors during pregnancy and orientation (as much as possible in utero) towards the relevant structure.[614, 618] They also play an important role in transport between hospitals.[614] While some networks are directly involved in the organisation of such transport, others establish procedures and use shared medical files which facilitate transfers.

In 2014, there were 55 perinatal health networks in France, corresponding to various geographical areas (region, department, living areas[mm], etc.).[614] According to a national survey in 2010, only 2% of the maternity services were not member of such a network while this percentage was 8% in 2003.[614]

8.4.2.3 *Minimum volume*

A minimum volume threshold is defined for maternity services to obtain the license to practice obstetrics. This threshold has been set to 300 deliveries per year in the 1998 decree.[354] The rationale behind this limit is that low volume of activity does not permit enough practice for the teams that is necessary to cope with incidents during deliveries. However, the number of 300 deliveries per year does not seem to be based on any specific study.[614]

Exceptions are possible when remoteness of maternity services imposes ‘excessive[nn] travel time to a significant part of the population’.[354] Thanks to this, 13 small maternity services still performed less than 300 deliveries in

[mm] Living areas (‘*bassins de vie*’) are defined as “the smallest area on which population has access to the most common equipment and services” (shopping, education, health, sport, transport, etc.)[323]

[nn] The notion of ‘excessive’ travel time is not defined in the law, nevertheless some ARS have set it to 45 minutes.[619]

2013 (they were 42 in 2002).[614] A recent report from the French Court of Audit criticised the decision to maintain such small maternities.[614] Specifically, it stated that additional specific mechanisms for enhancing safety should be put in place. The report recognises that geographical aspects sometimes require to maintain small maternities. For instance, in the South of Corse, an important part of the population would have to travel more than 2h30 to reach the maternity of Ajaccio or Bastia, justifying the non-closure of a small maternity in the area. However, it also highlights that alternative solutions could be considered such as care hotels.

8.4.2.4 Occupancy rate

Occupancy rates, defined as the ratio between the number of realised days per year and the number of beds, in obstetrics units in France are low. The average occupancy rate is 70%, but most level III units have a rate above 80% while most level I units have a rate below 60%.[614] On average, smaller units have lower occupancy rates (see Table 113). Small maternity services (less than 1 000 deliveries per year) have particularly low occupancy rates. This may be due to the obligation to have minimum 15 beds in an obstetrics service.[614] Indeed, some units count 15 beds, which are not justified by their actual activity. Taking into account the particular characteristics of obstetrics (unplanned activity, subject to seasonal variation), experts have defined a target occupancy rate of 74%-82%[oo].[620] In 2012, only 32% of the maternity services reached that target, nevertheless 84% of the biggest units (more than 2 000 deliveries per year) attained it.[614]

Table 113 – Average occupancy rate in obstetrics in France in 2012

	Average occupancy rate*
Global	70.2%
By type	
Type I	57.2%
Type II	72.2%
Type III	84.1%
By size (number of deliveries per year)	
≥ 4 000	84.9%
3 000-3 999	78.3%
2 000-2 999	78.7%
1 000-1 999	69,0%
500-999	55.6%
300-499	46,0%
<300	26.9%

**Occupancy rate is measured as [(number of realised days/365) / number of beds]*100*
Source: Vanlerenberghe(2015)[614]

These low occupancy rates indicate that the use of resources is not optimal. Operational costs are too large compared to activity. Combined with a length of stay that is quite large in France in comparison to other countries, it reflects inefficiencies in the system.[614]

[oo] The target is set to 270-300 days of occupation per bed per year.

8.4.2.5 *Length of stay*

The average length of stay for a normal delivery in France was 4.1 days in 2014, which is long compared to other countries (2.9 days on average in OECD countries in 2013, 3.2 days on average in countries of the EU-26[pp] in 2014).[69, 444] It has decreased, but at a slow pace (see Table 114).

Table 114 – Evolution of the average length of stay (in days) for a delivery in France

	2003	2014
Normal delivery	4.7	4.1
Vaginal delivery	4.9	4.3
C-section delivery	8.0	6.7
All deliveries	5.5	4.8

Note: for the definitions of the different types of deliveries, see Box 30.
Sources: DREES (2016)[329] and OECD (2017)[611]

It has been estimated that € 318 million could be saved, if the average length of stay could be further decreased to 3 days.[621] To permit earlier discharge, support should be provided to mothers at home. Therefore, a programme has recently been established with that purpose. The programme PRADO ('*programme d'accompagnement du retour à domicile*') has been first experimented in 2010 and successively extended. The programme is proposed in 364 maternity services (concerns 63% of vaginal deliveries)[622]. In 2014, more than 225 000 women[623] have benefited from it and the objective is to reach 700 000 women[624] in 2017. However, the impact of the PRADO on the average length of stay has been very limited.[623, 625, 626] Indeed, the programme was first intended to women who had a vaginal delivery without complication and leave the maternity unit after at least 72 hours. In 2014, it has been extended to women who had a C-section and leave the maternity unit after at least 96 hours. In 2015, pilot projects have been launched to further extend it to early discharged women (within 24 to 72 hours after a vaginal delivery or before 96 hours after a C-section).[627]

8.4.2.6 *Access*

According to the last available estimations[353, 628], for half of the vaginal deliveries, the travel time from home to the maternity service is less than 17 minutes. Only one fourth incurs a travel time of more than 29 minutes. Average travel time to the delivery unit is 19 minutes. Table 115 provides more details.

Table 115 – Supply and travel time to maternity services in France, 2010

	Total	Level I	Level II	Level III
Number of maternity services	535	263	212	60
Number of beds (and distribution)	16 986	34%	45%	21%
Number of deliveries (and distribution)	789 508	28%	48%	24%
Number of beds per 1 000 deliveries	21.5	25.9	20.2	19.0
Median observed travel time to the maternity service (minutes)	17	17	18	16
Proportion of deliveries at more than 30 minutes from home	22.7%	20.2%	23.7%	23.9%
Proportion of deliveries at more than 45 minutes from home	7.6%	6.1%	7.5%	9.6%

Source: Baillot and Evain (2012)[628]

[pp] No data for Estonia and Portugal.

8.4.2.7 *Impact of concentration*

The standards promoted by the 1998 decrees, more severe than the previous ones, led to the closure of an important number of maternity services, unable to meet the new requirements. The number of maternity services decreased by one third between 1996 and 2012 (from 815 to 544 units). The number of beds has followed the same evolution, decreasing by 32% while the number of births stayed relatively constant over the period.[614]

Maternity services that were not allowed to perform obstetrics anymore had the possibility to be transformed into 'perinatal proximity centres' that provide pre- and postnatal care but no deliveries and without overnight stay. In 2012, there were 78 such centres in France.[614]

Closures have been concentrated, mostly, in small units (less than 1 000 deliveries per year), their number decreasing from 358 in 2002 to 216 ten years later. At the same time, the number of units performing more than 2 000 deliveries per year increased by 40% (from 103 in 2002 to 145 in 2012). In particular, there are three times more maternity services performing more than 4 000 deliveries in 2012 than in 2002. The concentration of care benefited the largest maternity services whose activity has considerably increased (see Table 116).[614] It must be noted that no particular additional standards have been defined for very big units. In Ile-de-France, five of such maternities have organised themselves to discuss on their specificities. Indeed, this 'club of the 4 000' estimates that their large size requires a particular organisation, that should be formalised in the law.[614]

Table 116 – Evolution of the number of maternity services and number of deliveries, per size, in France, 2002-2012

Size (deliveries per year)	Services (2002)		Services (2012)		Deliveries (2002)		Deliveries (2012)	
	Number	%	Number	%	Number	%	Number	%
≥ 4000	5	1%	16	3%	24 965	3%	73 944	9%
3000-3999	11	2%	33	6%	36 640	5%	110 713	14%
2000-2999	87	13%	96	18%	204 136	26%	232 035	28%
1000-1999	220	32%	183	33%	306 746	39%	257 990	32%
500-999	234	34%	162	30%	172 377	22%	123 019	15%
300-499	82	12%	35	6%	32 817	4%	14 148	2%
<300	42	6%	19	4%	9 324	1%	4 362	<1%
Total	681	100%	544	100%	787 005	100%	816 211	100%

Source: Vanlerenberghe(2015)[614]

As previously mentioned, the major impact of the reorganisation of the supply was the closure of an important number of type I maternity services and the displacement of the deliveries that would have occurred in such units towards level II or III maternities.[614] However, no decrease in access has been observed.[614, 628, 629] The median travel time was 17 minutes in 2010, as it was in 2001.[628] While closures changed the localisation of the maternity services and tend to increase median travel time, this is compensated by the improved availability of level II and III maternities, so that it is possible for women needing specific care to choose the closest maternity service.[628] Another factor explaining that travel time did not

increase despite the closures, are the derogations granted to small units in remote areas (see section 8.4.2.3).[614]

Globally, the number of available beds (per woman aged 15 or more[qq]) has decreased by 17% between 2002 and 2012.[614] Nevertheless, only 7% of the maternity services experience periods where they do not have enough delivery beds to satisfy the demand. And these issues are concentrated in level III maternities (25% of them face such issues).[614] Indeed, these units often have to admit low-risk women. While it does not lead to higher rates of interventions for low-risk births (over-medication)[630], it is not optimal as it creates shortage of delivery beds. Potential solutions exist: setting a maximum quota of inscriptions for low-risk pregnancies in such units, setting a minimum reserved quota for pathologic pregnancies in such units, or systematically reorienting women with low-risk pregnancies if a maternity service of another type is available close to their living place.[614]

Few research has been conducted on the efficiency of the new system. An IGAS[rr] study from 2012 stated that 'the quality of service has been improved, but at the cost of higher expenses'.[619] This higher cost comes from two main factors. First, the choice has been made to maintain a sufficient access by allowing some maternities to operate with very low volume. The functioning of these units is costly. Moreover, it is difficult to improve the quality of service in units that face a constant risk of closure. Second, women tend to choose fully-equipped units even if they do not need it. This contributes to the closure of level I units and displacement of the deliveries towards level II or III maternities. As a consequence, the cost of normal deliveries increases.

8.4.3 England

In England, healthcare (within the National Health Service) is free at the point of use and is mainly financed by general taxation, as well as by additional funds coming from national insurance contributions paid by employers and employees. Publicly funded healthcare is provided by government-owned hospitals (National Health Services (NHS) Trusts and Foundation Trusts) with salaried doctors and nurses, and by self-employed GPs.[631]

There is no formal national plan for the NHS. Nevertheless, the Department of Health is responsible of setting a policy framework for NHS, public health, adult social care and other related areas.[631] Until recently, Strategic Health Authorities (SHAs), established in 2002, provided local strategic leadership. Also created in 2002, primary-care trusts (PCTs) were responsible for purchasing (commissioning) health services to match the needs of their local geographically defined populations. There were 28 SHAs and 303 PCTs originally, reduced in 2006 to respectively 10 and 152 (further reduced to 151 in April 2010), making each PCT covering, on average, a population of around 340 000 persons.[631]

The NHS has been extensively reorganised in April 2013, following the Health and Social Care Act of 2012. This Act moved the system towards more clinically led commissioning, replacing the PCTs by 211 Clinical Commissioning Groups (CCGs)[304] run by GPs, covering geographically defined populations ranging of 250 000 persons on average.[632] From April 2015, the number of CCGs is reduced to 209 when 3 CCGs merged.[633] Clinical commissioning groups commission maternity services from local providers (136 NHS trusts and 15 mother and baby units provided by mental health trusts).[634]

[qq] The number of available beds compared to the number of births has only decreased by 7%.[614]

[rr] Inspection générale des affaires sociales

8.4.3.1 *Organisation of maternity services*

There are three main types of maternity units (see Box 34). In 2012, 87% of the women gave birth in an 'obstetric unit', 9% in an 'alongside midwifery unit' and 2% in a 'freestanding midwifery unit'. The remaining 2% births took place at home.[635] Two acute trusts had midwife-led units only. Women with a low-risk pregnancy leading to a normal birth (a birth without medical intervention) usually experience midwife-led care, even in an obstetric unit.[636].

Box 34 – Types of maternity units in England

Obstetric unit (OU): an NHS clinical location in which care is provided by a team, with obstetricians taking primary professional responsibility for women at high risk of complications during labour and birth. Midwives offer care to all women in an obstetric unit, whether or not they are considered at high or low risk, and take primary responsibility for women with straightforward pregnancies during labour and birth. Diagnostic and treatment medical services including obstetric, neonatal and anaesthetic care are available on site.

Alongside midwifery unit (AMU): an NHS clinical location offering care to women with straightforward pregnancies during labour and birth in which midwives take primary professional responsibility for care. During labour and birth, the full range of diagnostic and treatment medical services, including obstetric, neonatal and anaesthetic care are available, should they be needed, in the same building, or in a separate building on the same site. Transfer will normally be by trolley, bed or wheelchair.

Freestanding midwifery unit (FMU): an NHS clinical location offering care to women with straightforward pregnancies during labour and birth in which midwives take primary professional responsibility for care. General Practitioners may also be involved in care. During labour and birth, diagnostic and treatment medical services, including obstetric, neonatal and anaesthetic care, are not immediately available but are located on a separate site should they be needed. Transfer will normally involve car or ambulance.

Sources: National Audit Office (2013)[635] and Paparella (2016)[634].

In 2007, 152 trusts provided maternity care in 262 maternity units. Following mergers, the number of trusts providing maternity care was reduced to 148 by the end of 2010, but the number of units increased by 11% to 289 (see Table 117). According to the last available data, there were 133 trusts providing maternity services in 2015.[637] The geographical distribution of maternity units, in particular obstetric units, reflects the centres of population.[638]

Table 117 – Evolution of supply of maternity units in England 2007-2010

Number of units	October 2007		December 2010	
Obstetric units (OUs)	180	68.7%	177	61.25%
Alongside midwifery units (AMUs)	26	9.9%	53	18.34%
Freestanding midwifery units (FMUs)	56	21.4%	59	20.42%
Total	262	100%	289	100%

Source: Redshaw et al. (2011)[638]

Evidence shows that midwife-led structures lead to better outcomes for low-risk women. For these cases, birth is as safe for new-borns in midwifes-led units as it is in obstetric units, but with a lower rate of intervention and a decreased use of pain relief.[639, 640] Midwife-led settings had also been shown to be more cost-effective than obstetric units.[640, 641] In 2007, the Department of Health has promoted a 'national choice guarantee'[642]: by the end of 2009 all women, depending on their circumstances, would be offered a choice of where to give birth. At the time, most (66%) of the trusts only proposed maternity care in obstetric units. This proportion has been reduced to 49% in 2010 (see Table 118). Indeed, the proportion of trusts with at least one alongside midwifery unit had doubled (from 17% to 35%). A comparison of trusts' configurations regarding maternity care in different areas across England indicates that the change has taken place all over the country.[638]

Table 118 – Evolution of the configuration of maternity care in trusts in England 2007-2010

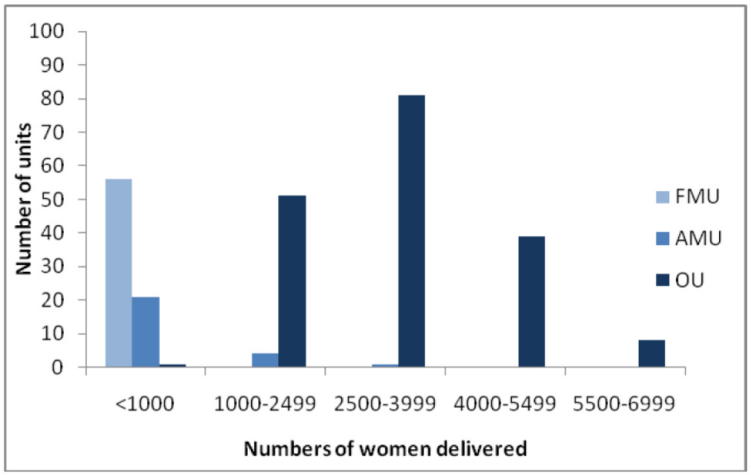
Trust configuration	October 2007		December 2010	
One or more OUs	100	65.8%	72	48.6%
One or more OUs and one or more AMUs	20	13.2%	38	25.7%
One or more OUs and one or more FMUs	23	15.1%	22	14.9%
One or more of all types of units (OU, AMU and FMU)	5	3.3%	13	8.8%
One or more FMUs only	4	2.6%	3	2.0%
Total	152	100%	148	100%

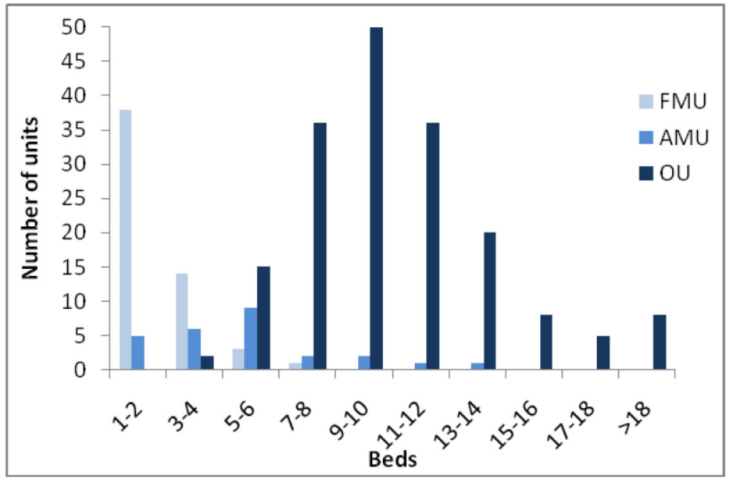
Source: Redshaw et al. (2011)[638]

In alongside and freestanding midwifery units, guidelines are developed in terms of eligibility for admission to the midwives-led unit and for decision-making around transfer to the obstetric unit.[643] The most common exclusion criteria are gestational age (less than 36-37 weeks), multiple birth, previous C-section, known breech position, high body-mass index (above 30-40) and that the woman plan to use epidural anaesthesia.[638]

Midwifes-led units are significantly smaller and have a lower level of activity than obstetrics units. In 2007, the average number of women delivered in obstetric units was 3 283, while it was only 738 in alongside midwifery units and 201 in freestanding midwifery units. On average, obstetric units have 10.7 delivery beds, alongside midwifery units have 5.2 and freestanding midwifery units only 2.5.[638] Figure 144 shows the distribution of the number of deliveries and the number of beds in different types of units. More than a quarter of obstetric units (26%) deliver more than 4 000 women per year, 29% deliver less than 2 500.[638]

Figure 144 – Distribution of the number of deliveries and the number of delivery beds in different types of maternity units in England, 2007





Note: FMU stands for freestanding midwifery unit, AMU for alongside midwifery unit and OU for obstetric unit.
Source: Redshaw et al. (2011)[638]

8.4.3.2 Networks

Neonatal care networks exist since 2004-2005 to provide a more structured and integrated approach to care. Within the network, neonatal facilities are classified in three levels[634, 636]:

- level 1 units provide special care only;
- level 2 units provide high dependency care and limited (short term) intensive care;
- level 3 neonatal units provide the whole range of (intensive) neonatal care, and some also provide neonatal surgery and other specialised services (e.g., cardiac).

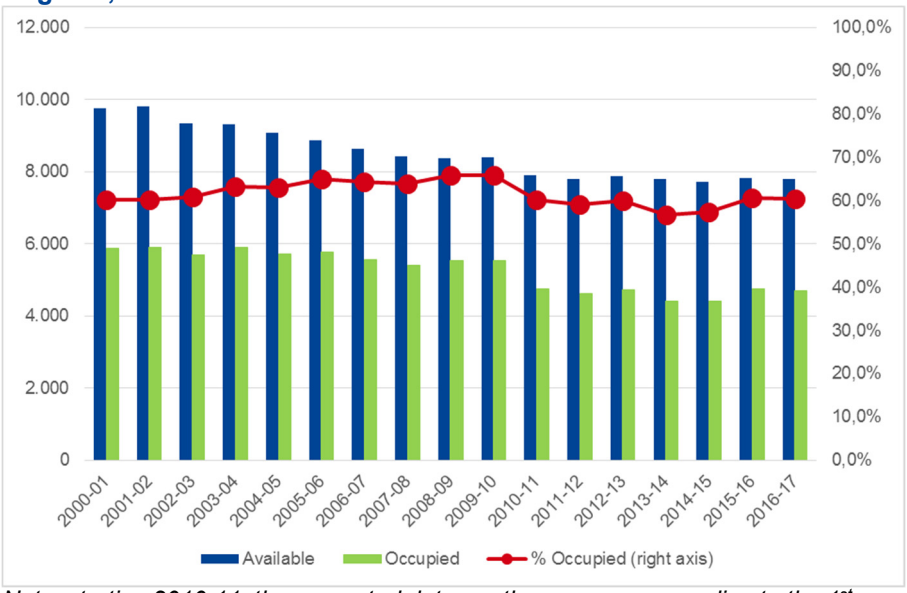
There are 23 neonatal networks, with clear guidelines for transfers.[636] Almost all trusts (98.5%) were part of such a network in 2013 (against 97.4% in 2007).[634] Of the 10% of babies who were admitted to a neonatal unit, 12% were transferred for care to another trust, less than 1% were transferred to another neonatal network. The median distance reported by maternity units is 17 miles.[636]

Networks in maternity care are relatively less well established than neonatal networks[634] but are encouraged by the Department of Health.[635] More and more trusts take part to such a network (from 58.6% coverage in 2007 to 73.8% in 2013).[635] They organise the rapid transfer and treatment of women and new-borns facing complications using agreed referral pathways across the network.[634]

8.4.3.3 Occupancy rate

Average occupancy rate of maternity beds is around 60% (see Figure 145), with strong variation between trusts (from 6.6% to 100% in 2016-17, the median being at 59%).[644] There is an important variation in the occupancy rate of maternity units depending on the type of unit. The median trust counts 3.6 delivery beds per 1 000 births per year (meaning that each bed is used for 0.7 births per day).[636] Some trusts only have two delivery beds per 1 000 births per year (each delivery bed is used for 1.4 births per day).[636] Obstetric units have the highest delivery bed use (3 delivery beds per 1 000 births), midwifery-led units having much lower use (6.3 delivery beds per 1 000 births for alongside midwifery units and 10.2 for freestanding midwifery units).[636] This is linked to the lower levels of activity in midwifery-led units.[636] On average, 318 deliveries occurred in each bed in obstetric units in 2007, 146 in alongside midwifery units and 89 in freestanding midwifery units.[638]

Figure 145 – Average daily available and occupied maternity beds in England, 2000-2017

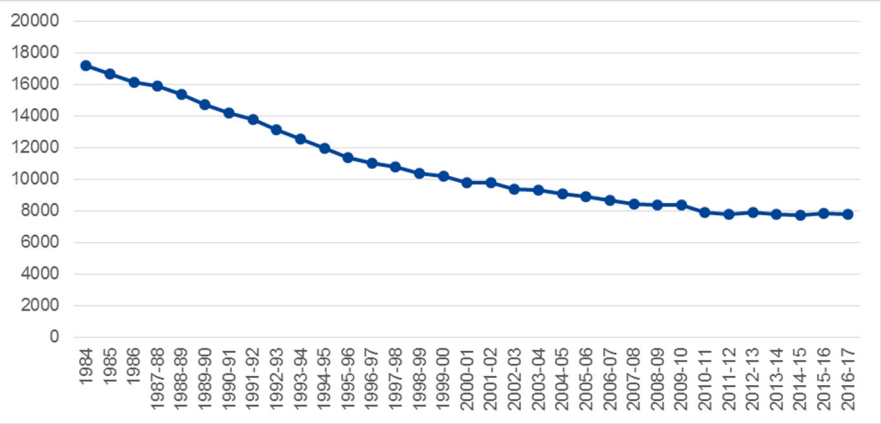


Note: starting 2010-11, the presented data are the ones corresponding to the 1st quarter of the year.
Source: NHS England (2017)[644]

The number of maternity beds has been divided by two since the eighties (see Figure 146), following the same trends as other beds types. Where the demand risks to exceed capacity, some units (12%) use caps on the annual number of births permitted on their site. If needed, short-term closures are also used, meaning that women who do not need urgent care are diverted

to another maternity unit. Between April and September 2012, 28% of the units had been closed for at least half a day (with a median of three days per unit).[635] The main reason for these closure is a lack of physical capacity.

Figure 146 – Average daily number of available maternity beds in England, 1984-2017



Note: starting 2010-11, the presented data are the ones corresponding to the 1st quarter of the year.
Sources: The NHS confederation (2006)[645] and NHS England (2017)[644].

8.4.3.4 Length of stay

Average length of stay for a normal delivery is 1.5 days in the UK in 2014, which is the smallest amongst the 26 states of the European Union (whose average is 3.2 days).[69] In 1990, 55% of women in England stayed in hospital for three or more days following birth.[646] Although there is considerable variation between hospitals, all have observed a substantial decline of the average length of stay.[647] In 2012-2013, amongst all types of delivery stays, 43.8% had a total duration of one day or less, 68.7% two days or less and only 11.3% lasted five days or more. The longest stays were associated with C-section deliveries.[648] It has been claimed that a further reduction in length of stay while maintaining bed occupancy levels could improve efficiency by reducing the number of beds and staff time required to provide the same level of service.[635] However, if quality of care has to be maintained, staffing and bed capacity cannot be simply reduced proportionately: it has been estimated that reducing average length of stay on a typical postnatal unit by six hours or 17 % would reduce costs by just 8%, which may of course still be a significant saving.[647]

8.4.3.5 Access

According to the 'national choice guarantee'[642] women should have the choice of the place of delivery (choice of the type of unit as well as of the provider). However, no guidance is given regarding which level of accessibility represents a realistic choice.[635] Despite the increase in the number of midwifes-led units, the number of locations where maternity services are provided has declined, because the number of obstetric units has decreased.[635] Nevertheless, the average time to reach the closest unit remained unchanged (13 minutes).[635]

The possibility to choose the type of unit has been improved: 79% of the women of childbearing age live within a 30-minute drive of both a midwifes-led unit and an obstetric unit in 2013. This proportion was 59% in 2007. 65% of women are within a 30-minute drive of two or more obstetric units. But around 8 % of women have no obstetric unit within a 30-minute drive and 3% would have to drive for more than an hour to reach the second-nearest obstetric unit.[635]

8.4.3.6 Future

In February 2016, NHS England published a major review of maternity services, called 'Better Births'.[649] The report defines the future vision for maternity services across England: 'to become safer, more personalised, kinder, professional and more family friendly; where every woman has access to information to enable her to make decisions about her care; and where she and her baby can access support that is centred on their individual needs and circumstances.'[650]

The Maternity Transformation Programme aims to achieve the vision set out in Better Births by bringing together a wide range of organisations. Commissioners and providers are requested to work together across areas

called Local Maternity Systems (LMSs) covering 500 000 to 1.5 million people.[651]

Alongside these changes regarding maternity services, sustainability and transformation plans (STPs) were introduced in December 2015. The new policy (that is being called 'place-based planning') incites NHS organisations to collaborate to plan and provide local services.[652] In March 2016, NHS England published a map of 44 Sustainability and Transformation 'footprints'[653], i.e. geographical areas on which the plans will be based.[281]

Local Maternity Systems are expected to align with STPs footprints in the vast majority of cases, although some have population sizes outside the range defied for LMSs.[651] While most of the STPs refer to maternity services, the content varies widely from one to another. Some set out a lot of information regarding how they will implement the main recommendations of Better Births to STPs, some only mention maternity in the context of a forthcoming service reconfiguration.[654]

Many concerns have been raised regarding potential closure of maternity units and foreseen access difficulties following the plans.[655-657] For instance, the Guardian stated that 'thousands of hospital beds are set to disappear, pregnant women will face long trips to give birth (…) as part of controversial NHS plans to reorganise healthcare in England.'[657]

8.4.4 Sweden

8.4.4.1 Organisation of maternity services

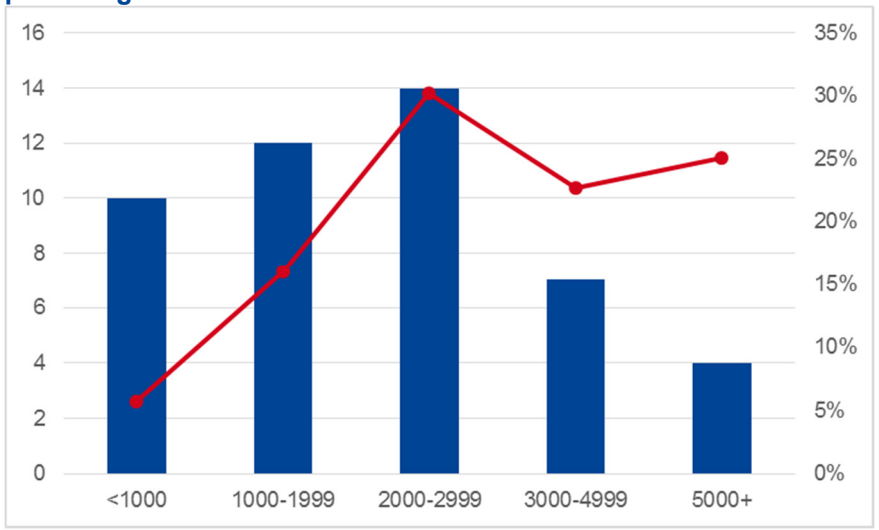
Sweden has among the lowest perinatal mortality and maternal mortality rates in the world[658] (see also Figure 140). For many years, the country has been rated the best country in the world to be a mother[ss660]. Almost all deliveries (99%) occur within the hospital.[658, 661, 662]

Maternity care in Sweden is publicly funded, is free at the point of service and is provided to all residents. As other health care services, the political view is that it should be characterised by a high level of accessibility, good quality, and freedom of choice.[660, 662]

In Sweden, the 21 county councils and regions are obliged to provide health care to their population.[663] In 2014, 47 hospitals in Sweden provided maternal health care services.[664] Eleven of them performed more than 3 000 deliveries and concentrated almost half (48%) of the deliveries occurring in the country (see also Figure 147). Four hospitals performed more than 5 000 deliveries and the biggest unit (Sahlgrenska universitetssjkh) performed almost 10 000 deliveries, which represent 9% of the deliveries in the country.

[ss] Sweden is currently still in the top-5 countries to be a mother.[659]

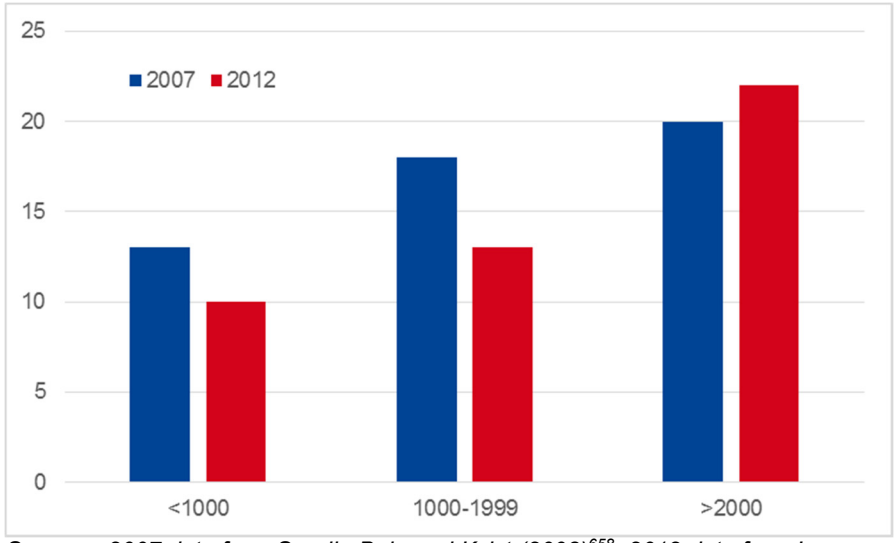
Figure 147 – Maternity services in Sweden by number of deliveries and percentage of total deliveries in 2014



Blue bars (left axis) represent the number of units per category, red points (right axis) represent the percentage of national deliveries occurring in each category of unit.
Source: Sveriges Officiella Statistik (2015)[664]

Comprehensive restructuring of the Swedish hospital system was carried out in the 1990s and early 2000s to consolidate resources in order to increase efficiency and to cut costs. In particular, maternity care was consolidated in fewer and larger hospitals.[665] The reorganisation was mainly initiated as a result of the economic crisis beginning in 1991 and was further strengthened by a new law stipulating that no county was allowed to run an annual deficit in the health care budgets.[666] Most of the smaller maternity services were closed because they had too few deliveries, and therefore, were assessed to be unable to maintain safety.[661, 662] Figure 148 illustrates this process, showing the increase in the number of big maternity services (more than 2 000 deliveries), while the number of smaller ones decreases. During the period 1987-2004, 18 maternal clinics were closed.[666]

Figure 148 – Maternity services in Sweden by number of deliveries in 2007 and 2012



Sources: 2007 data from Sandin-Bojo and Kvist (2008)[658], 2012 data from Larsson et al. (2016)[667]

The organisation of maternity care has evolved. In many hospitals, the care has been differentiated into two levels: on the one hand, care of women with normal processes during pregnancy and on the other hand care of women at high obstetric risk or who have obstetric complications.[668] Midwives are the primary caregivers for the first category of women. In the case of high obstetric risk, or when complications occur, midwives collaborate with obstetricians, who take over responsibility.[667, 668] Obstetricians are therefore considered as those trained in pathologies, while midwives are regarded as the appropriate providers for most births.[660] The boundary between normal and high-risk pregnancies is not fixed, it is socially defined and changes over time.[668]

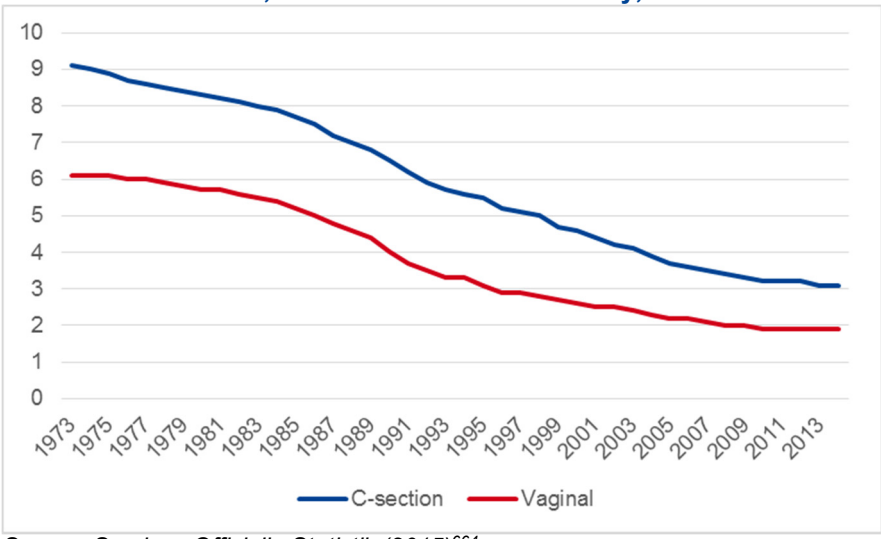
8.4.4.2 *Overcapacity and referrals*

In Sweden, women are free to choose their maternity care provider. Hospitals can decline to accept patients when they reach full capacity but must find another bed at another facility for expectant mothers.[669] Precisely, pregnant women are advised to make a phone call to their chosen maternity service when labour has started, before they go to the ward for delivery. Between October 1998 and April 1999, in a study in one of the Stockholm hospitals, it has been found that 9% of all women who contacted the ward during the study period for admission were referred to another maternity service, because of lack of delivery beds and staff.[661] In 2013, 1 983 pregnant women (6.3%) in the Stockholm County were referred to another unit during labour.[670] which represents an increase of about 15 percent from 2012. There are large variations between counties, for instance in Västra Götaland less than 1% of pregnant women were referred to another hospital in 2012.[671] The phenomenon seems to be concentrated in urban areas and in particular in Stockholm and, to a lesser extent, in Malmö.[671] This shortage of beds is also seen as one of the drivers of the reduction of length of stay (see section 8.4.4.3), and women sometimes feel urged to leave the hospital shortly after the delivery due to the overcrowding.[672]

8.4.4.3 *Length of stay*

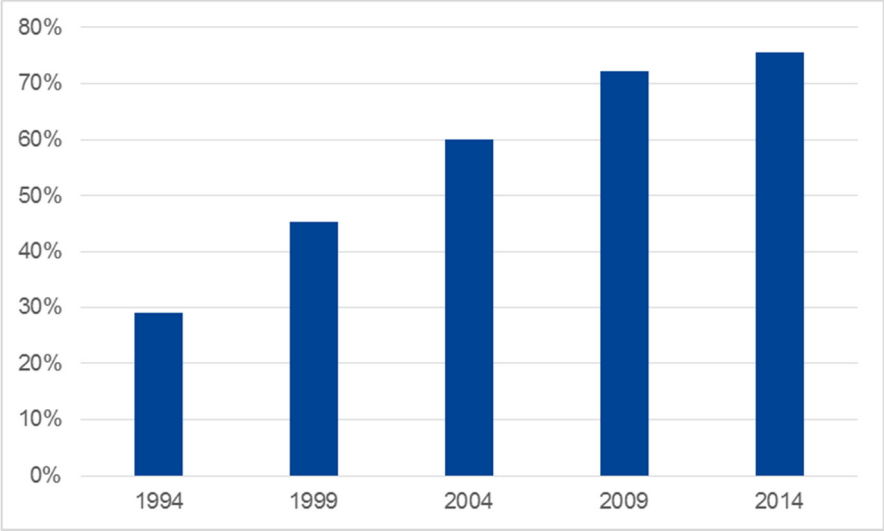
As in other western countries, the length of postpartum stay has steadily decreased in Sweden in the last fifty years. While the average length of stay after a vaginal delivery (resp. a C-section) was 6.1 (resp. 9.1) days in 1973, it was only 1.9 (resp. 3.1) in 2014 (see Figure 149). In the sixties, the recommended length of stay after a normal delivery was 7 or 8 days.[672] Early discharge has been evaluated and introduced in Sweden in the mid-1980s with the aim of facilitating more family-oriented postnatal care.[673] It was defined as the discharge of a healthy mother and infant within 3 days postpartum.[672, 674] Currently, the great majority (76% in 2014) of women are discharged within two days after a vaginal birth in singletons (see Figure 150).

Figure 149 – Evolution of the average length of stay following childbirth in Sweden, distributed mode of delivery, 1973-2014.



Source: Sveriges Officiella Statistik (2015)[664]

Figure 150 – Proportion of short hospital stay (0-2 days) after vaginal birth in singletons in Sweden, 1992-2014.



Source: Sveriges Officiella Statistik (2015)[664]

Shorter length of stay has shifted much of the postpartum recovery from the hospital to the home.[675] Maternity services are now mainly dedicated to complicated pregnancy or delivery. Alternative postpartum care options, such as early-discharge programmes and family suites, are intended to healthy mothers and new-borns. In the family suite programmes, the mother and infant are transferred to a hotel for patients no less than 4 hours after a normal delivery, or after having spent one night at the hospital. Midwives offer support and assistance at the ward during the day, and at night, a nurse is available at the hotel reception desk.[676] The early discharge programmes consist of home visits and/or daily phone call consultations as well as a final check-up with counselling and a neonatal examination.[677]

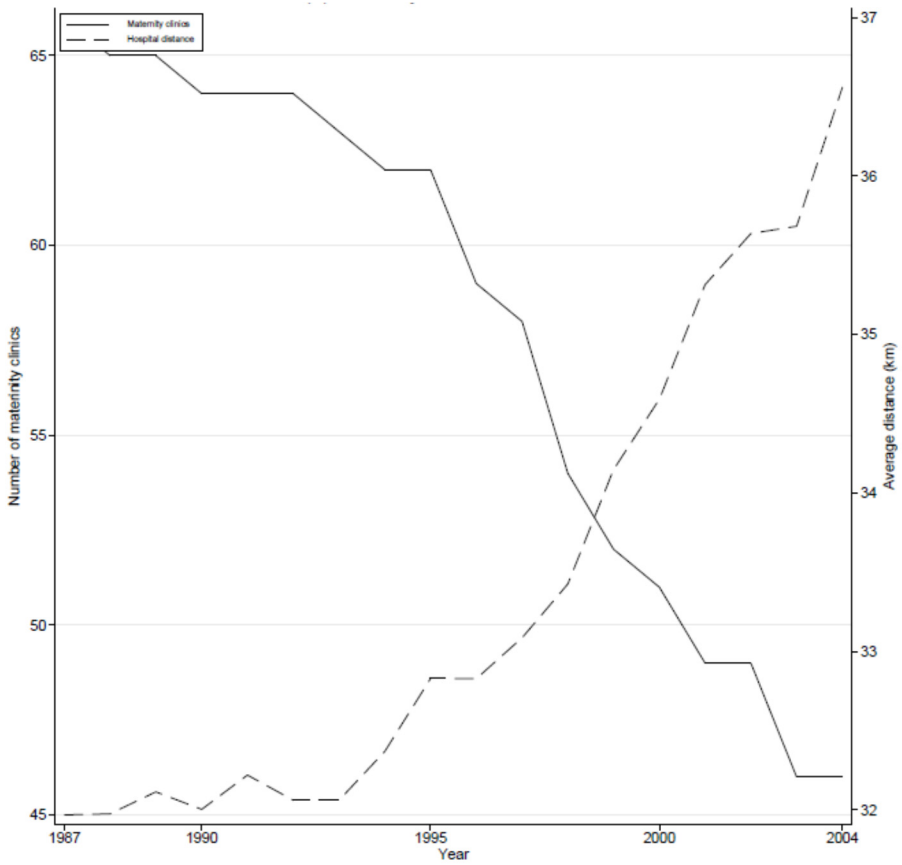
For instance, in Umea in northern Sweden, family suites have been available since 1994 and a voluntary early discharge programme, with follow-up at home, was introduced in 1998.[676] During the period 1999–2002, 20% of healthy term-born infants in Swedish hospitals benefited from family suite programmes and 45% from early discharge programmes.[677]

8.4.4.4 Access

Globally, the distances to the maternity service in Sweden are quite large compared to other countries such as England or France. In a sample of 115 low-risk pregnant women in 2002 in the northernmost county of Sweden, the median distance to the maternity service was 65 kilometres. Only 25% of the participants to the study were at less than 20 kilometres from the unit, while 25% had to travel more than 110 kilometres.[673] These large distance have been intensified by the successive closures of maternity services. In a preliminary study, Avdic et al. (2016)[666] found that the average distance to a maternity clinic[tt] in Sweden increased as the number of units were reduced over time, as illustrated in Figure 151. Recent closures raised lot of concern regarding the increased distance women will face. For instance, lot of protests have been organised in Sollefteå (a municipality of about 20 000 inhabitants in the northern Sweden) against the closure of the maternity service in January 2017, the closest other units being located more than 100 kilometres away.[678-680]

[tt] For an individual residing in a given municipality a given year, the distance is measured as the distance to the modal hospital to which most of the inhabitants of the municipality were admitted in that particular year.

Figure 151 – Number of maternity clinics and average distance in Sweden, 1987-2004



Solid line: number of maternity clinics, measured on the left axis; dashed line: average distance in kilometres, measured on the right axis.
Source: Avdic et al. (2016)[666]

8.5 Criteria for concentration of care

8.5.1 Introduction

Regarding the organisation of care for mothers and new-borns, policies have focused on two principal areas.[681] On the one hand, a tendency is observed towards regionalisation of care, i.e. the concentration of care for high-risk pregnancies in regional centres with specialised care. On the other hand, a policy objective is the guarantee of a minimal level of safety for low-risk pregnancies and for the unforeseen risks that can arise during delivery and postpartum. As high-risk pregnancies are considered out of scope for this report, we focus on the second area. Such policies include creating risk triage systems for delivery in non-medicalised settings, specifying minimum staffing and services for all maternity services, etc.[681] In particular, it consists of finding a balance between efficiency (concentrating maternity care, and closing small maternity services) and the accessibility for the patients.

8.5.2 Costs savings

Box 35 – Economies of scale and economies of scope

A hospital or a service experiences **economies of scale** when the cost per patient (or per case, or per day) declines as the number of patients (or cases, or days) increases. In that case, average cost decreases as the scale or the volume of activity increases. Economies of scale are expected to exist when fixed costs are high relative to variable costs. Examples of fixed, semi-fixed and variable costs in the case of a maternity service are presented in Table 119. As the scale increases, the fixed costs are spread over a larger volume.

Economies of scope are present when producing two or more services together costs less than producing them separately. It is the case when there are costly fixed inputs that are shared between service lines.

Table 119 – Examples of fixed, semi-fixed and variable costs

Fixed costs (do not change with the volume)	Semi-fixed costs (can change according to the volume, but some indivisibility, i.e. fixed over a particular volume interval)	Variable costs (can change fully according to the volume)
Capacity (number of beds, number of delivery rooms, etc.): considered to be fixed, as it cannot be changed easily Fixed minimum staffing (including minimum staff that must be present 24/7) Required equipment to run the unit Medical and non-medical equipment in delivery rooms, theatres, labour rooms, post-natal rooms, etc. Cleaning Management costs Property costs Administration costs Maintenance costs Etc.	Staffing for delivery rooms, theatre, antenatal visits, etc. (can be changed to adapt to the number of deliveries) Some administrative costs Monitoring costs Information technology costs Etc.	Drugs Medicine Disposables Catering Laundry Etc.

Source: adapted from Frontier Economics (2012)[682] and Mogyorosy and Smith (2005)[683]

8.5.2.1 Economies of scale

When looking at the effect of volume on the average cost, it is important to distinguish between the cost-volume link within a same facility, and the comparison of costs between two facilities of different sizes.[684] For a hospital or a service of a given capacity and staff, increasing volume generally decreases average cost (until the capacity ceiling is reached). What we are interested in is the second effect: are average costs in smaller hospitals higher than in larger ones, even if both are operating at full capacity?

Extensive literature on this question has been developed at the hospital level[uu].[684] In early studies, differences in case mix where not controlled for, which makes interpretation difficult (larger hospitals may attract more costly cases so that their average cost may be higher even if economies of scale are present). But most recent studies better control for case-mix differences, and use a wide range of statistical methods. These studies consistently report constant or increasing average costs for acute hospitals (i.e. absence of economies of scales or even presence of diseconomies of scale). If economies of scale are present, they appear for low level of capacity (around 100-200 beds). Diseconomies of scale seem to appear above 300-600 beds.

[uu] The interested reader is referred to Van de Voorde et al. (2014)[20], chapter 13.

It must be noted that most of these studies are performed in the UK or in the US.[684] It is difficult to assess if the results would fit in another context. An important element is the definition of what constitutes minimum staff and equipment requirements. This definition may vary importantly in different countries. Where requirements are stronger, unexploited economies of scale are more likely. Indeed, the costs of minimum staff and equipment requirements are fixed even if the hospital does not utilize these inputs at full capacity. As the activity volume increases above the level that can be performed by the minimum staff and equipment, additional staff and equipment inputs become variable costs.

Even fewer studies have specifically examined maternity services. While references to economies of scale in maternity services were found back in the 1940s[685], our focus concerns more recent studies. The reader must be aware that, in this context also, research is biased towards Anglo-Saxon hospitals. Therefore the above remark regarding cautious interpretation applies. In Scotland, a national study looked at the impact of volume on the ratio of actual to expected costs, where expected costs are the ones that would prevail if the unit cost was the same as the average unit cost for a peer group.[686] A decreasing relationship was found between the annual number of births and this cost ratio. In England, Frontier Economics (2012) found substantial economies of scale in maternity services. [682] The minimum efficient scale (lowest point on the long run average cost curve) was found to be at least 8 000 births per year for consultant-led units and 3 500 births per year for midwifes-led units. In the same context, Monitor (2014) only found a slightly decreasing relation between scale and costs.[687] The difference between both results is likely to lie in the data used for computing the costs. While Monitor (2014) uses (reference) costs that are observed in practice, Frontier Economics (2012) uses theoretical costs based on best practice guidelines. As best practices are more and more adopted, economies of scale may therefore emerge.[687] Jones (2013) formulates doubts about the quality of reference costs submitted by hospitals.[685] Nevertheless, using these costs, he found that hospitals performing 3 000-5 000 deliveries per year have lower costs than the national average due to economies of scale. Average cost is found to be £ 1 450 (€ 1 750) for a maternity service with 10 000 deliveries while it is £ 2 150 (€ 2 590) when 1 000 deliveries are performed. Another study found that an increase in size of a typical maternity unit from £ 5 million to £ 10 million would imply a reduction in the reference cost index of more than 15%.[688] Sandall et al. (2014) found no economies of scale in the cost of a delivery only but economies of scale appeared across the total maternity episode (i.e. including antenatal and postnatal care).[689] Costs are lower when the size, measured as the number of deliveries, is larger.

8.5.2.2 Economies of scope

Literature about scope of hospital services is dominated by the clinical view of what services need to be connected to deliver safe care, however little economic evidence is available on the impact of such decisions on costs.[682, 690]

Economic studies related to economies of scope are generally performed at the hospital level and provide mixed evidence. In a Norwegian study, Kittelsen and Magnussen (2003) found strong economies of scope for surgical and medical services, intermediate economies of scope for inpatient and outpatient production, and weak economies of scope for elective and emergency care cases.[691] In England, Freeman et al. (2016) showed evidence of diseconomies of scope for these two admission types at the hospital level (increased elective volume is associated with an increase in the cost of emergency care).[692] However, they found positive spillover effects of emergency admissions across services lines (increased emergency admissions in one service is associated with a decrease in the cost of emergency care in other service lines). These spillover effects were not present for elective admissions. Marini and Miraldo (2009) found global diseconomies of scope for Foundation Trusts and economies of scope for non-Foundation Trusts.[693] In Denmark, economies of scope were found by Kristensen et al. (2012).[694] For instance, large hospitals are estimated to save 14.2% of total costs due to the joint production of inpatient, outpatient and emergency services. Wang et al. (2006) presented evidence of economies of scope between outpatient and inpatient services in both large and small hospitals in Australia.[695]

We are not aware of any study that specifically looked at economies of scope for maternities or obstetrics services and their complementarities with other service lines.

8.5.3 Occupancy rate

If bed occupancy is too low, a unit may be financially unsustainable as income is insufficient to cover fixed costs. However, if bed occupancy is too high, the unit may be unable to handle peaks in demand.[635] Research by the Maternity Care Coalition (2011) in the US indicates that the accepted standard for average bed occupancy in maternity services ranges from 70% to 80%.[696] The American College of Obstetrics and Gynecology recommends a target of 75%, which is considerably lower than the commonly used target of 85% for general and acute beds.[697] Indeed, obstetrics generally operates independently of other services[697] and have a high proportion of elective admissions. At the lower end of this range, the normative occupancy rate used for maternity services in Belgium is 70%.

While the average occupancy depends on the size of the unit, larger units being able to operate at higher average occupancy (i.e. gain economies of scale), Jones (2012) calculates that even for the largest units in England, a maximum average occupancy of no greater than 75% should apply in order to have an available bed for the next arriving mother.[698] It is stated that a maternity service should be operating below 0.1% turn-away[vv], although below 1% turn-away is tolerable.[700]

8.5.4 Volume and outcome

It is often claimed that better clinical outcomes are obtained in units with higher volume of activity. The most studied explanation is related to clinical experience which is supposed to increase with volume. That focus has been influential in the trend towards greater concentration of services (into larger hospitals).[684] The potential existence of a link between volume and outcomes does not necessarily mean that outcomes are better in larger hospitals, however they could be improved would activity be concentrated in services that meet minimum volume criteria.[684] Following this rationale, many countries have taken initiatives to close maternity services that have a low annual volume of deliveries (under 300 or under 500 per year).[681]

Scientific evidence regarding the volume-outcome link in maternity services is quite mixed, especially for low-risk births. Some studies[701-703] have found that delivery (for low-risk women[ww]) in a small unit is associated with lower outcomes, but others[704, 705] found that outcomes are unrelated to the size of the maternity service.

In a study following concentration of maternity services in Australia, Tracy et al. (2006) compared birth outcomes for primiparous low-risk women delivering in hospitals of different sizes and found no significant difference in neonatal mortality, once adjusted for risk status.[705] Therefore, lower hospital volume is not associated with higher neonatal mortality. Moreover, operative interventions at birth are less likely in smaller hospitals. This study contrasts with Moster et al. (1999) who studied neonatal mortality in Norway.[701] According to them, the neonatal death rate after low-risk deliveries was lowest for maternity services with 2 001–3 000 births per year and increased with decreasing size of the maternity service. They conclude that 2 000 to 3 000 births per year were needed to reduce the risk of neonatal deaths. Also studying neonatal mortality, Heller et al. (2002) presented evidence of lower birthweight-specific mortality rates in large delivery units in Germany.[702] The highest rate was found in delivery units with less than 500 births per year.

Research on maternal complications is also not conclusive. Using a nationwide cohort in US hospitals, Janakiraman et al. (2011) studied four categories of complications (lacerations, haemorrhage, infections, and thrombosis).[704] Aside from infections that were more common in larger hospitals, they found that hospitals in the lowest-volume quartile (less than 255 deliveries per year) had marginally higher odds of several individual types of complications, but most of which did not reach statistical significance. The effect of size on a composite indicator of complication was not significant neither. However, the provider volume was found to be

[vv] Turn-away is the proportion of patients who are unable to gain immediate access to the appropriate bed.[699]

[ww] High-risk pregnancies being considered as out of scope for this report.

associated with complications. Providers in the lowest volume quartile (seven or fewer deliveries per year) had higher rates of each type of complication, and a 50% higher risk-adjusted probability of complications overall than providers in the highest-volume quartile. Using a cohort from 11 states in the US, Kyser et al. (2012) found opposite results.[703] In their study, women who deliver at very low volume hospitals (decile 1 and 2) are found to have higher complication rates (the composite indicator includes haemorrhage, severe perineal lacerations, operative complications, infection, thrombotic complications and mortality). Odds of experiencing the composite measure of complications were between 43% and 60% higher for decile 1 hospitals compared to decile 10 even when adjusted for patient demographics and comorbidity. In California, Snowden et al. (2015) found that (adjusted) rates of chorioamnionitis, endometritis, severe perineal lacerations, and wound infection did not differ between hospital volume categories.[706] However, higher (adjusted) rates of postpartum haemorrhage were found in the lowest-volume rural hospitals (less than 600 deliveries per year).

8.5.5 Access / Distance

The trend toward concentration of services implies a reduction of patient access, as small local maternity services are closed.[684] In particular distance to the closest unit tends to increase. Effects of distance (or travel time) on the utilisation of services have been extensively studied, but seem less relevant in the case of maternities. Nevertheless, it is important to note that, when accessibility is reduced, part of the health care cost (notably transport cost) is shifted to patients. Moreover, this increased cost is not uniformly distributed across the population.

Some studies have looked at effects of distance on medical outcomes for low-risk[xx] maternity services. Most of them found no significant influence of travel time on perinatal mortality. In the English county of Cumbria, Dummer and Parker (2004) found no significant impact of travel time on risk of infant mortality (early neonatal, neonatal, and postneonatal deaths) and stillbirth.[707] This result confirms previous findings in the same region from Parker et al. (2000) who found no significant impact on stillbirth risk of distance of mother's residence from the first or second nearest maternity services.[708] In the same way, Combier et al. (2013) found no significant association between travel time of 30 minutes or more and perinatal mortality in the French region of Burgundy (Bourgogne).[709] In Wales, Paranjothyet al. (2004) showed that longer travel time to the hospital is associated with increased risk of neonatal death.[710] However, when looking at travel time to the nearest maternity service (rather than the place of birth), no significant association was found. An exception is Combier et al. (2013) who found that the risk of stillbirth and perinatal mortality significantly increases for travel time longer than 45 minutes in the French region of Burgundy.[711] Another study is found in the Netherlands where a travel time from home to hospital of 20 minutes or more by car is associated with an increased risk of mortality and adverse outcomes in women.[712, 713] However, in this country, most women start labour at home, even in the case of a planned hospital delivery, which makes the results difficult to compare to other settings. Looking at other outcomes, longer travel time has been shown to be associated with increased risks of foetal heart rate anomalies, meconium-stained amniotic fluid, and antenatal hospitalisations.[709, 711] The likelihood of out-of-hospital delivery also increases with travel time.[709, 711, 714]

[xx] High-risk pregnancies being considered as out of scope for this report.

DISCUSSION AND CONCLUSION

The discussion and conclusion can be found in the Short Report of this study, which is published as a separate document on our website. It can be accessed from the same referral page as the current document.

APPENDICES

APPENDIX 1. APPENDIX TO CHAPTER 2

Appendix 1.1. Incidence and prevalence of dementia in Flanders based on Intego database

A research team of the KU Leuven has built a registry of GP-contacts; a representative sample of Flemish GPs is participating. Incidence and prevalence rates of reasons for GP-visits, based on the International Classification of Primary Care (ICPC) are calculated; on the website (https://intego.gbiomed.kuleuven.be/intego-apps/inc_prev_v0/) incidence rates are presented. In addition, we contacted the responsible person (Bert Vaes) of the Intego-database for further information. He provided us with following data:

INCIDENCE P70 (n cases per 1 000 persons per year) (yearly contact group)											
Sample	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
All ages	1	1.08	0.85	1.01	1.17	1.33	1.09	1.28	1.31	1.13	1.34
Female All ages	1.22	1.31	1.15	1.17	1.45	1.67	1.31	1.58	1.57	1.33	1.46
Male All ages	0.77	0.83	0.52	0.84	0.88	0.96	0.85	0.94	1.03	0.92	1.21
Over 65 years	4.74	4.96	4.29	4.92	5.8	6.18	4.79	5.29	5.45	5.03	5.89
Female over 65	5.5	5.86	5.66	5.48	6.73	7.18	5.64	6.22	6.24	5.46	6.28
Male over 65	3.76	3.81	2.54	4.22	4.63	4.93	3.74	4.1	4.48	4.5	5.41
Over 80 years	8.54	11.74	8.25	10.23	9.73	13.34	10.04	8.88	9.84	9.54	12.84
Female over 80	9.59	13.21	9.4	8.58	11.69	14.57	10.81	10.25	11.47	9.63	12.37
Male over 80	6.75	9.21	6.25	13.12	6.34	11.25	8.79	6.64	7.28	9.4	13.55

PREVALENCE P70 (% in group on January 1st) (yearly contact group)											
Sample	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
All ages	0.38	0.4	0.43	0.42	0.44	0.48	0.49	0.54	0.62	0.61	0.64
Female All ages	0.53	0.53	0.57	0.57	0.58	0.61	0.64	0.68	0.78	0.78	0.79
Male All ages	0.22	0.26	0.28	0.26	0.29	0.33	0.34	0.37	0.44	0.43	0.49
Over 65 years	1.91	1.97	2.09	2.03	2.13	2.28	2.33	2.37	2.68	2.63	2.72
Female over 65	2.49	2.45	2.61	2.61	2.68	2.76	2.85	2.84	3.23	3.22	3.18
Male over 65	1.15	1.35	1.42	1.29	1.44	1.67	1.68	1.76	2.01	1.92	2.17
Over 80 years	4.44	4.24	4.52	4.2	4.51	4.53	4.98	4.73	5.31	5.25	5.44
Female over 80	5.37	4.88	5.28	4.93	5.04	5.04	5.71	5.55	6.24	6.29	6.1
Male over 80	2.79	3.12	3.18	2.9	3.57	3.66	3.76	3.36	3.81	3.6	4.43

Appendix 1.2. Studies on the prevalence of dementia in hospitals

Country - year	Prevalence dementia in hospital		Source
	Hospital beds	**Hospital admissions**	
Australia 2000-2009		From the patients (65+) that were admitted due to a fall related hip fracture, between 24% (observed diagnosis) to 29% (inferred diagnosis) of these people had dementia.	Scandol et al. (2013)[181]
Australia 2008-2010		From patients aged 70 years and older admitted to general medical, general surgical and orthopaedic wards of four acute hospitals, 29.4% were considered to have cognitive impairment, including 20.7% who were considered to have dementia. This rate increased to 47.4% in the oldest patients (aged 90+).	Travers et al. (2013, 2014)[169, 170]
China 2002-2012	The prevalence of dementia was 2.6% among hospitalised (exclusive the departments of paediatrics, gynaecology and obstetrics) adults (65+) admitted for diagnoses other than dementia.		Li et al. (2013)[165]

Ireland 2010-2012	Patients with dementia accounted for 10% of total bed days.	Patients with dementia accounted for 2% of all inpatient episodes.	Briggs et al. (2016)[223]
Ireland 2010		1.1% of all patients discharged from acute hospitals had a diagnosis of dementia.	Connolly and O'Shea (2015)[131]
Italy 2002-2006		Demented patients represented 8.6%.	Zuliani et al. (2012)[172]
Greece unclear		85% of patients (68+) admitted for hip fracture surgery suffered from dementia. In other surgical patients (68+) prevalence of dementia was 61.5%.	Yiannopoulou et al. (2012)[715]
UK 2001	People with dementia over 65 years are using up to 25% of hospital beds at any one time.		Lakey (2009)[176]
UK 2006-2010	Older people with dementia currently occupy up to 25% of NHS hospital beds.		Kasteridis et al. (2015)[201]
UK 2007		42.4% of the older people (70+) undergoing emergency medical admission had dementia of which only half diagnosed prior to admission.	Sampson et al. (2009, 2013)[120, 716]
UK unclear		Around 40% of patients older than 70 years with acute medical admissions have dementia, but only half of these patients have been diagnosed. In patients older than 90 years, the prevalence of dementia in acute hospitals was reported as 48% in men and 75% in women.	Singh et al. (2013)[222]
UK 2011		10% of admissions in acute hospitals can be attributed to patients with dementia.	Dementia Action Alliance (2012)[138]
UK 2016	25 per cent of hospital beds are occupied by people with dementia at any one time. However, informal reports suggest this is a gross underestimate, with some hospitals stating that 40 to 50 per cent of their patients have dementia.		Boaden (2016)[160]

USA 1990-2007		2.9% of adult (18+) patients admitted with lower limb fracture.	Menendez et al. (2013)[156]
USA 2008		3.6% of admissions in patients aged 65+.	Husaini et al. (2015)[717]
USA 2012	3.12% of hospital beds in patients aged 60+.		Beydoun et al. (2015)[178]

Appendix 1.3. Ambulatory care sensitive conditions

Country	Source	Conditions seen as 'ambulatory care sensitive conditions'	Type: ED-visits or hospital admissions	Volume
Australia	Australian Institute of Health and Welfare[85]	There are several conditions for which hospital admissions could be prevented through early disease management or ambulatory care or where hospital care could be provided in an alternative setting such as the patient's home. These avoidable admissions are often referred to as 'ambulatory care sensitive conditions' (ACSCs). ACSCs include hospitalisations of people from conditions that, with appropriate primary care, should not become serious enough to require admission to a hospital. ACSCs can be divided into three subcategories: • vaccine-preventable conditions (for example, influenza and pneumonia); • chronic conditions that can be managed by pharmaceuticals, patient education and lifestyle; • acute conditions commonly prevented with antibiotics or other medical interventions available in primary care (such as dental conditions).	Admissions	Research findings suggest that hospitalisation is potentially preventable for one or more of the principal diagnoses within 2 of the 10 most common reasons for hospital care for people with dementia, namely Respiratory infections/inflammations and Oesophagitis, gastroenteritis and miscellaneous digestive system disorders. For people with dementia, Respiratory infections/ inflammations accounted for 2 584 hospital episodes, of which 920 (36%) belonged to people in residential aged care. Oesophagitis, gastroenteritis and miscellaneous digestive system disorders accounted for 1 400 hospital episodes, of which 123 (9%) belonged to people in residential aged care. Research also suggests that episodes relating to Kidney and urinary tract infections may be potentially preventable through timely and effective primary care and that hospitalizations due to injury may be avoidable through injury prevention practices. Kidney and urinary tract

				infections and Injuries accounted for a further 3 769 hospital episodes, of which 1 255 (33%) belonged to residential aged care residents.
Canada	Gruneir et al. (2010); Gruneir (2013)[103, 104]	Ambulatory care sensitive conditions are a set of chronic conditions and infections that are responsive to early primary care activities such that acute care use should be unnecessary or avoidable. These conditions were angina pectoris, asthma, pneumonia, cellulitis, congestive heart failure (CHF), chronic obstructive pulmonary disease (COPD), dehydration, diabetes mellitus, gastroenteritis, grand mal status and epileptic convulsions, hypertension, hypoglycemia, kidney and urinary tract infections, and severe ear, nose, and throat infections.	ED-visits	25% of ED-visits by nursing home residents were classified as potentially preventable.
Ireland	Briggs et al. (2013)[107]	A 'potentially preventable' attendance is one that may have been avoided if optimal management of an existing condition was available in the nursing home at an earlier stage.	ED-visits	Over half of all ED-visits were deemed 'potentially preventable'.
Sweden	Pimougnet et al. (2016)[141]	The avoidable hospitalisations indicator includes a number of selected diagnoses. First are diagnoses that reflect outpatient treatment of chronic or long-term conditions. The selected conditions are anaemia, asthma, diabetes, heart failure, hypertension, chronic obstructive lung disease and angina pectoris. Second are several acute conditions for which proper treatment within a reasonable period of time should avert hospitalization. The selected conditions are bleeding ulcers, diarrhoea, epileptic seizures, inflammatory diseases of female pelvic organs, pyelitis and ear, nose and throat infection.	Admissions	The rate of hospitalisation for primary care sensitive conditions was 25.6 per 1 000 person-years in participants who did not develop dementia and 88.2 in participants who did.
UK	Sampson et al. (2009)[120]	Conditions for which practicable improvements in access to timely and effective ambulatory care would either reduce the incidence of the condition or avoid substantial proportions of current hospital admissions. In this study they looked for 3 ACSC conditions: pneumonia, urinary tract infection and acute ischaemic heart disease.	Admissions	In people with dementia, 23.8% were admitted for pneumonia, 14.2% with urinary tract infection and 4.5% with acute ischaemic heart disease.

UK	Care Quality commission (2013)[86]	Avoidable conditions used here includes urinary infections, dehydration, pressure ulcers, pneumonia and other lower respiratory tract infections, severe malnutrition and fractures.	Admissions	In more than half (78 out of 151) of Primary Care Trust areas, people in care homes with dementia were admitted to hospital with 'avoidable conditions' significantly more than people without dementia.
UK	Glover et al. (2014)[142]	Not specified	Admissions	12% of the coded admission diagnoses were for 'ambulatory care sensitive conditions'
UK	Malhotra and Somerville (2014)[143]	Conditions that could have been prevented managed and treated in the community and/or may suggest poor care, neglect or lack of competency. Avoidable conditions used here includes urinary infections, dehydration, pressure ulcers, pneumonia and other lower respiratory tract infections, severe malnutrition and fractures.	Admissions	Hospital admissions for avoidable conditions were 30% higher for people living with dementia in a care home than those without dementia.
UK	Public Health England (2015)[118]	Acute conditions, where early intervention can prevent more serious progression	Admissions	20% of admissions in the study period were likely to fall into the category of acute conditions, where early prevention could have prevented more serious progression: is category. 9% were for diseases of urinary system, 8% for pneumonia and 3% for other acute lower respiratory infections.
USA	Becker et al. (2012)[111]	Conditions are considered potentially avoidable, as these are physical health conditions that can often be treated safely at a lower level of care or occur as a result of lack of timely, adequate treatment at a lower level of care. The list of diagnoses used in this analysis to identify ACS hospitalisations follows a national consensus list of diagnoses and previous research and include diagnoses as cellulitis; chronic obstructive pulmonary disorder; dehydration; diabetes mellitus; ear, nose, and throat infection; gastroenteritis; hypertension; hypoglycemia; pneumonia; and urinary tract infection.	Admissions	22% of all hospitalisations of patients 65+ admitted from assisted living facilities (in which 34% with dementia) were considered as ambulatory care sensitive.

USA	Givens et al. (2012)[106]	Not further defined	Admissions	The authors conclude that the majority (59%) of hospitalizations among NH residents with advanced dementia were due to infections, and thus, were potentially avoidable, as infections are often treatable in the NH setting.
USA	Phelan et al. (2012)[114]	ACSC are conditions for which hospitalisation may potentially be prevented with timely, evidence-driven, outpatient care.	Admissions	40% of the dementia group had at least one ACSC admission as compared to 17% of the dementia-free group. Three ACSCs accounted for 2/3 of all potentially preventable admissions: bacterial pneumonia, congestive heart failure, and urinary tract infection; admission rates among those with dementia were significantly higher for all 3 conditions. Admission rates for dehydration and duodenal ulcer, though low overall, were also significantly higher among those with dementia. Admissions for ACSCs accounted for 28% of all hospitalisations among those with dementia vs. only 19% of all admits among those who remained dementia-free.
USA	Stephens et al. (2012)[101]	ACSC are such conditions that if these conditions are managed with timely and effective primary care that some proportion of the ED visits and hospitalisations may be prevented. *(List of conditions not further specified in article, but based on Agency for Healthcare Research and Quality (2001). AHRQ quality indicators guide to prevention quality indicators: Hospital admission for ambulatory care sensitive condition)*	ED-visits	26% of nursing home residents with very mild–mild Cognitive Impairment had an ACSC ED visit, compared with 24% of those without Cognitive impairment or 14.7% of those with severe Cognitive impairment.
USA	Lin et al. (2013)[144]	They use the term 'preventable hospital admissions' (PAH) and defined them as 'hospital admissions preventable by good ambulatory care, or by early intervention to avoid severe disease'.	Admissions	In a sample of 195 024 patients with dementia, compared to similar size matched sample without dementia, they found following occurrences of PAHs:

		A hospitalisation was classified as a PAH if it was directly related to one of five avoidable adverse events designated by the Medicare Ambulatory Care Indicators for the Elderly (MACIEs): • serious short-term complications of diabetes; • Serious long-term complications of diabetes; • chronic obstructive pulmonary disease or asthma; • hypertension; • heart failure.		1. serious short-term complications of diabetes: 1.3% in dementia patients vs 0.9% in controls (OR: 1.43) 2. serious long-term complications of diabetes: 2.8% vs 2.6% (OR: 1.08) 3. chronic obstructive pulmonary disease (COPD) or asthma: 20.2% vs 23% (OR: 0.85) 4. hypertension: 0.46% vs 0.37% (OR: 1.22) 5. heart failure: 11.7% vs 13% (OR: 0.89) The risks of PAHs increased significantly with the number of comorbidities. Compared to those with earlier stage disease, beneficiaries with advanced dementia had significantly higher risks of PAHs.
USA	Davydow et al. (2014)[145]	ACSC-related hospitalisations: admissions for diabetes with short-term complications, admissions for perforated appendix, admissions for diabetes with long-term complications, admissions for chronic obstructive pulmonary disease, admissions for congestive heart failure, admissions for bacterial pneumonia, admissions for urinary tract infections, admissions for angina without concomitant procedures, admissions for uncontrolled diabetes without complications, admissions for lower extremity amputations among patients with diabetes, admissions for immunization-preventable influenza, admissions for immunization-preventable pneumococcal pneumonia, admissions for dehydration.	Admissions	• admissions for bacterial pneumonia: 28% • admissions for congestive heart failure: 25% • admissions for dehydration: 16% • admissions for urinary tract infections: 15%
USA	Ennis et al. (2014)[146]	a primary discharge diagnostic code of angina, asthma, bacterial pneumonia, cellulitis, congestive heart failure exacerbation, chronic obstructive pulmonary disease exacerbation, dehydration, diabetes, duodenal ulcer, ear/nose/throat infection, gastric ulcer, gastroenteritis, hypertension, hypoglycemia, hypokalemia, influenza,	Admissions	6 % of the periods included an ACSC hospitalization.

		malnutrition, peptic ulcer, seizure disorder, or urinary tract infection.		
USA	Feng et al. (2014)[98]	Avoidable admissions: We defined potentially avoidable hospitalizations using a list of conditions and diagnosis-related groups identified by an expert panel as either preventable or manageable outside of the acute care setting and appropriate for disabled Medicare and Medicaid beneficiaries. The list of conditions considered potentially avoidable for hospitalization was specific to the care setting, taking into account the fact that medical services are generally less available in home and community-based settings than in nursing homes. For example, acute, severe diarrhea due to gastroenteritis or food poisoning can often be managed in nursing homes without hospitalization, but patients with the same condition in the community may require hospitalization Avoidable ED-visits: We used the same set of principal diagnosis codes to define potentially avoidable ED-visits that we used to define potentially avoidable hospitalizations. Given the lack of consensus on a definition of the former, we conservatively defined them as a subset of outpatient ED-visits that did not lead to admissions, and the principal diagnosis codes associated with such ED-visits were for any of the conditions deemed potentially avoidable for hospitalization. ED visits that resulted in the patient's being hospitalized were not included because in those cases, a physician had deemed the patient's condition serious enough to warrant an admission	Admissions/ED-visits	7.6% of community dwelling people with dementia and 23.3% of nursing home residents with dementia had an avoidable hospital admission. 4.6% of community dwelling people with dementia and 7.2% of nursing home residents with dementia had an avoidable ED-visit. Remark: these rates were substantially higher in the last year of life
USA	Zhu et al. (2015)[115]	Definition and List of ACSC conditions, based on AHRQ_2001: diabetes mellitus, Chronic obstructive pulmonary disorder, Chronic heart failure, bacterial pneumonia, urinary tract infection, hypertension, dehydration, angina, and asthma	Admissions	In a 10 year cohort study, 30.3% of patients with dementia had at least one hospitalization (compared to 19.6% of non-demented patients); Most (83.5%) of patients with dementia had at least one ACS admission.

Appendix 1.4. Length of hospital stay in patients with dementia

Country	Year	Source	Length of stay dementia (mean)	Length of stay control	Remarks
No country specific	Systematic review up to 2008	Mukadam and Sampson (2011)[94]	Dementia significantly increased the length of admission by 6–30 days		55+
Australia	2006-2007	Bail et al. (2015)[151]	10.9	7.1	50+
Australia	2003-2012	Harvey et al. (2016)[167]	16.5	13.6	65+; injury-related hospitalization
Australia	2003-2012	Mitchell et al. (2016)[168]	13.4	8.8	People 50+ admitted to hospital because of self-harm injury
Australia	2000-2009	Scandol et al. (2013)[181]	mean LOS post-hip fracture for dementia sufferers was significantly shorter than those without a diagnosis of dementia even		Fall related Hip fracture patients
Australia	2008-2010	Travers et al. (2013 2014)[169, 170]	12	9.8	
Australia	2006-2012	Tropea et al. (2016)[152]	Median: 7.4 days (IQ:6.7–10.0)	6.6 (IQ: 5.7-8.3)	People with cognitive impairment defined as having dementia or delirium coded during the admission
China	2002-2012	Li et al. (2013)[165]	13	15	60+
Finland	2006	Gnjidic et al. (2014)[123]	16.1	7.1	65+
Finland	1998-2009	Jamsen et al. (2015)[171]	13	8	Patients following primary hip and knee arthroplasty for osteoarthritis
Finland	2005-2011	Taipale et al. (2016)[126]	The difference in the mean number of hospital days per person-years among persons with AD compared		

			with persons without AD increased during the follow-up from 1.4 (95% CI 1.3–1.6)days to 14.2 (95% CI 13.6–14.8) days		
Finland	2006-2009	Tolppanen et al. (2015)[124]	37	15	
Germany	2013	Motzek et al. (2016)[159]	9.3	7.3	
Ireland	2010-2012	Briggs et al. (2016)[130]	31.0	14.1	65+ university hospital
Ireland	2010	Connolly and O'Shea (2015)[131]	<65: 16.2 65-74: 24.4 75-84: 26.8 85+: 23.7	4.2 8.7 11.0 12.8	All acute hospitals of Ireland
Italy	2000-2006	Zuliani (2012)[172]	8 (median)	7	60+
Japan	2010-2012	Murata et al. (2015)[173]	21.7	18.1	Patients with peptic ulcer
Taiwan	2001-2009	Hsiao et al. (2015)[127]	9 (median)	8	65+
Taiwan	2004-2007	Hu et al. (2012)[154]	21.2	14.7	60+
Taiwan	2005-2007	Shen et al. (2012)[155]	7	4	
UK	2015	Boaden (2016)[160]	11.8	5.5	65+
UK	2008-2010	Chen et al. (2014)[174]	1.9	0.8	65+ (regards 6 months prior to dementia diagnosis)
UK	2010-2011	CHKS (2013)[158]	Patients with dementia typically stay 25 per cent longer than those without		
UK	2015	Corrigan (2016)[175]	LOS on average, a quarter longer than for those without dementia		
UK	2010 2011	Dementia Action Alliance (2012)[138]	13.57 13.25	10.67 10.85	
UK	2009	Corrigan et al. (2016)[176]	86% of all nurse managers felt that people with dementia either always or sometimes have a longer		

			stay in hospital than people without dementia admitted with the same medical condition		
UK	2012	Partridge et al. (2014)[177]	32.5% of patients with cognitive impairment or dementia had a LOS >12 days versus 13.5% of the patients without cognitive impairment/dementia		Patients admitted for vascular surgery
UK	2007	Sampson et al. (2009)[120]	11 (median)	7	
USA	2002-2012	Beydoun et al. (2015)[178]	LOS was extended by dementia diagnosis by about 0.80 days on average		No mean given
USA	2000-2012	Lin et al. (2015)[179]	The median LOS was 1 day greater for hospitalizations with dementia		65+
USA	1990-2007	Menendez et al. (2013)[156]	7.9	7.2	
USA	1999-2008	Sherzai et al. (2016)[180]	Young old (60-90): 6.6 Old old (90+): 6.12	5.6 6.04	
USA	1999-2010	Zhu et al. (2015)[115]	Patients with clinically diagnosed dementia had longer hospital LOS (IRR=1.059, 95% CI=[0.998, 1.129]), compared to propensity matched patients without dementia,		

Appendix 1.5. In-hospital interventions

Intervention	Studies
General	• A meta-review of Craven[242], based on 9 reviews, concludes that discharge planning, post-discharge support and nutritional interventions appear to be effective in reducing readmissions. Combined interventions appear to be more effective than isolated interventions. REVIEW INDIRECT • However, another review[220] states that there is a paucity of intervention studies directed at hospitalized cognitively impaired individuals, with dementia or other causes of cognitive impairment. REVIEW INDIRECT
Interventions at the ED	• According to Dewing & Dijk[221], their review on interventions for dementia patients in the acute hospital revealed little evidence to suggest the effectiveness of any multidisciplinary interventions in emergency departments. REVIEW DIRECT • The review of Singh[222] states that evidence suggests (however based on 1 study only) that investing in services for people at an earlier point in the hospital care pathway can improve the well-being of people with dementia and their carers and can prevent crises and unplanned admission to acute hospital beds, in addition to delaying the need for institutional care. However, no effect estimates are presented. REVIEW DIRECT • The review of Lowthian[718] studied ED transitional care communication strategies and concludes based on 5 studies that compared with usual care, the evidence indicates no benefit for ED communication strategies for unplanned ED re-attendance up to 30 days (odds ratio (OR) 1.32, 95% confidence interval (CI) 0.99 - 1.76; n = 1 389), unplanned hospital admission up to 30 days (OR 0.90, 95% CI 0.70 - 1.16; n = 1 389). REVIEW INDIRECT • A review[109] mentions the use of technicians (paid medical student research assistants) to screen for cognitive dysfunction, fall risk, or functional decline in patients older than 65 years presenting to the ED; an evaluation of this indicated that an individual dedicated to screening older adults for geriatric syndromes would benefit overall from clinical care without negatively impacting patient flow. REVIEW INDIRECT • The review of Pinkney[719] points to a study (the Wright-2014 study below) about a triage and early treatment system for elderly patients in London that appeared to reduce avoidable acute hospital admissions. REVIEW INDIRECT • A review of Mccabe[720] points to a trial in which the role of comprehensive geriatric assessment in the ED was evaluated: The Emergency Frailty Unit (EFU) was a designated 8–12 bedded ward area within the main ED with medical input provided by a consultant geriatrician and full multidisciplinary team support. The EFU was shown to be effective at reducing admission rates (relative risk [RR] 0.88, 95% confidence interval [CI] 0.81 - 0.95) and reducing hospital readmissions in people aged 85 years who were discharged from the ED. The McCabe review included another study (the Aldeen study below) in which liaison geriatric assessment in the ED setting has been evaluated: Patients who were assessed by the liaison service had a lower admission rate to hospital than patients who did not (44% vs 60%), with no increased risk of ED revisits. REVIEW INDIRECT • An USA study of Aldeen[721] in which ED nurses were trained in geriatric assessment and care coordination skills; patients were eligible to be seen by those trained nurses if they had an Identification of Seniors At Risk (ISAR) score greater than 2 or at ED clinician request. The admission rate for the patients seen by those trained nurses was 44.9% (95% CI = 40.1 - 49.7), compared with 60.0% (95% CI = 58.8 - 61.2) in the patients that were not seen by those trained nurses (cave, this control group contained both eligible and non eligible patients). To be

	remarked is that 29% of patients were eligible for the intervention, but that only 19% of these eligible patients received it. Moreover, length of stay at the ED was 1.1 hours longer for the patients seen by the trained nurses. COMPARATIVE INDIRECT • The review of the Australian Commission identified a questionnaire based study that concludes that screening older adults for geriatric syndromes at ED would benefit overall from clinical care.[109] NON COMPARATIVE INDIRECT • Medical assessment units for elderly at the ED was the subject of a review by Rushton[722]; they included 18 studies and found that medical assessment units for elderly were reported as contributing positively to streamlining the process of admission and discharge, improving patient flow and reducing lengths of stay and wait times in either the ED or the hospital. REVIEW INDIRECT • The review of Huntley[218] identified 1 study on Geriatric ED versus conventional ED: no difference was found in any of the outcomes (number of admissions, length of stay, number of subsequent ED visits and readmissions at 6 months, activities of daily living at 6 months and mortality at 30 days and 6 months. REVIEW INDIRECT • Schnitker et al.[723] conducted a systematic literature review to identify practices designed to meet the specific care needs of older cognitively impaired patients in emergency departments. They conclude that additional research is needed to identify how to best care for older patients with cognitive impairment in a busy ED setting. REVIEW INDIRECT • Wright[724] studied an emergency admission avoidance system for older people. The intervention combines ED-based early senior doctor review, comprehensive geriatric assessment, therapist assessment and supported discharge, post-discharge supported recovery; and a rapid access 'hot clinic', and was supported by a post-acute care enablement team, providing short-term nursing support immediately post-discharge. The intervention was evaluated through a pre- and post-retrospective cohort study comparing 5,416 emergency geriatric admissions in the 12 months preceding the intervention with the 5,370 emergency geriatric admissions in the 12 months following. The percentage of admissions resulting in same-day discharges increased from 12.26 to 16.23% (OR: 1.386, 95% CI: 1.203 - 1.597, P < 0.001). The median length of stay reduced by 2 days, and mean length of stay by 18.16% (1.78 days, P < 0.001). COMPARATIVE INDIRECT IN CONCLUSION, there is some low indirect evidence that interventions at the ED may reduce hospital admissions and hospital length of stay.
Specialised (dementia) units in the acute hospital	• The Cochrane review of Smith[196] points to a study in which patients with dementia after hip fracture were enrolled in an 'enhanced care model' in the hospital; participants with both mild and moderately severe dementia in the enhanced care model had a shorter median length of stay in hospital than for those in the conventional care group (Mann-Whitney U Test: mild dementia P = 0.002, 1 trial, n = 77; moderate dementia P =0.04, 1 trial, n = 36), but this was no longer the case for people with severe dementia. A second study in this review found no difference between different management strategies in hospital length of stay. The review concludes that there is currently insufficient evidence to draw conclusions about how effective the models of enhanced rehabilitation and care after hip fracture used in these trials are for people with dementia above active usual care. The current evidence base derives from a small number of studies with quality limitations. REVIEW DIRECT • The review of Dewing & Dijk[221] suggest that specialist wards/units can enhance some aspects of the quality of care, reduce adverse consequences of hospitalization but do not significantly impact on reducing length of stay; but neither do they add to it. REVIEW DIRECT • A comparative non-randomised study of Briggs et al.[223] found that there was no significant difference in LOS for patients with dementia when comparing specialized geriatric medicine wards with non geriatric medicine wards overall (28.5±31.4 vs 25.1±38.7, p=0.471), COMPARATIVE DIRECT • Gladman et al[224-226] developed a specialist medical and mental health unit to care for hospitalised patients with dementia and delirium and evaluated the impact of the unit in a RCT. Features of the specialist unit included joint staffing by medical and mental health professionals; enhanced staff training in delirium, dementia, and person centred dementia care; provision of organised purposeful activity; environmental

modification to meet the needs of those with cognitive impairment; delirium prevention; and a proactive and inclusive approach to family carers. The control group consisted of five acute geriatric medical wards and six general (internal) medical wards. 310 patients were recruited from the specialist unit and 290 from the control group. They found that the unit had no significant benefits over usual care in terms of mortality, institutionalisation, mental or functional outcomes, readmission rates or length of hospital stay but there were benefits in terms of patient experience and quality of care and carer satisfaction with care. COMPARATIVE DIRECT

- Gonski et al.[227] created a behavioral unit in an acute aged care service providing specialised management to patients displaying difficult behaviours due to delirium and/or dementia. This unit provided intensive nursing care for patients who are unable to be managed adequately on the general medical wards because of the severity of their behavioral problems. All the patients were provided with care by a multidisciplinary team consisting of a geriatrician and nursing and allied health staff. Forty patients (88.9%) had dementia and of those 21 (46.7%) had superimposed delirium. findings from this study showed no improvement in LOS of the patients when compared with LOS of the dementia patients in general wards reported in other studies. COMPARATIVE DIRECT
- In the study of Rosler[228] patients with a fracture of the proximal femur and dementia (n = 53) who were admitted to the specialised ward (cognitive geriatric unit, CGU), were compared to patients (N= 76) admitted to regular geriatric wards (non-Cognitive Geriatric Unit). The CGU has additional components compared to conventional geriatric treatment: hidden exit doors, increased light in hallways and patient rooms, night-lights, a treatment room on the ward to decrease patient transferral, a living and eating room, and a loop track for wandering patients. The length of stay was longer for patients on the CGU than patients on the non-CGU ward (19.9 ± 4.9 vs.17.7 ± 4.7 days (t(94) = − 2.188, p = 0.031). COMPARATIVE DIRECT
- Stenvall[229] compared a geriatric ward specialized in geriatric orthopedic patients (n=28) versus a specialist orthopedic ward (n=36) for patients with dementia after hip fracture. The intervention consisted of staff education, individualized care planning and rehabilitation, active prevention, detection and treatment of postoperative complications, especially delirium. Mean length of stay was 20.2 in intervention groups vs 32.3 in control, but not statistically different. There was no difference between the groups regarding readmissions within 30 days. COMPARATIVE DIRECT
- The review of Dasgupta[220] concludes that special care units for elderly with cognitive impairment within the acute care setting, run by specially trained staff have been adapted in some centers, but hard outcome data comparing them to a concurrent control group are lacking. REVIEW INDIRECT
- The review of Philp[235], based on 3 reviews and 1 RCT, states that within the hospital setting, there was an evidence for the effectiveness of geriatric assessment units and orthogeriatric units targeting frail older people in reducing the length of stay. REVIEW INDIRECT
- Krams et al.[236] performed a systematic review on Rehabilitation Care after Hip Fracture in Older Patients with Cognitive Impairment. They could include 3 randomized studies showing that duration of hospitalization was shorter in the intervention than control group. REVIEW INDIRECT
- The review of Tarazona[237] that included 86 studies, states that orthogeriatric units improve the quality standards of care of geriatric patients with hip fracture, such as survival and functional recovery rates, thereby also reducing the length of stay and costs. REVIEW INDIRECT
- Gonzalez[238] compared orthogeriatric care versus orthopaedic care with geriatric consultation for patients with a hip fracture (among which 22.5% with severe incognitive impairment) and found that orthogeriatric care lead to 33% less length of hospital stay. COMPARATIVE INDIRECT
- A Spanish observational study[239] found that after introducing an orthogeriatric care unit for patients with a femur fracture (of which 40% with dementia), the length of stay dropped from 16.6 days in 2009 to 13.7 in 2012. COMPARATIVE INDIRECT

	• An RCT[725] on Comprehensive geriatric care for patients (including 13% with dementia) with hip fractures, found the length of stay was significantly longer in the CGA group compared to usual orthopaedic care 912.6 vs 11.0). COMPARATIVE INDIRECT • A large (n>80 000) study[726] from Sweden in patients with a hip fracture (including 17% patients with dementia) found after adjustment for covariates listed geriatric ward hospital admission was associated with an average 14% lower risk of readmission within 30 days of discharge (odds ratio 0.86, 95% CI 0.80-0.91) compared to patients that were admitted to regular hospital wards. On the other hand, compared with patients treated at regular hospitals, those who received care at geriatric ward hospitals had a longer mean LOS (by 2.4 days). COMPARATIVE INDIRECT • Patient-Centered Rehabilitation Model for older persons post-hip fracture repair, including those with cognitive impairment, was studied by McGilton et al.[727]. The intervention concerned an interdisciplinary rehabilitation program that incorporates education for healthcare professionals (HCPs), including nurses, which is focused on geriatric care including management of dementia and delirium, support for HCPs from an Advanced Practice Nurse, and family support and education. One hundred forty-nine patients aged 65 and older participated as patients in the usual care (76) or intervention (73) groups; 30% had impairment cognition (MMSE >= 24). Primary outcome, mobility, did not differ between groups. No clear results are presented with regard to hospital use. COMPARATIVE INDIRECT • Watne[728] compared in a randomized trial orthogeriatric care integrated in the acute geriatric ward (n=163) to usual care in the orthopaedic ward (n=166) in patients admitted acutely to the hospital with a hip fracture; 50% of patients in both groups had dementia. The median length of stay was three days longer in the intervention group (median eleven versus eight days, P ≤0.001). Number of readmissions at 4 and 12 months did not differ. COMPARATIVE INDIRECT • The geriatric monitoring unit (GMU)[729] is a specialised 5-bed unit for the care of delirious older adults within an acute tertiary hospital; of the 122 patients with delirium who were admitted to the GMU over a 1-year period, 82 (67.2%) had underlying dementia. The demented group was compared to the non-demented group: there was no difference in duration of delirium or length of total hospital stay. The overall length of hospital stay, averaging 17.0 days, compared favorably with a pre-GMU cohort. COMPARATIVE INDIRECT
Liaison psychiatry and geriatric liaison in the acute hospital	• The review of Singh[222] concludes that active psychiatry liaison intervention in older people with hip fracture has been shown to reduce length of stay and provide substantial cost savings; however this was based on a single study from 1991. REVIEW DIRECT • The review of Dewing & Dijk[221] states that the role of the specialist nurse or liaison service is poorly documented and few recent published evaluations could be found; overall, these roles remain poorly evaluated and a more rigorous evidence base is needed to support any longer term development of specialist and in-reach roles. REVIEW DIRECT • Deschodt et al.[730] performed a review on geriatric liaison services in the acute hospital; they included 12 studies and conclude that inpatient geriatric consultation team interventions have a significant impact on mortality rate at 6 and 8 months postdischarge, but have no significant impact on functional status, readmission or length of stay. REVIEW INDIRECT • The Rapid Assessment, Interface and Discharge (RAID)[222, 731] service provides a new model of liaison psychiatry in hospital that delivers a rapid response, 24-hour, 7 days a week, age-inclusive service and comprehensive range of mental health specialties, including old age, working age, postnatal mental health and substance misuse. The service aims at a 1-hour target for assessing patients who present to ED and a 24-hour target for assessing patients on all wards, and is available to any patient aged 16 years or over. They compared the RAID group (N=886; older people formed one-third of the referrals and 22% had dementia) consisting of all emergency admissions with a mental health diagnosis that were referred to and managed by the RAID team to the simultaneous group (N=2 654) consisting of all emergency admissions with a mental health diagnosis that were not referred to RAID and to a historical group (N=2 873) before RAID was started. The mean length of stay was 9.4 days for the RAID group compared with 5.2 days for simultaneous control group and 10.3 days for the

	historical controls. The RAID intervention decreased the hazard of readmission by 60% from the simultaneous control group and by 65% from the historical group. COMPARATIVE INDIRECT • A nurse led comprehensive delirium management programme for older acute care patients with cognitive impairment was studied by Hasemann et al.[732]. A total of 268 patients with cognitive impairment participated in the pre/post comparison study. The intervention and treatment as usual groups consisted of 138 and 130 patients, respectively. Of the 130 patients in the usual care group, 43 (33.1%) became delirious during their hospital stay. In the intervention group, the delirium incidence was lower but not significantly (P = 0.896), with a reduction rate of 3.6%, resulting in 44 (31.9%) delirious patients. The mean LOS in the intervention group (9.7) was not statistically different from the LOS (10.3) in the control group.
Comprehensive geriatric assessment	• A meta-review[224] identified 3 meta-analyses that reported evidence in favour of CGA for frail older patients in acute hospital (not clear what type of favourite outcomes). However, in a subsequent review of primary studies there was no clear evidence of benefit for CGA interventions in terms of mortality or readmissions (RR 0.95, 95% CI 0.83 to 1.08) or for subsequent institutionalisation, functional ability, quality of life or cognition. REVIEW INDIRECT • The review of Wang[733] included 15 studies on comprehensive geriatric care for elderly patients with hip fracture. They found no significant difference on in-patients mortality, follow-up mortality and length of stay between both groups. REVIEW INDIRECT
Case management in hospitals	• An Australian review[109] concludes that there is little evidence regarding the effectiveness of case management in hospitals. REVIEW INDIRECT • Another review[240] based on 2 previous reviews confirms that there was weak evidence pointing to a potential beneficial impact on length of stay and readmissions of multidisciplinary hospital-initiated nurse-led case management for older people. REVIEW INDIRECT
Function focused care	• The family-centered, function-focused care intervention[230] was tested in dyads of hospitalized, medical patients with dementia and family caregivers. This study utilized a comparative repeated measures design and was implemented on five medical units of two hospitals (in total 2 intervention units and 3 control units); 88 dyads were enrolled, 44 on the intervention units and 44 on the control units. The average hospital length of stay did not differ significantly between the intervention group (4.0 ± 2.1) and the control group (4.4 ± 2.0). There was a modest treatment effect upon the number of 30-day hospital readmissions, which was lower in the treatment group as compared with the control group ($\chi 2 = 5.8$; $p = 0.02$). COMPARATIVE DIRECT
Transitional care	• Ray et al.[231] reviewed the literature concerning transitions in care for patients with dementia; they conclude that there is a dearth of evidence as to the impact of intervention approaches in this population, and the intervention studies reviewed focused rather narrowly on rehospitalization rates and had inconsistent findings. REVIEW DIRECT • Part of the review of Dawson[190] is related to short-term services to support people to return home following hospital stays, called intermediate or transitional care; they found no direct research evidence. REVIEW DIRECT • The review of Allen[734], based on 12 trials state that results indicate that, except for general practitioner and practice nurse interventions, transitional care for older persons (not clear how many patients with dementia were included in the studies) delayed and prevented early re-hospitalization. Outcome data in relation to length of stay were inconclusive. REVIEW INDIRECT • Fleming[735] tested a *transitional care intervention* consisting of the use of a Care Transitions Coordinator, early engagement of the patient, caregiver, and family with condition-specific coaching, careful medication management; and physician engagement with scheduling and reminders of physician visits early in the transition process. The care transitions initiative was tested in three large, academic institutions in the northeast and southeast of the United States for 12 months. The 12-month average readmission rate (as calculated month by month)

	in the last 6 months of the study decreased from 17% to 12%. (Not clear how many patients with dementia were involved/ only pre-post study). COMPARATIVE INDIRECT • Gladman et al.[224] studied an '*interface geriatrician intervention'*: community geriatricians went to the hospital to see higher-risk older patients (identified using the ISAR tool) who had been randomised to the intervention and who were to be imminently discharged. Of 1 001 eligible patients, 433 were recruited: 217 in the control group and 216 in the intervention group. The primary outcome was the number of days spent at home (for those admitted from home) or the number of days spent in the same care home (if admitted from a care home). Secondary outcomes included mortality, institutionalisation, hospital resource use and scaled outcome measures (including quality of life, disability and mental well-being). There were no significant differences in any of the outcomes. COMPARATIVE INDIRECT • Naylor et al.[736] report the effects of three evidence-based interventions of varying intensity, each designed to improve outcomes of hospitalized cognitively impaired older adults. In the period 2006-2008 202 older adults with cognitive impairment (assessed within 24h of index hospitalization) were enrolled at one of three hospitals within an academic health system. Each hospital was randomly assigned one of the following interventions: Augmented Standard Care (ASC; lower dose: n = 65), Resource Nurse Care (RNC; medium dose: n = 71) or the Transitional Care Model (TCM; higher dose: n = 66). The TCM protocol consisted of hospital and home visits, at least one physician follow-up visit, telephone outreach and 7 days a week availability; the intervention supplemented care of hospitalized patients and substituted for skilled RN home care. The TCM group demonstrated lower mean rehospitalization rates per patient compared with the RNC ($p < 0.001$) and ASC groups at 30 days. At 90-day postindex hospitalization, the TCM group continued to demonstrate lower mean rehospitalization rates per patient only when compared with the ASC group. A second article of Naylor [737] reports on the same intervention but now for the period 2008-2010 in the same hospitals. Now 205 additional patients with cognitive impairment (in the total sample phase 1 and phase 2, 18% had a confirmed diagnosis of dementia) were included. Rates for total all-cause rehospitalizations and days were significantly reduced in the TCM versus ASC group ($p < 0.001$, both). COMPARATIVE INDIRECT • Transitional care unit in the hospital (TCU)[738] is an inpatient unit designed to provide an elderly friendly, geriatric rehabilitation-style environment and intended for elderly patients that were hospitalized for acute illness, and in for whom recovery is delayed or more supports are needed before discharge (these patients are categorized as requiring an alternate level of care (ALC)). Of the 86 of these 'ALC' patients in the postintervention group, 57 (66%) were transferred to the TCU. The 57 receiving TCU were compared to the 29 that were not admitted to the TCU and received standard care and to 49 ALC patients in a preintervention group. 50% of patients suffered from dementia. Length of stay reduction occurred among the postintervention group during the acute portion of the hospital stay (14.0 days postintervention group vs 22.5 days preintervention group; $P < .01$); however no differences existed in length of stay after the acute portion nor in total length of stay. COMPARATIVE INDIRECT
Discharge planning **Discharge planning is the process of identifying and preparing for the patient's anticipated healthcare needs on discharge from an inpatient facility**	• Dawson et al.[190] conclude that direct evidence was limited. REVIEW DIRECT • A qualitative review[739] found that the case for beginning discharge planning on admission to hospital for patients with dementia is generally regarded leading to a reduction in readmission rates, but this was not underbuilt with facts. QUALITATIVE REVIEW DIRECT • A before after UK study[232] with a dedicated discharge planner found that average length of stay was reduced by 1.9 days per person and 26% reduction in re-attendances to ED. COMPARATIVE DIRECT • The Cochrane review of Goncalves[241], based on 30 studies, states that a discharge plan tailored to the individual patient probably brings about a small reduction in hospital length of stay (mean difference − 0.73 days) and reduces the risk of readmission to hospital at three months follow-up for older people with a medical condition. However, patients with dementia were often excluded in the included trials. REVIEW INDIRECT

	• The review of Craven[242] targeted at frail older people states, based on an earlier version of the Cochrane review of Goncalves and an additional RCT, states that evidence suggests that structured and tailored discharge planning is associated with reduced readmission rates. REVIEW INDIRECT • The review of Miani[240] based on 1 earlier review and 3 primary studies, found conflicting evidence about the effect of discharge planning (not specific for patients with dementia) on length of stay and readmissions. REVIEW INDIRECT • The meta-review of Philp[235] concludes that there was evidence of effectiveness of discharge planning in reducing length of stay and preventing readmission to hospital; however it is not clear what exact effect-sizes are and to what extent patients with dementia were in the underlying reviews and trials. REVIEW INDIRECT • The meta-review of Kansagara[243] found that among 10 reviews of mixed patient populations, there was consistent evidence that enhanced discharge planning and hospital-at-home interventions reduced readmissions There is moderate-strength evidence that structured and individually tailored discharge planning reduces readmissions within 90 days (relative risk [RR]: 0.82, 95% confidence interval [CI]: 0.73 to 0.92) and hospital length of stay (20.91 days, 95% CI: 21.55 to 20.27) Successful interventions are comprehensive, extend beyond hospital stay, and have the flexibility to respond to individual patient needs. The strength of evidence should be considered low because of heterogeneity in the interventions studied, patient populations, clinical settings, and implementation strategies. REVIEW INDIRECT • The meta-review of Damery et al.[244] included 15 reviews on discharge management. Six reviews reported significant reductions in readmission rates for patients with heart failure, COPD and general chronic diseases; reductions ranged from 15% to 66%. In contrast, discharge management for patients who had stroke was notably ineffective in reducing readmission rates although LOS reduced by 7.7 days in one stroke review. REVIEW INDIRECT • Mabire[245] found that nurse discharge planning did not significantly reduce hospital readmission rate and the overall effect score for length of stay was significant (weighted mean difference = 0.29, P < 0.01), suggesting that discharge planning increased the length of hospitalization. REVIEW INDIRECT
Integrated care interventions	• Damery et al.[244] performed an umbrella review to summarise the evidence regarding the effectiveness of integrated care interventions for adult patients with one or more chronic diseases (including dementia) in reducing hospital activity; interventions must have delivered care crossing the boundary between at least two health and/ or social care settings. They could include 50 reviews studying interventions focused on case management (n=8), chronic care model (CCM) (n=9), discharge management (n=15), complex interventions (n=3), multidisciplinary teams (MDT) (n=10) and self-management (n=5). They conclude that although all outcomes showed some significant reductions, and a number of potentially effective interventions were found, interventions rarely demonstrated unequivocally positive effects. REVIEW INDIRECT
Screening in the hospital	• The Australian review[109] concludes that there is very limited evidence regarding whether improved detection of cognitive impairment in patients results in improved processes of care or patient outcomes. REVIEW INDIRECT
Training	• The Australian review[109] concludes that although there is a great deal of evidence to indicate that staff working in acute hospitals are not adequately trained in dementia care, there is very limited research evidence to indicate that dementia education and training for staff improves the quality of care provided to patients or improves patient outcomes. REVIEW DIRECT • This is confirmed by another review[233] that included 14 studies; they conclude that the majority of the studies mainly evaluated learning, with few studies evaluating changes in staff behaviour/practices and patients' outcomes. REVIEW DIRECT • The review of Dewing & Dijk[221] state that the value and the outcomes of dementia training programs are usually not formally evaluated or published. REVIEW DIRECT

Specialist nurses	• A review on specialist (dementia) nurse identified[234] only 1 trial; they conclude that direct evidence for the effectiveness of these roles is lacking but that a number of areas were identified in which a nurse specialist role could make a contribution, including preventing adverse events and improving patient experiences and outcomes. REVIEW DIRECT
Other interventions	• The review of Dewing & Dijk[221] points to a study that used volunteers to provide person-centred support for people with dementia in an acute hospital; no significant differences were found in patient outcomes (including length of stay, falls, use of antipsychotic drugs and death rates) between the intervention and control hospitals. REVIEW DIRECT • A before after study[740] tested the effect of physical restraint reduction in older patients; in the subsample of cognitively impaired patients, the average LOS decreased significantly from 23.0 days in 2007 to 17.8 days in 2009 ($P < .001$). COMPARATIVE INDIRECT

APPENDIX 2. APPENDIX TO CHAPTER 3

Appendix 2.1. Specialised services commissioned by NHS England (Year 2015-2016)

- Adult ataxia telangiectasia services
- Adult congenital heart disease services
- Adult highly specialist oesophageal gastric services in the form of gastro-electrical stimulation for
- patients with intractable gastroparesis Adult highly specialist pain management services
- Adult highly specialist respiratory services
- Adult highly specialist rheumatology services
- Adult secure mental health services
- Adult specialist cardiac services
- Adult specialist eating disorder services
- Adult specialist endocrinology services
- Adult specialist neurosciences services
- Adult specialist ophthalmology services
- Adult specialist orthopaedic services
- Adult specialist pulmonary hypertension services
- Adult specialist renal services
- Adult specialist services for patients infected with HIV
- Adult specialist vascular services
- Adult thoracic surgery services
- Alkaptonuria service
- Alström syndrome service
- Ataxia telangiectasia service for children
- Atypical haemolytic uraemic syndrome services
- Autoimmune paediatric gut syndromes service
- Autologous intestinal reconstruction service for adults
- Bardet-Biedl syndrome service
- Barth syndrome service
- Beckwith-Wiedemann syndrome with macroglossia service
- Behcet's syndrome service
- Bladder exstrophy service
- Blood and marrow transplantation services
- Bone conduction hearing implant services Breast radiotherapy injury rehabilitation service
- Child and adolescent mental health services – Tier 4
- Choriocarcinoma service
- Chronic pulmonary aspergillosis service
- Cleft lip and palate services
- Cochlear implantation services
- Complex childhood osteogenesis imperfecta service
- Complex Ehlers Danlos syndrome service
- Complex neurofibromatosis type 1 service
- Complex spinal surgery services
- Complex tracheal disease service
- Congenital hyperinsulinism service

- Craniofacial service
- Cryopyrin associated periodic syndrome service
- Cystic fibrosis services
- Diagnostic service for amyloidosis
- Diagnostic service for primary ciliary dyskinesia
- Diagnostic service for rare neuromuscular disorders
- Encapsulating peritoneal sclerosis treatment service
- Epidermolysis bullosa service
- Extra corporeal membrane oxygenation service for adults
- Extra corporeal membrane oxygenation service for neonates, infants and children with
- respiratory failure
- Ex-vivo partial nephrectomy service
- Fetal medicine services
- Gender identity development service for children
- and adolescents
- Gender identity disorder services
- Hand transplantation for adults
- Heart and lung transplantation service
- Highly specialist adult gynaecological surgery and urinary surgery services for women
- Highly specialist adult urological surgery services for men
- Highly specialist allergy services
- Highly specialist dermatology services
- Highly specialist metabolic disorder services
- Highly specialist pain management services for
- children and young people
- Highly specialist palliative care services for children and young people
- Highly specialist services for adults with infectious diseases
- Hyperbaric oxygen treatment services
- Insulin-resistant diabetes service
- Islet transplantation service
- Liver transplantation service
- Lymphangioleiomyomatosis service
- Lysosomal storage disorder service
- Major trauma services
- McArdle's disease service
- Mental health service for deaf children and adolescents
- Neurofibromatosis type 2 service
- Neuromyelitis optica service
- Neuropsychiatry services
- Ocular oncology service
- Ophthalmic pathology service
- Osteo-odonto-keratoprosthesis service for corneal blindness
- Paediatric and perinatal post mortem services
- Paediatric cardiac services
- Paediatric intestinal pseudo-obstructive disorders service

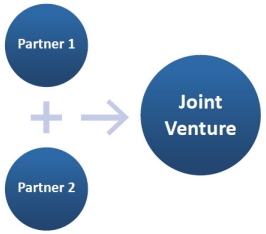
- Pancreas transplantation service
- Paroxysmal nocturnal haemoglobinuria service
- Positron Emission Tomography-Computed Tomography services
- Primary ciliary dyskinesia management service
- Primary malignant bone tumours service
- Proton beam therapy service
- Pseudomyxoma peritonei service
- Pulmonary hypertension service for children
- Pulmonary thromboendarterectomy service
- Radiotherapy services
- Rare mitochondrial disorders service
- Reconstructive surgery service for adolescents with congenital malformation of the female genital tract
- Retinoblastoma service
- Secure forensic mental health service for young people
- Severe acute porphyria service
- Severe combined immunodeficiency and related disorders service
- Severe intestinal failure service
- Severe obsessive compulsive disorder and body dysmorphic disorder service
- Small bowel transplantation service
- Specialist burn care services
- Specialist cancer services
- Specialist cancer services for children and young people
- Specialist colorectal surgery services Specialist dentistry services for children and young people
- Specialist ear, nose and throat services for children and young people
- Specialist endocrinology and diabetes services for children and young people
- Specialist gastroenterology, hepatology and nutritional support services for children and young people
- Specialist genetic services Specialist gynaecology services for children and young people
- Specialist haematology services for children and young people
- Specialist haemoglobinopathy services
- Specialist immunology services for adults with deficient immune systems
- Specialist immunology services for children with deficient immune systems
- Specialist mental health services for deaf adults
- Specialist morbid obesity services
- Specialist neonatal care services
- Specialist neuroscience services for children and young people
- Specialist ophthalmology services for children and young people
- Specialist orthopaedic surgery services for children and young people
- Specialist paediatric intensive care services
- Specialist paediatric liver disease service
- Specialist perinatal mental health services
- Specialist plastic surgery services for children and young people

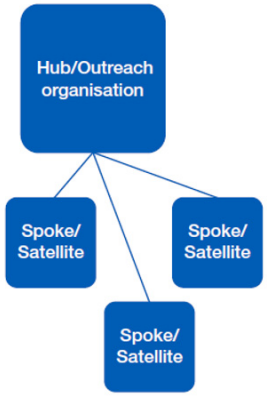
- Specialist rehabilitation services for patients with highly complex needs
- Specialist renal services for children and young people
- Specialist respiratory services for children and young people
- Specialist rheumatology services for children and young people
- Specialist services for children and young people with infectious diseases
- Specialist services for complex liver, biliary and pancreatic diseases in adults
- Specialist services for haemophilia and other related bleeding disorders
- Specialist services for severe personality disorder in adults
- Specialist services to support patients with complex physical disabilities 'excluding wheelchair services'
- Specialist surgery for children and young people
- Specialist urology services for children and young people
- Spinal cord injury services
- Stem cell transplantation service for juvenile idiopathic arthritis and related connective tissue disorders
- Stickler syndrome diagnostic service
- Vein of Galen malformation service
- Veterans' post-traumatic stress disorder programme
- Wolfram syndrome service
- Xerodermatic pigmentosum service

Appendix 2.2. Characteristics of the models studied in the Dalton review

Table A. 1 – Different organisational forms and their potential applications

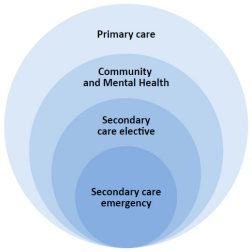
Definition/ key characteristics	Schematic presentation	Potential applications and examples	Potential benefits	Governance	Potential barriers
Collaborative: voluntary pooling of resources of organisations to improve financial/patient outcomes, while retaining their original legal entity					
		FEDERATION			
• Collaboration on 1 or more services or back office provisions • Organisation sovereignty retained • Legal agreement not required • Best practice: Memorandum of Understanding (MoU) specifying that one organisation leads the governance, quality and finance • Extremely flexible. • Lack of structural integration and thus no fear of being subsumed in a larger group		• Back office functions and performance improvement activities: geographically not limited • Sharing clinical resources: limited to regional and contiguous • Unlikely to be a suitable response to serious financial difficulties • Unlikely to be a vehicle to create multi-service organisations given the lack of legal structure but fertile ground for service-level innovation Examples (increasing degree of collaboration): ○ Support services: procurement partnership; ○ Performance improvement activities: performance benchmarking and standardised care pathways. ○ Clinical services/resources: telemedicine (e.g. consultant on call via	• Improve outcomes and operational efficiency by sharing best practices and alignment of patient pathways Economies of scale by sharing clinical resources/expertise and back office functions	• Partnership Board: ○ Formality level depends on collaboration type ○ Board with representatives from partner organisations ○ Headed by CEO (lead organisation or rotating system) ○ Defines strategic goals • Member organisations: ○ No change and no loss of sovereignty	• Consensus decision making process to maintain organisational sovereignty → significant strategic changes are difficult

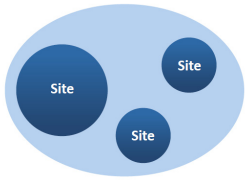
Definition/ key characteristics	Schematic presentation	Potential applications and examples	Potential benefits	Governance	Potential barriers
		skype) or consolidating specialisms			
JOINT VENTURE (JV)					
Two or more organisations pool their sovereignty in a: • Corporate JV involves a new legal entity to manage a particular service line with shared risk. Financial and clinical business JV is separated from that of each partner. JV can do its own strategic planning • Contractual JV to create a shared services agreement with another organisation In contractual arrangements one trust takes the lead responsibility for governance, quality, performance and finance reporting. All risk born by host association. JV typically have a narrow focus (1 service line).		• Densely populated areas where activity can be consolidated without significantly impairing patient access to services • Deployed where critical mass enables the more effective delivery of clinical standards or performance targets • Could be used to create a hub for developing specialist expertise that could give rise to a service-level chain Contractual JV sometimes used to pool resources to bid for the award of a contract Examples: ○ Pathology: Viapath (JV in London to drive innovation of pathology services) ○ Technology services: UCLH imaging services ○ Elective surgery: elective orthopaedics centre (e.g. standardised pathway; innovative thinking and process redesign; joint procurement prosthetic contracts) ○ Property services	• Access to partners' skills and expertise of others to improve your own services • Shared risks borne by JV (corporate JV) separated from partners • Greater ownership (e.g. by reinvesting surplus directly into new equipment and innovation) • Economies of scale • Eliminate diseconomies of scope in trusts unable to generate sufficient volumes: pooling of the clinical workforce to meet the quality staffing standards 24/7	A Partnership Board (lead organisation or equals), consisting of representatives of each of the partners, exercises strategic leadership *Corporate JV:* • Formalised governance structure with own business plan *Contractual JV:* • Risks not evenly spread (e.g. not meeting time-to-treatment targets from all sites borne by host site) • Confusion about accountability • Lack of reinvestment surplus in JV (distributed across all sites) • Lack of control on staff different sites (e.g. implications surgery schedule) • Importance of exit arrangements (e.g. trigger mechanisms: financial or clinical points at which partners are obliged whether exit should take place)	Lack of expertise in contractual negotiations may require expensive external advice

Definition/ key characteristics	Schematic presentation	Potential applications and examples	Potential benefits	Governance	Potential barriers
		○ Research and education			
Contractual: formalised agreements often with agreed performance and quality standards					
		SERVICE LEVEL CHAIN			
• One provider provides services for other providers • Host and outreach provider maintain sovereignty • May share equipment and premises but rarely staff • Typically 1 specialism • Time-bound arrangements with control being temporarily transferred to another organisation • Several possible ways, e.g.: ○ Host provider outsourcing services to the service level provider ○ Service level agreement (SLA) where the host organisation holds the service level provider accountable for delivery ○ Paying a fee to use the policies and protocols of the first provider	 	• To transform poor clinical and/or financial performance • Not suitable in case of fundamentally unsustainable organisations • Most suitable for stand-alone specialisms, ambulatory care and certain imaging-heavy specialities that can be delivered remotely • Suitable for advanced medical imaging: technicians can be used to take images (e.g. glaucoma, stroke imaging), remote technology could be used to send the images to the hub for consultants to view, deliver care instructions and ask the patient to attend the hub if needed • Successful examples: ophthalmology and cancer services. Individual organisations unable to keep pace with technological advancements (e.g. Moorfields eye hospital operates a networked model across 23 locations)	Benefits host organisation: • Access to intangible assets (e.g. care pathways; expertise, financial control process) • Allow to focus on core site functions • Association with a specialist brand • Economies of scope if increasing the amount of services provided Benefits to outreach organisation: • Spreads own brand • Income creation. • Potential economies of scale and scope •	• Organisation of the chain is centralised to the hub • Led by the Trust Board of the hub/outreach organisation • Hub sets and enforces standards, the spoke, operates as a delivery centre that can be scaled up or down as based on business needs • Clinical audit units of a chain operate at the overarching corporate structure and are not located in operating units • Cultural fit and quality of the working relationships required to obtain success	• Geographical distances can make quality and performance management more difficult as smaller scale means decentralised management structure less viable. • Transition from single site centre to a hub and spoke form can be complex • Potential brand reputation damage if associated with bad practices at host or by outreach organisations

Definition/ key characteristics	Schematic presentation	Potential applications and examples	Potential benefits	Governance	Potential barriers
MANAGEMENT CONTRACT					
• Some or all management control of the operations of an organisation is awarded to another organisation to manage for an agreed duration • Flexible • Time-bound arrangements with control being temporarily transferred to another organisation with sufficient management expertise		• To transform poor clinical and/or financial performance through change of control of some or all of the organisation's assets: successful organisations takes control of less successful one • Making use of management expertise other organisation • Not suitable where organisations are fundamentally unsustainable without major service reconfiguration in the local health economy • May address capacity or capability issues to allow focus on core site functions, or offer method of expansion through partnership with property or operating company	• Possibly some economies of scale • Standardised practices could be brought across wholesale from the organisation that is managing the contract • Sharing back office functions (e.g. procurement and operational and clinical policies and procedures) • Access to previously unavailable expertise providing financial control, standardised processes, some consolidation of non-clinical functions • Incentives for contractor may be management fee or profit share arrangement (or combination)	• In case of wider issues (e.g. site not financially viable in its current form), contractual constraints will not allow for significant enough change to alter this	• Difficult to establish and maintain appropriate governance and accountability

Consolidation: change of ownership occurs and organisations come together to form a new organisation potentially delivering different services than previously

Definition/ key characteristics	Schematic presentation	Potential applications and examples	Potential benefits	Governance	Potential barriers
INTEGRATED CARE ORGANISATION					
• Joins some or all of the acute, community, primary care, social care and mental health services in a variety of forms • Managing patients from a particular population through care pathways supported by shared data, IT and information systems • Risk-adjusted capitation based budgets • Type of Primary and Acute Care System • Whole care pathway is controlled by a single provider (formal or virtual via a network/alliance) • The commissioner enters into a contract with one organisation and that organisation sub-contracts with other providers to deliver care along the pathway		• Defined local populations: high-volume, -intensity users • Secondary care led ➔ hospitals operate in new areas and can balance investment in community-based with a divestment in hospital-based care (without financial risk) • Different types varying from loosely to fully integrated (NHS attempts to move to the latter): ○ *Independent practice association*: independent physician practices working together in contracting with health insurers ○ *Physician hospital organisation*: contract with health insurers to deliver care for defined population (not so formal agreements) ○ *Multi*-specialty group practices: umbrella organisation of specialists (most strong link to hospital) ○ *Integrated delivery services*: Own hospitals and other providers with own health plan	• International examples have demonstrated improved patient outcomes and cost saving. • A single provider responsible for the entire care pathway simplifies care provision • Incentives to: provide care in most appropriate setting, focus on prevention and maintaining health, aligned patient flow. • Unlikely to be suitable response to short to medium-term financial issues given longer period to realise return as 'integration costs before it pays'	• ACOs consist of providers from separate legal entities that are committed to work together for a minimum number of years and cover a defined populations • ICOs do not have to be separate legal entities. They follow the ACO structural form or more loosely configured alliances • Contracts in order of increasing degree of organisational alignment ○ Independent provider contracts ○ Alliance contract ○ Lead contract ○ Integrated providers ○ Fully integrated system (Same entity both pays and delivers care)	• In the short term integration usually requires investment and may see ROI only in the longer term and length of contract duration needs to be longer than the current three years for this to be worthwhile • Accurate data on patient flows, pricing and outcomes is required and is difficult to align IT and information systems to gather this reliably • Action and agreement on the commissioner side is required to enable these forms to emerge more widely and effectively

Definition/ key characteristics	Schematic presentation	Potential applications and examples	Potential benefits	Governance	Potential barriers
MULTI-SITE TRUST					
• Merger of ≥2 organisations • New organisation or one organisation acquiring the other one(s) • Contiguous, clustered in a single geography		• Exists in all geographical circumstances • May not be clinically and financially sustainable in some areas without significant service change and/or diversification • Expansion largely relies on ability to consolidate services, having demonstrated patient benefits, may be better suited to urban and suburban areas • Most prevalent option in the NHS, the status quo • NHS mergers in the past were not so successful but better results appeared in cases where high-performing trusts acquired less performing trusts	• Possible economies of scale through service rationalisation and unified and support functions. Yet, economies of scale may already have been realised (NHS England already characterised by large hospitals) • Ability to move staff between sites to meet changing demand and share expertise	• Several configurations possible but strong hospital and clinical directors (not too remote from the individual sites) are important • Mostly centralised leadership with a single executive team providing strategic and operational leadership • In case of very large, multiple site trusts a group governance structure is indicated, such as the 'parent company' approach: Board of the parent company sets broad group strategy while individual companies of the group direct and control their own business	• Normal barriers to acquisition and accompanying service change, i.e. consumes significant management energy • Change of ownership may fall with in competition regime, not as restrictive as perceived but need robust demonstration of patient benefits
MULTI-SERVICE CHAIN OR FOUNDATION GROUP					
• Single operation with individual sites operating within a framework of delegated responsibility • Deliver services to multiple populations, not geographically defined		• All geographical circumstances including non-contiguous configurations • Dependent on the ability of the group to replicate operational practices/standards on new sites and having the necessary capability and	• Improved quality and operational efficiency in new sites by standardisation and replication of proven operating frameworks, procedures and	• Distinct to a large merged organisation <-> separate 'group' headquarters set the strategic and sites the operational leadership • Board at the HQ to be detached from being the board of the primary organisation so that the	• Normal barriers to acquisition, i.e. consumes significant management energy • Plus need to replicate the operating framework,

Definition/ key characteristics	Schematic presentation	Potential applications and examples	Potential benefits	Governance	Potential barriers
• Headquarters set strategic goals and individual sites keep operational autonomy		capacity to run services on distant sites • May be better suited than multi-site trust to acquiring new sites with limited potential for service rationalisation • Probably less suitable for acquiring sites with significant financial problems	policies developed on existing sites • Potential economies of scope through greater focus on operational management • May be possible for foundation groups to operate in situations that would be unsustainable for some standalone providers	HQ board could give equal consideration to all of the subsidiaries • Feedback loops to encourage continuous improvement and rapid systematisation of innovation (sites identifying and HQ spreading innovation) • Matrix: Individual sites have an executive team with CNO, CMO, etc. managerially accountable to site director but professional accountable to relevant head of the group	procedures and protocols on other sites and be able to undertake the cultural change required to integrate new acquisitions • Geographical distance means effective decentralised management structures

Source: Dalton review[302]

APPENDIX 3. APPENDIX TO CHAPTER 7

Table A. 2 – Current RIZIV – INAMI reimbursement codes

Process		Description	Nomenclature code
TREATMENTS DELIVERY	Cat I: Simple EBRT (palliative treatments or standard curative EBRT with less than 11 fractions)	EBRT simple cat 1	444113
		EBRT simple cat 1 (during hospital stay)	444124
	Cat II: Standard EBRT with standard fractionation	EBRT medium cat 2	444135
		EBRT medium cat 2 (during hospital stay)	444146
	Cat III: Tridimensional standard EBRT	EBRT complex cat 3	444150
		EBRT complex cat 3 (during hospital stay)	444161
	Cat IV: Complex EBRT (IMRT, TBI, stereotactic treatments)	EBRT complex cat 4 (TBI-RS-…)	444172
		EBRT complex cat 4 (TBI-RS-…) (during hospital stay)	444183
	Category XI	superficial radiotherapy with electrons	444194
		superficial radiotherapy with electrons (during hospital stay)	444205
	Category VIII: Brachytherapy alone	brachytherapy higher reimbursement	444216
		brachytherapy higher reimbursement (during hospital stay)	444220
	Category IX	skin radiotherapy by brachytherapy	444231
		skin radiotherapy by brachytherapy (during hospital stay)	444242
	Category VII: palliative brachytherapy	brachytherapy lower reimbursement	444253
		brachytherapy lower reimbursement (during hospital stay)	444264
	Category V: All other	brachytherapy higher reimbursement, combined with external treatment	444290
		brachytherapy higher reimbursement, combined with external treatment (during hospital stay)	444301
	Category VI:	brachytherapy lower reimbursement, combined with external treatment	444312
		brachytherapy lower reimbursement, combined with external treatment (during hospital stay)	444323
	Category XI	superficial radiotherapy with (low energy) photons	444334
		superficial radiotherapy with (low energy) photons (during hospital stay)	444345

TREATMENT PREPARATION		simulation for cat 1-8	444356
		simulation for cat 1-8 (during hospital stay)	444360
		second simulation for cat 2-8	444371
		second simulation for cat 2-8 (during hospital stay)	444382
		treatment planning for cat 1-8	444393
		treatment planning for cat 1-8 (during hospital stay)	444404
		second treatment planning for cat 2-8	444415
		second treatment planning for cat 2-8 (during hospital stay)	444426
		3D treatment planning supplement for cat 3-6	444430
		3D treatment planning supplement for cat 3-6 (during hospital stay)	444441
		IMRT treatment planning supplement for cat 3-6	444452
		IMRT treatment planning supplement for cat 3-6 (during hospital stay)	444463
QA and SUPPLEMENTS		portal image by film for cat 1-6, max 4x per treatment series	444474
		portal image by film for cat 1-6, max 4x per treatment series (during hospital stay)	444485
		EPI for cat 1-6, max 4x per treatment series	444496
		EPI for cat 1-6, max 4x per treatment series (during hospital stay)	444500
		in vivo dosimetry, max 4x per treatment series	444511
		in vivo dosimetry, max 4x per treatment series (during hospital stay)	444522
		supplement for use of MLC	444533
		supplement for use of MLC (during hospital stay)	444544
		supplement for use of brachytherapy afterloader	444555
		supplement for use of brachytherapy afterloader (during hospital stay)	444566
		supplement for individual fixation system cat 1-6	444570
		supplement for individual fixation system cat 1-6 (during hospital stay)	444581
		supplement for the use of blocks (if no MLC used)	444592
		supplement for the use of blocks (if no MLC used, during hospital stay)	444603

Table A. 3 – Incidence (2014) and incidence trends (2004-2014) by sex, tumour type and subcategory (stage where applicable), Belgium

	Males						Females					
	2014			2004-2014			2014			2004-2014		
Tumour	Nobs	CR	WSR	AAPC	95 % Confidence Interval	p-Value	Nobs	CR	WSR	AAPC	95 % Confidence Interval	p-Value
Bladder	**1°909**	**34.9**	**15.8**	**-0.6**	**[-0.9, -0.2]**	**0.0037**	**508**	**8.9**	**3.1**	**0.6**	**[-0.7, 1.9]**	**0.3239**
combStage I	879	16.1	7.3	2.8	[2.1, 3.5]	<.0001	219	3.9	1.4	3.8	[1.7, 6.0]	0.0030
combStage II	538	9.8	4.3	1.0	[-0.2, 2.2]	0.0984	148	2.6	0.7	0.4	[-2.3, 3.2]	0.7428
combStage III	183	3.3	1.5	-1.0	[-3.4, 1.4]	0.3648	45	0.8	0.3	0.7	[-3.5, 5.1]	0.7187
combStage IV	203	3.7	1.8	1.9	[-0.7, 4.6]	0.1431	67	1.2	0.5	3.3	[-0.1, 6.8]	0.0574
combStage 0,is	11	0.2	0.1	-	-	-	2	0.0	0.0	-	-	-
combStage X,NA	95	1.7	0.8	-14.1	[-16.2, -12.0]	<.0001	27	0.5	0.2	-11.1	[-15.2, -6.7]	0.0005
Brain	**469**	**8.6**	**6.2**	**0.7**	**[-0.4, 1.9]**	**0.1893**	**331**	**5.8**	**4.2**	**-0.9**	**[-2.3, 0.5]**	**0.1865**
Gliomas	447	8.2	5.6	0.4	[-0.8, 1.7]	0.4638	321	5.7	3.9	-1.0	[-2.5, 0.6]	0.2119
Embryonal tumours	17	0.3	0.5	4.4	[-2.0, 11.3]	0.1663	8	0.1	0.2	2.1	[-4.1, 8.7]	0.4635
Other neuro-epithelial tumours	5	0.1	0.1	-	-	-	2	0.0	0.1	-	-	-
Breast							**10°466**	**184.4**	**106.4**	**0.1**	**[-0.4, 0.5]**	**0.7581**
combStage I							4°497	79.2	49.0	2.2	[1.4, 3.0]	0.0002
combStage II							3°553	62.6	35.0	-0.5	[-0.9, -0.2]	0.0132
combStage III							1°202	21.2	11.5	-0.4	[-1.3, 0.5]	0.2975
combStage IV							614	10.8	5.3	-0.5	[-1.4, 0.4]	0.2554
combStage 0,is							146	2.6	1.9	-	-	-
combStage X,NA							454	8.0	3.8	-12.8	[-16.1, -9.5]	<.0001
Cervix							**653**	**11.5**	**8.0**	**-0.4**	**[-1.6, 0.8]**	**0.4434**

combStage I							261	4.6	3.7	1.4	[-0.5, 3.3]	0.1456
combStage II							67	1.2	0.7	2.3	[-0.9, 5.5]	0.1432
combStage III							128	2.3	1.6	3.3	[0.5, 6.1]	0.0248
combStage IV							62	1.1	0.6	4.9	[1.7, 8.3]	0.0078
combStage 0,is							7	0.1	0.1	-	-	-
combStage X,NA							128	2.3	1.3	-7.8	[-8.9, -6.7]	<.0001
Colon	**3°823**	**69.8**	**35.2**	**1.5**	**[0.3, 2.8]**	**0.0197**	**3°091**	**54.5**	**23.0**	**1.7**	**[1.1, 2.4]**	**0.0002**
combStage I	1°109	20.3	10.9	11.1	[8.5, 13.8]	<.0001	689	12.1	5.9	10.2	[8.6, 11.8]	<.0001
combStage II	989	18.1	8.6	0.9	[-0.1, 1.8]	0.0652	887	15.6	6.0	0.5	[-0.7, 1.7]	0.3802
combStage III	861	15.7	7.9	2.0	[0.7, 3.3]	0.0086	794	14.0	5.7	2.3	[1.2, 3.3]	0.0010
combStage IV	641	11.7	5.9	1.8	[1.0, 2.6]	0.0009	538	9.5	4.2	2.6	[1.7, 3.5]	0.0002
combStage 0,is	3	0.1	0.0	-	-	-	2	0.0	0.0	-	-	-
combStage X,NA	220	4.0	2.0	-10.2	[-11.8, -8.7]	<.0001	181	3.2	1.2	-11.0	[-12.3, -9.6]	<.0001
Gall bladder	**35**	**0.6**	**0.3**	**0.9**	**[-2.7, 4.7]**	**0.5798**	**80**	**1.4**	**0.5**	**-0.9**	**[-4.0, 2.4]**	**0.5639**
combStage I	3	0.1	0.0	-	-	-	6	0.1	0.0	-13.6	[-23.9, -1.9]	0.0308
combStage II	12	0.2	0.1	-3.0	[-13.9, 9.3]	0.5848	14	0.2	0.1	-4.8	[-10.0, 0.7]	0.0806
combStage III	5	0.1	0.0	-	-	-	17	0.3	0.1	19.0	[-5.7, 50.3]	0.1227
combStage IV	10	0.2	0.1	6.4	[1.2, 11.9]	0.0218	33	0.6	0.2	6.8	[0.7, 13.4]	0.0352
combStage X,NA	5	0.1	0.0	-10.6	[-16.7, -4.0]	0.0066	10	0.2	0.1	-5.5	[-12.3, 1.9]	0.1288
Head and neck	**1°992**	**36.4**	**21.3**	**-1.3**	**[-2.1, -0.4]**	**0.0090**	**679**	**12.0**	**6.7**	**1.0**	**[0.2, 1.9]**	**0.0246**
combStage I	421	7.7	4.5	2.1	[0.7, 3.6]	0.0093	143	2.5	1.5	6.9	[4.9, 8.9]	<.0001
combStage II	238	4.3	2.5	0.6	[-1.1, 2.3]	0.4804	111	2.0	1.0	3.2	[1.4, 4.9]	0.0027
combStage III	272	5.0	2.9	-0.3	[-1.8, 1.2]	0.6271	92	1.6	1.0	2.8	[-0.2, 5.8]	0.0643
combStage IV	804	14.7	8.7	0.9	[-0.2, 2.2]	0.1099	232	4.1	2.3	1.9	[0.6, 3.3]	0.0117
combStage 0,is	1	0.0	0.0	-	-	-	1	0.0	0.0	-	-	-

combStage X,NA	256	4.7	2.6	-10.5	[-12.5, -8.5]	<.0001	100	1.8	1.0	-7.8	[-9.5, -6.2]	<.0001
Kidney	**1°075**	**19.6**	**11.2**	**1.3**	**[1.0, 1.6]**	**<.0001**	**613**	**10.8**	**5.4**	**0.3**	**[-0.9, 1.6]**	**0.5708**
combStage I	569	10.4	6.0	5.7	[4.4, 7.0]	<.0001	341	6.0	3.0	3.9	[2.8, 5.1]	<.0001
combStage II	104	1.9	1.1	-0.1	[-3.0, 2.9]	0.9697	45	0.8	0.4	0.9	[-4.4, 6.4]	0.7284
combStage III	162	3.0	1.6	1.4	[-0.3, 3.0]	0.0923	78	1.4	0.6	-0.1	[-2.4, 2.2]	0.9225
combStage IV	166	3.0	1.6	0.5	[-1.4, 2.4]	0.5856	101	1.8	0.8	-0.1	[-2.3, 2.1]	0.8978
combStage X,NA	74	1.4	1.0	-9.3	[-11.3, -7.3]	<.0001	48	0.8	0.6	-9.3	[-11.9, -6.6]	<.0001
Leukemia	**942**	**17.2**	**10.5**	**1.7**	**[0.7, 2.8]**	**0.0045**	**711**	**12.5**	**6.7**	**1.2**	**[-0.4, 2.8]**	**0.1382**
Lymphoid	559	10.2	6.3	1.7	[0.3, 3.1]	0.0233	382	6.7	3.7	1.1	[-1.1, 3.3]	0.3159
Myeloid	383	7.0	4.2	1.8	[0.2, 3.4]	0.0299	329	5.8	3.0	1.4	[-0.8, 3.6]	0.1992
Liver	**596**	**10.9**	**5.8**	**7.1**	**[5.5, 8.6]**	**<.0001**	**268**	**4.7**	**2.2**	**6.5**	**[4.0, 9.1]**	**0.0002**
combStage I	77	1.4	0.7	14.3	[9.6, 19.1]	<.0001	41	0.7	0.4	10.1	[3.5, 17.1]	0.0072
combStage II	63	1.2	0.6	8.1	[1.3, 15.5]	0.0254	40	0.7	0.3	11.3	[4.6, 18.5]	0.0041
combStage III	94	1.7	0.9	1.8	[-2.9, 6.7]	0.4183	19	0.3	0.1	-8.0	[-14.9, -0.5]	0.0420
combStage IV	123	2.2	1.2	14.7	[10.2, 19.3]	<.0001	73	1.3	0.6	15.4	[11.0, 20.0]	<.0001
combStage X,NA	239	4.4	2.4	5.3	[2.9, 7.8]	0.0008	95	1.7	0.8	4.9	[2.1, 7.9]	0.0036
Lung	**5°797**	**105.9**	**53.7**	**-1.1**	**[-1.3, -0.9]**	**<.0001**	**2°655**	**46.8**	**24.1**	**4.2**	**[3.5, 5.0]**	**<.0001**
combStage I	984	18.0	9.1	1.6	[0.2, 3.0]	0.0354	509	9.0	4.7	8.7	[7.1, 10.2]	<.0001
combStage II	517	9.4	4.6	4.1	[2.3, 5.9]	0.0007	164	2.9	1.4	7.8	[3.9, 11.9]	0.0015
combStage III	1°155	21.1	11.0	-0.1	[-1.0, 0.9]	0.8830	480	8.5	4.5	5.4	[3.9, 7.0]	<.0001
combStage IV	2°534	46.3	23.6	2.5	[1.5, 3.6]	0.0004	1°220	21.5	11.2	7.8	[6.5, 9.3]	<.0001
combStage 0,is	3	0.1	0.0	-	-	-	2	0.0	0.0	-	-	-
combStage X,NA	604	11.0	5.3	-12.1	[-13.8, -10.3]	<.0001	280	4.9	2.3	-8.5	[-10.6, -6.4]	<.0001
Lymphoma	**1°409**	**25.7**	**15.5**	**0.7**	**[0.2, 1.1]**	**0.0086**	**1°026**	**18.1**	**10.0**	**-0.1**	**[-0.7, 0.5]**	**0.6627**
Hodgkin (HD)	217	4.0	3.4	1.1	[-0.9, 3.2]	0.2590	138	2.4	2.6	1.1	[-0.5, 2.8]	0.1514

Non-Hodgkin (NHL)	1°192	21.8	12.1	0.4	[-0.2, 1.0]	0.1490	888	15.6	7.4	-0.5	[-1.0, 0.1]	0.0945
Melanoma	**1°193**	**21.8**	**13.5**	**5.4**	**[4.0, 6.9]**	**<.0001**	**1°732**	**30.5**	**20.1**	**5.3**	**[4.3, 6.3]**	**<.0001**
combStage I	817	14.9	9.6	10.1	[7.8, 12.3]	<.0001	1°308	23.0	16.1	8.4	[5.8, 11.0]	<.0001
combStage II	195	3.6	1.9	3.7	[2.0, 5.4]	0.0009	227	4.0	1.9	3.3	[-0.0, 6.7]	0.0547
combStage III	78	1.4	0.9	6.1	[3.6, 8.7]	0.0004	68	1.2	0.8	6.8	[3.8, 9.9]	0.0007
combStage IV	24	0.4	0.2	-1.0	[-5.0, 3.1]	0.5893	17	0.3	0.2	-2.0	[-8.0, 4.4]	0.4989
combStage 0,is							1	0.0	0.0	-	-	-
combStage X,NA	79	1.4	0.8	-6.6	[-15.0, 2.7]	0.1450	111	2.0	1.1	-8.2	[-18.0, 2.6]	0.1216
Myeloma	**440**	**8.0**	**4.0**	**1.2**	**[0.1, 2.3]**	**0.0379**	**384**	**6.8**	**3.0**	**-0.4**	**[-2.0, 1.2]**	**0.5736**
Oesophagus	**1°068**	**19.5**	**10.2**	**0.3**	**[-0.5, 1.0]**	**0.4333**	**383**	**6.7**	**2.9**	**1.4**	**[0.5, 2.2]**	**0.0059**
combStage I	177	3.2	1.7	4.9	[3.1, 6.7]	0.0002	64	1.1	0.5	6.2	[-0.1, 12.9]	0.0545
combStage II	144	2.6	1.3	-2.3	[-3.4, -1.1]	0.0021	59	1.0	0.5	2.8	[-0.0, 5.8]	0.0556
combStage III	280	5.1	2.7	4.2	[1.4, 7.1]	0.0083	88	1.6	0.7	3.3	[1.3, 5.5]	0.0060
combStage IV	285	5.2	2.8	0.1	[-2.0, 2.3]	0.8973	74	1.3	0.5	1.1	[-0.6, 2.8]	0.1856
combStage 0,is	25	0.5	0.3	-	-	-	6	0.1	0.1	-	-	-
combStage X,NA	157	2.9	1.4	-7.3	[-8.0, -6.6]	<.0001	92	1.6	0.6	-4.9	[-7.4, -2.4]	0.0022
Ovary							**848**	**14.9**	**7.6**	**-3.0**	**[-4.0, -2.1]**	**<.0001**
combStage I							143	2.5	1.6	0.1	[-3.1, 3.5]	0.9316
combStage II							37	0.7	0.3	-1.0	[-6.6, 4.9]	0.7052
combStage III							256	4.5	2.4	0.8	[-1.1, 2.7]	0.3842
combStage IV							201	3.5	1.6	2.8	[-0.4, 6.1]	0.0810
combStage 0,is							2	0.0	0.0	-	-	-
combStage X,NA							209	3.7	1.7	-12.3	[-17.3, -7.0]	0.0008
Pancreas	**871**	**15.9**	**8.1**	**3.3**	**[2.1, 4.5]**	**0.0002**	**844**	**14.9**	**6.4**	**4.1**	**[3.2, 5.0]**	**<.0001**
combStage I	68	1.2	0.6	9.5	[3.7, 15.6]	0.0049	72	1.3	0.6	10.8	[7.0, 14.7]	0.0001

combStage II	188	3.4	1.8	6.2	[3.5, 9.0]	0.0006	198	3.5	1.6	6.6	[4.6, 8.5]	<.0001
combStage III	66	1.2	0.6	3.8	[1.5, 6.2]	0.0047	58	1.0	0.5	1.3	[-1.8, 4.5]	0.3854
combStage IV	405	7.4	3.9	4.8	[3.0, 6.7]	0.0002	347	6.1	2.6	6.5	[5.0, 7.9]	<.0001
combStage 0,is	1	0.0	0.0	-	-	-						
combStage X,NA	143	2.6	1.2	-3.6	[-5.3, -1.7]	0.0019	169	3.0	1.1	-2.3	[-4.3, -0.2]	0.0347
Prostate	**7°953**	**145.3**	**73.4**	**-3.5**	**[-4.1, -2.9]**	**<.0001**						
combStage I	2°635	48.1	23.5	38.4	[18.8, 61.2]	0.0012						
combStage II	1°785	32.6	18.4	-10.1	[-13.3, -6.7]	0.0002						
combStage III	1°187	21.7	11.5	-1.5	[-2.5, -0.4]	0.0127						
combStage IV	922	16.8	8.0	3.6	[2.3, 4.9]	0.0002						
combStage X,NA	1°424	26.0	12.1	-13.1	[-16.9, -9.1]	<.0001						
Rectum	**1°644**	**30.0**	**15.9**	**0.8**	**[0.0, 1.5]**	**0.0495**	**946**	**16.7**	**7.7**	**-0.1**	**[-1.0, 0.8]**	**0.7656**
combStage I	529	9.7	5.3	5.3	[3.5, 7.1]	<.0001	276	4.9	2.4	4.6	[3.5, 5.8]	<.0001
combStage II	269	4.9	2.5	-1.7	[-3.2, -0.2]	0.0288	180	3.2	1.4	-1.8	[-3.6, -0.0]	0.0507
combStage III	412	7.5	4.0	0.5	[-0.4, 1.4]	0.2821	235	4.1	1.9	-2.2	[-3.3, -1.0]	0.0025
combStage IV	266	4.9	2.6	1.3	[-0.6, 3.2]	0.1591	136	2.4	1.1	2.1	[-0.1, 4.3]	0.0673
combStage 0,is	62	1.1	0.7	36.0	[28.7, 43.7]	<.0001	33	0.6	0.4	27.7	[16.8, 39.6]	0.0002
combStage X,NA	106	1.9	0.9	-8.3	[-10.6, -6.0]	<.0001	86	1.5	0.6	-7.2	[-9.0, -5.4]	<.0001
Stomach	**540**	**9.9**	**4.8**	**-3.3**	**[-4.4, -2.1]**	**0.0001**	**479**	**8.4**	**3.7**	**-0.5**	**[-1.8, 0.7]**	**0.3597**
combStage I	79	1.4	0.6	-4.6	[-8.5, -0.7]	0.0296	60	1.1	0.5	-0.8	[-5.3, 3.8]	0.6864
combStage II	79	1.4	0.7	2.4	[-3.6, 8.8]	0.3883	67	1.2	0.5	3.8	[0.3, 7.4]	0.0384
combStage III	70	1.3	0.6	-0.6	[-5.1, 4.1]	0.7772	47	0.8	0.4	1.1	[-2.3, 4.6]	0.4964
combStage IV	128	2.3	1.2	-3.9	[-4.6, -3.1]	<.0001	98	1.7	0.8	-1.3	[-4.1, 1.5]	0.3185
combStage 0,is	1	0.0	0.0	-	-	-				-	-	-
combStage X,NA	183	3.3	1.6	-6.0	[-8.0, -3.9]	0.0001	207	3.6	1.6	-1.6	[-3.6, 0.5]	0.1263

Testis	**359**	**6.6**	**6.6**	**3.3**	**[2.6, 4.0]**	**<.0001**						
combStage I	309	5.6	5.7	6.2	[5.4, 7.1]	<.0001						
combStage II	18	0.3	0.3	-3.8	[-10.7, 3.6]	0.2705						
combStage III	22	0.4	0.4	4.3	[-2.6, 11.7]	0.2005						
combStage X,NA	10	0.2	0.2	-15.8	[-22.1, -8.9]	0.0009						
Thyroid	**267**	**4.9**	**3.5**	**4.3**	**[2.7, 6.0]**	**0.0002**	**805**	**14.2**	**10.9**	**4.7**	**[3.8, 5.6]**	**<.0001**
combStage I	141	2.6	2.0	11.7	[8.0, 15.5]	<.0001	551	9.7	8.1	10.9	[8.6, 13.2]	<.0001
combStage II	34	0.6	0.4	7.0	[-0.1, 14.6]	0.0562	64	1.1	0.8	7.4	[4.5, 10.3]	0.0002
combStage III	31	0.6	0.4	7.1	[3.1, 11.2]	0.0031	69	1.2	0.8	5.9	[2.0, 9.9]	0.0074
combStage IV	34	0.6	0.3	2.7	[-1.5, 7.1]	0.1839	44	0.8	0.4	0.9	[-2.2, 4.2]	0.5309
combStage X,NA	27	0.5	0.4	-9.8	[-13.3, -6.3]	0.0002	77	1.4	0.9	-12.4	[-15.2, -9.5]	<.0001
Uterus							**1°474**	**26.0**	**12.0**	**-1.8**	**[-2.3, -1.4]**	**<.0001**
combStage I							922	16.2	7.8	2.6	[1.8, 3.5]	0.0001
combStage II							69	1.2	0.5	-4.3	[-6.6, -2.0]	0.0027
combStage III							147	2.6	1.2	1.0	[-2.7, 4.8]	0.5489
combStage IV							94	1.7	0.6	3.0	[-0.5, 6.7]	0.0909
combStage 0,is							2	0.0	0.0	-	-	-
combStage X,NA							240	4.2	1.9	-12.7	[-15.1, -10.3]	<.0001
Vagina							**43**	**0.8**	**0.3**	**-4.4**	**[-7.9, -0.7]**	**0.0258**
combStage I							9	0.2	0.1	-0.4	[-9.9, 10.2]	0.9388
combStage II							4	0.1	0.0	5.7	[-7.4, 20.7]	0.3755
combStage III							4	0.1	0.0	-6.5	[-19.3, 8.3]	0.3340
combStage IV							9	0.2	0.0	-0.5	[-11.7, 12.2]	0.9315
combStage X,NA							17	0.3	0.1	-8.9	[-14.7, -2.8]	0.0107
Vulva							**237**	**4.2**	**2.0**	**3.2**	**[2.0, 4.5]**	**0.0002**

combStage I							137	2.4	1.2	16.4	[12.8, 20.1]	<.0001
combStage II							9	0.2	0.1	-15.2	[-22.6, -7.2]	0.0030
combStage III							39	0.7	0.3	6.8	[1.4, 12.4]	0.0196
combStage IV							12	0.2	0.1	2.6	[-3.9, 9.5]	0.3954
combStage 0,is							1	0.0	0.0	-	-	-
combStage X,NA							39	0.7	0.3	-9.2	[-12.4, -5.9]	0.0002
Other	**1°980**	**36.2**	**18.0**	**-0.1**	**[-0.8, 0.5]**	**0.6312**	**1°526**	**26.9**	**11.7**	**-0.0**	**[-1.2, 1.1]**	**0.9491**
Anus	65	1.2	0.6	4.0	[1.0, 7.1]	0.0156	115	2.0	1.0	4.7	[2.9, 6.6]	0.0002
Biliary	159	2.9	1.3	0.4	[-1.2, 2.1]	0.5731	129	2.3	0.9	1.1	[-1.3, 3.4]	0.3379
Mesothelioma	246	4.5	2.1	-0.7	[-1.5, 0.0]	0.0598	48	0.8	0.3	0.8	[-3.7, 5.4]	0.7165
Myelodysplastic syndrome	466	8.5	3.7	4.5	[2.7, 6.3]	0.0004	369	6.5	2.4	5.4	[3.7, 7.1]	<.0001
Skin (non-melanoma, non-SCC/BCC)	114	2.1	1.1	-1.1	[-3.0, 0.8]	0.2340	129	2.3	1.0	-1.1	[-2.9, 0.8]	0.2227
Small intestine	188	3.4	1.9	5.4	[3.1, 7.6]	0.0004	160	2.8	1.4	4.3	[1.7, 6.9]	0.0046
Soft tissue	214	3.9	2.5	-0.0	[-1.3, 1.3]	0.9844	147	2.6	1.6	-1.4	[-3.2, 0.4]	0.1263
Unknown primary	528	9.6	4.7	-4.9	[-6.6, -3.2]	0.0001	429	7.6	3.1	-3.7	[-6.2, -1.1]	0.0111
TOTAL	**34°362**	**627.7**	**333.4**	**-0.6**	**[-0.8, -0.3]**	**0.0011**	**30°782**	**542.3**	**288.5**	**0.8**	**[0.7, 1.0]**	**<.0001**

Table A. 4 – Actual radiotherapy utilisation by cancer type and subcategory (stage where applicable), Belgium 2009-2010

Cancer Type	Actual Radiotherapy Utilisation (2009-2010)						
	EBRT (%)			BT only (%)	Any RT (%)	Overall	
	EBRT only	EBRT + BT	Any EBRT			N	%
Bladder	17.3	0.4	17.7	0.1	17.8	3 845	3.5
combStage I	10.3	0.1	10.4	0.1	10.5	1 714	1.6
combStage II	23.4	1.0	24.4	0.2	24.7	900	0.8
combStage III	25.0	0.3	25.3	0.3	25.6	348	0.3
combStage IV	29.1	0.3	29.4	0.0	29.4	398	0.4
combStage X,NA	15.7	0.2	15.9	0.0	15.9	485	0.4
Brain	70.4	0.0	70.4	0.0	70.4	1 464	1.3
Gliomas	70.2	0.0	70.2	0.0	70.2	1 410	1.3
Embryonal tumours	81.6	0.0	81.6	0.0	81.6	49	0.0
Other neuro-epithelial tumours	20.0	0.0	20.0	0.0	20.0	5	0.0
Breast	72.0	4.8	76.8	0.0	76.8	18 980	17.2
combStage I	74.0	7.4	81.4	0.1	81.4	7 642	6.9
combStage II	73.8	4.4	78.2	0.0	78.2	6 579	6.0
combStage III	82.9	1.4	84.4	0.0	84.4	2 374	2.2
combStage IV	53.4	0.4	53.8	0.1	53.8	1 092	1.0
combStage 0,is	88.1	3.0	91.1	0.0	91.1	101	0.1
combStage X,NA	42.6	1.3	43.9	0.0	43.9	1 192	1.1
Cervix	30.2	23.0	53.3	2.6	55.9	1 128	1.0
combStage I	14.3	10.7	24.9	4.0	29.0	449	0.4
combStage II	40.3	44.2	84.5	4.7	89.1	129	0.1

combStage III	52.4	39.6	92.1	0.6	92.7	164	0.1
combStage IV	53.2	13.5	66.7	0.0	66.7	111	0.1
combStage X,NA	29.1	27.3	56.4	1.5	57.8	275	0.2
Colon	**5.8**	**0.0**	**5.8**	**0.5**	**6.2**	**10 118**	**9.2**
combStage I	3.3	0.0	3.3	0.1	3.3	1 553	1.4
combStage II	4.0	0.0	4.0	0.2	4.2	3 056	2.8
combStage III	6.6	0.0	6.6	0.2	6.8	2 501	2.3
combStage IV	9.6	0.0	9.6	1.6	11.2	1 975	1.8
combStage X,NA	5.3	0.0	5.3	0.3	5.6	1 033	0.9
Gall bladder	**3.9**	**0.0**	**3.9**	**0.0**	**3.9**	**206**	**0.2**
combStage I	3.8	0.0	3.8	0.0	3.8	26	0.0
combStage II	0.0	0.0	0.0	0.0	0.0	39	0.0
combStage III	7.4	0.0	7.4	0.0	7.4	27	0.0
combStage IV	5.4	0.0	5.4	0.0	5.4	74	0.1
combStage X,NA	2.5	0.0	2.5	0.0	2.5	40	0.0
Head and neck	**71.6**	**0.1**	**71.7**	**0.2**	**71.9**	**4 558**	**4.1**
combStage I	53.2	0.0	53.2	0.2	53.5	834	0.8
combStage II	74.4	0.4	74.8	0.4	75.2	516	0.5
combStage III	84.5	0.0	84.5	0.0	84.5	606	0.5
combStage IV	83.0	0.1	83.0	0.0	83.0	1 526	1.4
combStage X,NA	61.1	0.0	61.1	0.5	61.5	1 076	1.0
Kidney	**12.9**	**0.0**	**12.9**	**0.0**	**12.9**	**2 662**	**2.4**
combStage I	4.4	0.0	4.4	0.0	4.4	1 304	1.2
combStage II	9.4	0.4	9.8	0.0	9.8	244	0.2
combStage III	15.1	0.0	15.1	0.0	15.1	417	0.4

combStage IV	38.4	0.0	38.4	0.0	38.4	398	0.4
combStage X,NA	15.4	0.0	15.4	0.0	15.4	299	0.3
Leukaemia	**10.0**	**0.0**	**10.1**	**0.2**	**10.2**	**2 640**	**2.4**
Lymphoid	8.1	0.1	8.2	0.3	8.5	1 467	1.3
Myeloid	12.4	0.0	12.4	0.0	12.4	1 173	1.1
Liver	**8.7**	**0.0**	**8.7**	**4.2**	**12.8**	**1 225**	**1.1**
combStage I	4.6	0.0	4.6	5.4	10.0	130	0.1
combStage II	6.0	0.0	6.0	3.0	9.0	167	0.2
combStage III	9.1	0.0	9.1	4.3	13.4	187	0.2
combStage IV	17.9	0.0	17.9	2.1	20.0	240	0.2
combStage X,NA	6.0	0.0	6.0	5.2	11.2	501	0.5
Lung	**46.0**	**0.0**	**46.1**	**0.1**	**46.2**	**14 417**	**13.1**
combStage I	32.9	0.0	32.9	0.2	33.1	2 125	1.9
combStage II	45.5	0.0	45.5	0.3	45.8	986	0.9
combStage III	59.4	0.1	59.5	0.0	59.5	2 901	2.6
combStage IV	49.4	0.0	49.4	0.1	49.4	5 673	5.1
combStage 0,is	0.0	0.0	0.0	0.0	0.0	1	0.0
combStage X,NA	35.4	0.0	35.4	0.1	35.5	2 731	2.5
Lymphoma	**23.3**	**0.0**	**23.4**	**0.0**	**23.4**	**4 092**	**3.7**
Hodgkin (HD)	46.8	0.0	46.8	0.0	46.8	560	0.5
Non-Hodgkin (NHL)	19.6	0.1	19.7	0.1	19.7	3 532	3.2
Melanoma	**8.2**	**0.1**	**8.3**	**0.1**	**8.4**	**3 667**	**3.3**
combStage I	2.9	0.0	3.0	0.1	3.1	2 148	1.9
combStage II	16.9	0.2	17.1	0.0	17.1	543	0.5
combStage III	26.7	0.0	26.7	0.0	26.7	195	0.2

combStage IV	44.0	0.0	44.0	1.2	45.2	84	0.1
combStage X,NA	8.3	0.0	8.3	0.0	8.3	697	0.6
Myeloma	**26.6**	**0.1**	**26.6**	**0.0**	**26.6**	**1 370**	**1.2**
Oesophagus	**41.6**	**0.3**	**41.8**	**0.4**	**42.2**	**2 373**	**2.2**
combStage I	25.2	0.3	25.5	0.6	26.1	333	0.3
combStage II	55.2	0.5	55.8	0.3	56.0	382	0.3
combStage III	57.3	0.4	57.7	0.2	57.9	513	0.5
combStage IV	38.2	0.2	38.3	0.5	38.9	579	0.5
combStage 0,is	100.0	0.0	100.0	0.0	100.0	3	0.0
combStage X,NA	30.7	0.0	30.7	0.4	31.1	563	0.5
Ovary	**6.4**	**0.1**	**6.4**	**0.1**	**6.6**	**1 538**	**1.4**
combStage I	5.0	0.0	5.0	0.9	5.9	220	0.2
combStage II	6.9	0.0	6.9	0.0	6.9	58	0.1
combStage III	6.3	0.2	6.5	0.0	6.5	413	0.4
combStage IV	7.8	0.0	7.8	0.0	7.8	348	0.3
combStage 0,is	0.0	0.0	0.0	0.0	0.0	1	0.0
combStage X,NA	6.0	0.0	6.0	0.0	6.0	498	0.5
Pancreas	**10.1**	**0.0**	**10.1**	**0.2**	**10.3**	**2 758**	**2.5**
combStage I	7.5	0.0	7.5	0.0	7.5	227	0.2
combStage II	14.0	0.0	14.0	0.3	14.4	592	0.5
combStage III	23.8	0.0	23.8	0.0	23.8	231	0.2
combStage IV	7.0	0.0	7.0	0.3	7.3	1 051	1.0
combStage X,NA	7.6	0.0	7.6	0.0	7.6	657	0.6
Prostate	**27.9**	**0.2**	**28.2**	**9.8**	**38.0**	**16 219**	**14.7**
combStage I	21.1	0.1	21.2	19.9	41.1	2 767	2.5

combStage II	22.2	0.2	22.4	10.8	33.1	5 980	5.4
combStage III	53.4	0.3	53.7	0.3	54.0	2 197	2.0
combStage IV	45.9	0.1	46.0	0.2	46.2	1 193	1.1
combStage X,NA	22.1	0.3	22.4	9.5	31.9	4 082	3.7
Rectum	**57.1**	**0.0**	**57.1**	**0.2**	**57.3**	**4 399**	**4.0**
combStage I	46.8	0.0	46.8	0.0	46.8	1 093	1.0
combStage II	68.1	0.0	68.1	0.1	68.2	921	0.8
combStage III	70.7	0.0	70.7	0.0	70.7	1 127	1.0
combStage IV	46.3	0.0	46.3	0.9	47.2	762	0.7
combStage 0,is	100.0	0.0	100.0	0.0	100.0	133	0.1
combStage X,NA	24.5	0.0	24.5	0.0	24.5	363	0.3
Stomach	**8.2**	**0.0**	**8.2**	**0.1**	**8.2**	**1 913**	**1.7**
combStage I	3.5	0.0	3.5	0.0	3.5	344	0.3
combStage II	12.7	0.0	12.7	0.0	12.7	236	0.2
combStage III	17.3	0.0	17.3	0.0	17.3	226	0.2
combStage IV	10.1	0.0	10.1	0.0	10.1	437	0.4
combStage X,NA	4.6	0.0	4.6	0.1	4.8	670	0.6
Testis	**13.9**	**0.0**	**13.9**	**0.0**	**13.9**	**591**	**0.5**
combStage I	15.2	0.0	15.2	0.0	15.2	492	0.4
combStage II	4.5	0.0	4.5	0.0	4.5	22	0.0
combStage III	10.7	0.0	10.7	0.0	10.7	56	0.1
combStage X,NA	0.0	0.0	0.0	0.0	0.0	21	0.0
Thyroid	**7.9**	**0.1**	**8.0**	**1.5**	**9.5**	**1 628**	**1.5**
combStage I	2.7	0.1	2.8	1.3	4.0	867	0.8
combStage II	7.4	0.7	8.1	0.7	8.8	136	0.1

combStage III	9.8	0.0	9.8	2.8	12.6	143	0.1
combStage IV	36.7	0.0	36.7	3.0	39.8	166	0.2
combStage X,NA	6.3	0.0	6.3	0.9	7.3	316	0.3
Uterus (corpus uteri)	**14.5**	**11.0**	**25.5**	**8.5**	**34.0**	**2 682**	**2.4**
combStage I	9.0	9.2	18.2	11.4	29.7	1 608	1.5
combStage II	22.5	27.1	49.6	13.2	62.8	129	0.1
combStage III	32.9	29.1	62.0	4.2	66.2	237	0.2
combStage IV	27.7	6.2	33.8	2.3	36.2	130	0.1
combStage X,NA	17.6	5.9	23.5	2.2	25.8	578	0.5
Vagina	**44.6**	**8.4**	**53.0**	**7.2**	**60.2**	**83**	**0.1**
combStage I	30.0	10.0	40.0	30.0	70.0	10	0.0
combStage II	27.3	45.5	72.7	0.0	72.7	11	0.0
combStage III	66.7	16.7	83.3	0.0	83.3	6	0.0
combStage IV	61.1	0.0	61.1	0.0	61.1	18	0.0
combStage X,NA	42.1	0.0	42.1	7.9	50.0	38	0.0
Vulva	**33.2**	**0.8**	**34.0**	**0.5**	**34.5**	**388**	**0.4**
combStage I	19.5	1.2	20.7	1.2	22.0	164	0.1
combStage II	37.1	2.9	40.0	0.0	40.0	35	0.0
combStage III	78.7	0.0	78.7	0.0	78.7	61	0.1
combStage IV	62.5	0.0	62.5	0.0	62.5	24	0.0
combStage X,NA	20.2	0.0	20.2	0.0	20.2	104	0.1
Other	**23.5**	**0.2**	**23.7**	**0.2**	**23.9**	**5 423**	**4.9**
Anus	71.9	2.5	74.4	0.7	75.1	281	0.3
Biliary	8.0	0.4	8.3	0.0	8.3	539	0.5
Mesothelioma	41.9	0.0	41.9	0.0	41.9	458	0.4

Myelodysplastic syndrome	5.1	0.0	5.1	0.0	5.1	1 063	1.0
Skin (non-melanoma, non-SCC/BCC)	27.6	0.0	27.6	0.2	27.8	413	0.4
Small intestine	4.4	0.0	4.4	0.9	5.3	455	0.4
Soft tissue	42.2	0.3	42.6	0.3	42.9	580	0.5
Unknown primary	24.7	0.0	24.7	0.2	24.9	1 634	1.5
TOTAL	**35.5**	**1.4**	**36.9**	**1.9**	**38.7**	**110 367**	**100.0**

Table A. 5 – Projections of incidences and radiotherapy needs in 2025, by sex, tumour type and subcategory (stage where applicable)

Cancer Type	Projections 2025 - males				Projections 2025 - females			
	Incidence		Radiotherapy		Incidence		Radiotherapy	
	N	CI	N	CI	N	CI	N	CI
Bladder	**2 227**	**(2 152;2 301)**	**397**	**(383;410)**	**598**	**(555;641)**	**106**	**(99;114)**
combStage I	1 025	(991;1 059)	108	(104;111)	258	(239;276)	27	(25;29)
combStage II	627	(607;648)	155	(150;160)	174	(162;187)	43	(40;46)
combStage III	213	(206;221)	55	(53;56)	53	(49;57)	14	(13;15)
combStage IV	237	(229;245)	70	(67;72)	79	(73;84)	23	(22;25)
combStage X,NA	111	(107;115)	18	(17;18)	32	(29;34)	5	(5;5)
Brain	**525**	**(503;546)**	**369**	**(354;384)**	**360**	**(345;374)**	**253**	**(243;264)**
Gliomas	500	(480;520)	351	(337;365)	349	(335;363)	245	(235;255)
Embryonal tumours	19	(18;20)	16	(15;16)	9	(8;9)	7	(7;7)
Other neuro-epithelial tumours	6	(5;6)	1	(1;1)	2	(2;2)	0	(0;0)
Breast					**12 125**	**(11 835;12 415)**	**9 312**	**(9 089;9 535)**
combStage I					5 210	(5 085;5 334)	4 243	(4 142;4 345)
combStage II					4 116	(4 018;4 215)	3 220	(3 143;3 297)
combStage III					1 393	(1 359;1 426)	1 175	(1 147;1 203)
combStage IV					711	(694;728)	383	(374;392)
combStage 0,is					169	(165;173)	154	(150;158)
combStage X,NA					526	(513;539)	231	(225;236)

Cervix					665	(645;685)	371	(360;382)
combStage I					266	(258;274)	77	(75;79)
combStage II					68	(66;70)	61	(59;63)
combStage III					130	(126;134)	121	(117;124)
combStage IV					63	(61;65)	42	(41;43)
combStage X,NA					130	(126;134)	75	(73;78)
Colon	4 643	(4 474;4 812)	289	(278;299)	3 558	(3 438;3 678)	221	(214;229)
combStage I	1 347	(1 298;1 396)	45	(43;47)	793	(766;820)	27	(26;27)
combStage II	1 201	(1 157;1 245)	50	(48;52)	1 021	(987;1 056)	42	(41;44)
combStage III	1 046	(1 008;1 084)	71	(69;74)	914	(883;945)	62	(60;65)
combStage IV	779	(750;807)	87	(84;90)	619	(598;640)	69	(67;72)
combStage X,NA	267	(257;277)	15	(14;16)	208	(201;215)	12	(11;12)
Gall bladder	42	(38;46)	2	(1;2)	82	(76;88)	3	(3;3)
combStage I	4	(3;4)	0	(0;0)	6	(6;7)	0	(0;0)
combStage II	14	(13;16)	0	(0;0)	14	(13;15)	0	(0;0)
combStage III	6	(5;7)	0	(0;0)	17	(16;19)	1	(1;1)
combStage IV	12	(11;13)	1	(1;1)	34	(32;36)	2	(2;2)
combStage X,NA	6	(5;7)	0	(0;0)	10	(10;11)	0	(0;0)
Head and neck	2 177	(2 084;2 269)	1 564	(1 497;1 631)	874	(803;944)	628	(577;679)
combStage I	460	(440;480)	246	(236;256)	184	(169;199)	98	(90;106)
combStage II	260	(249;271)	196	(187;204)	143	(131;154)	107	(99;116)
combStage III	297	(285;310)	251	(240;262)	118	(109;128)	100	(92;108)
combStage IV	879	(841;916)	729	(698;761)	299	(274;323)	248	(228;268)
combStage X,NA	280	(268;292)	172	(165;179)	129	(118;139)	79	(73;86)
Kidney	1 362	(1 282;1 441)	176	(166;186)	740	(701;779)	96	(91;101)
combStage I	721	(679;763)	32	(30;34)	412	(390;434)	18	(17;19)
combStage II	132	(124;139)	13	(12;14)	54	(51;57)	5	(5;6)
combStage III	205	(193;217)	31	(29;33)	94	(89;99)	14	(13;15)
combStage IV	210	(198;223)	81	(76;86)	122	(115;128)	47	(44;49)

combStage X,NA	94	(88;99)	14	(14;15)	58	(55;61)	9	(8;9)
Leukaemia	**1 345**	**(1 259;1 430)**	**138**	**(129;146)**	**1 051**	**(971;1 130)**	**107**	**(99;116)**
Lymphoid	821	(768;873)	69	(65;74)	578	(535;622)	49	(45;53)
Myeloid	524	(491;557)	65	(61;69)	472	(437;508)	59	(54;63)
Liver	**1 192**	**(1 109;1 275)**	**153**	**(142;163)**	**438**	**(389;486)**	**56**	**(50;62)**
combStage I	154	(143;165)	15	(14;16)	67	(60;74)	7	(6;7)
combStage II	126	(117;135)	11	(11;12)	65	(58;73)	6	(5;7)
combStage III	188	(175;201)	25	(23;27)	31	(28;34)	4	(4;5)
combStage IV	246	(229;263)	49	(46;53)	119	(106;132)	24	(21;26)
combStage X,NA	478	(445;511)	53	(50;57)	155	(138;172)	17	(15;19)
Lung	**6 494**	**(6 276;6 712)**	**2 998**	**(2 897;3 099)**	**4 193**	**(4 037;4 349)**	**1 936**	**(1 864;2 008)**
combStage I	1 102	(1 065;1 139)	365	(353;377)	804	(774;834)	266	(256;276)
combStage II	579	(560;599)	266	(257;274)	259	(249;269)	119	(114;123)
combStage III	1 294	(1 250;1 337)	769	(744;795)	758	(730;786)	451	(434;467)
combStage IV	2 839	(2 743;2 934)	1 404	(1 356;1 451)	1 927	(1 855;1 998)	953	(917;988)
combStage 0,is	3	(3;3)	0	(0;0)	3	(3;3)	0	(0;0)
combStage X,NA	677	(654;699)	240	(232;248)	442	(426;459)	157	(151;163)
Lymphoma	**1 721**	**(1 627;1 815)**	**403**	**(381;425)**	**1 196**	**(1 148;1 243)**	**280**	**(269;291)**
Hodgkin (HD)	265	(251;279)	124	(117;131)	161	(154;167)	75	(72;78)
Non-Hodgkin (NHL)	1 456	(1 376;1 535)	287	(272;303)	1 035	(994;1 076)	204	(196;212)
Melanoma	**1 888**	**(1 784;1 993)**	**158**	**(149;167)**	**2 468**	**(2 353;2 583)**	**207**	**(197;216)**
combStage I	1 293	(1 222;1 365)	40	(38;42)	1 864	(1 777;1 951)	57	(55;60)
combStage II	309	(292;326)	53	(50;56)	323	(308;339)	55	(53;58)
combStage III	123	(117;130)	33	(31;35)	97	(92;101)	26	(25;27)
combStage IV	38	(36;40)	17	(16;18)	24	(23;25)	11	(10;11)
combStage X,NA	125	(118;132)	10	(10;11)	158	(151;166)	13	(13;14)
Myeloma	**516**	**(501;532)**	**138**	**(133;142)**	**386**	**(373;399)**	**103**	**(99;106)**
Oesophagus	**1 344**	**(1 276;1 413)**	**567**	**(538;596)**	**445**	**(411;479)**	**188**	**(173;202)**
combStage I	223	(211;234)	58	(55;61)	74	(69;80)	19	(18;21)

combStage II	181	(172;190)	102	(96;107)	69	(63;74)	38	(35;41)
combStage III	352	(335;370)	204	(194;214)	102	(94;110)	59	(55;64)
combStage IV	359	(341;377)	139	(132;146)	86	(79;93)	33	(31;36)
combStage 0,is	31	(30;33)	31	(30;33)	7	(6;8)	7	(6;8)
combStage X,NA	198	(188;208)	61	(58;65)	107	(99;115)	33	(31;36)
Ovary					**777**	**(733;822)**	**51**	**(48;54)**
combStage I					131	(124;139)	8	(7;8)
combStage II					34	(32;36)	2	(2;2)
combStage III					235	(221;248)	15	(14;16)
combStage IV					184	(174;195)	14	(13;15)
combStage 0,is					2	(2;2)	0	(0;0)
combStage X,NA					192	(181;203)	12	(11;12)
Pancreas	**1 399**	**(1 297;1 502)**	**144**	**(134;155)**	**1 317**	**(1 224;1 410)**	**136**	**(126;145)**
combStage I	109	(101;117)	8	(8;9)	112	(104;120)	8	(8;9)
combStage II	302	(280;324)	43	(40;47)	309	(287;331)	44	(41;48)
combStage III	106	(98;114)	25	(23;27)	91	(84;97)	22	(20;23)
combStage IV	651	(603;698)	48	(44;51)	542	(503;580)	40	(37;42)
combStage X,NA	230	(213;247)	17	(16;19)	264	(245;282)	20	(19;21)
Prostate	**6 589**	**(6 371;6 807)**	**2 502**	**(2 419;2 585)**				
combStage I	2 183	(2 111;2 255)	897	(867;927)				
combStage II	1 479	(1 430;1 528)	490	(474;506)				
combStage III	983	(951;1 016)	531	(514;549)				
combStage IV	764	(739;789)	353	(341;364)				
combStage X,NA	1 180	(1 141;1 219)	376	(364;389)				
Rectum	**1 961**	**(1 862;2 059)**	**1 123**	**(1 066;1 179)**	**1 067**	**(1 029;1 105)**	**611**	**(589;633)**
combStage I	631	(599;663)	296	(281;310)	311	(300;322)	146	(141;151)
combStage II	321	(305;337)	219	(208;230)	203	(196;210)	138	(134;143)
combStage III	491	(467;516)	347	(330;365)	265	(256;275)	187	(181;194)
combStage IV	317	(301;333)	150	(142;157)	153	(148;159)	72	(70;75)

combStage 0,is	74	(70;78)	74	(70;78)	37	(36;39)	37	(36;39)
combStage X,NA	126	(120;133)	31	(29;33)	97	(94;100)	24	(23;25)
Stomach	**468**	**(415;522)**	**38**	**(34;43)**	**462**	**(432;492)**	**38**	**(35;40)**
combStage I	68	(61;76)	2	(2;3)	58	(54;62)	2	(2;2)
combStage II	68	(61;76)	9	(8;10)	65	(60;69)	8	(8;9)
combStage III	61	(54;68)	10	(9;12)	45	(42;48)	8	(7;8)
combStage IV	111	(98;124)	11	(10;12)	95	(88;101)	10	(9;10)
combStage X,NA	159	(140;177)	8	(7;8)	200	(187;213)	10	(9;10)
Testis	**458**	**(417;499)**	**64**	**(58;69)**				
combStage I	394	(359;429)	60	(55;65)				
combStage II	23	(21;25)	1	(1;1)				
combStage III	28	(26;31)	3	(3;3)				
combStage X,NA	13	(12;14)	0	(0;0)				
Thyroid	**387**	**(345;429)**	**37**	**(33;41)**	**1 103**	**(1 022;1 184)**	**104**	**(97;112)**
combStage I	204	(182;227)	8	(7;9)	755	(700;810)	30	(28;33)
combStage II	49	(44;55)	4	(4;5)	88	(81;94)	8	(7;8)
combStage III	45	(40;50)	6	(5;6)	95	(88;101)	12	(11;13)
combStage IV	49	(44;55)	20	(17;22)	60	(56;65)	24	(22;26)
combStage X,NA	39	(35;43)	3	(3;3)	106	(98;113)	8	(7;8)
Corpus Uteri					**1 446**	**(1 369;1 524)**	**491**	**(465;518)**
combStage I					905	(856;953)	268	(254;283)
combStage II					68	(64;71)	43	(40;45)
combStage III					144	(137;152)	96	(90;101)
combStage IV					92	(87;97)	33	(32;35)
combStage X,NA					235	(223;248)	61	(57;64)
Vagina					**51**	**(46;55)**	**31**	**(28;33)**
combStage I					11	(10;12)	7	(7;8)
combStage II					5	(4;5)	3	(3;4)
combStage III					5	(4;5)	4	(4;4)

combStage IV					11	(10;12)	6	(6;7)
combStage X,NA					20	(18;22)	10	(9;11)
Vulva					**260**	**(239;282)**	**90**	**(82;97)**
combStage I					151	(138;163)	33	(30;36)
combStage II					10	(9;11)	4	(4;4)
combStage III					43	(39;46)	34	(31;37)
combStage IV					13	(12;14)	8	(8;9)
combStage X,NA					43	(39;46)	9	(8;9)
Other								
Anus	74	(69;80)	56	(51;60)	145	(125;165)	109	(94;124)
Biliary	233	(205;261)	19	(17;22)	162	(150;174)	14	(13;15)
Mesothelioma	292	(268;315)	122	(112;132)	63	(51;74)	26	(21;31)
Myelodysplastic syndrome	818	(744;891)	42	(38;45)	522	(470;574)	27	(24;29)
Skin (non-melanoma, non-SCC/BCC)	167	(144;190)	47	(40;53)	170	(150;191)	47	(42;53)
Small intestine	282	(246;319)	15	(13;17)	195	(170;220)	10	(9;12)
Soft tissue	221	(211;231)	95	(91;99)	154	(144;163)	66	(62;70)
Unknown primary	409	(371;446)	102	(92;111)	285	(243;326)	71	(61;81)
TOTAL	**38 055**	**(37 479;38 631)**	**14 738**	**(14 515;14 961)**	**37 280**	**(36 763;37 796)**	**14 437**	**(14 237;14 637)**
TOTAL including a theoretical 25% retreatment rate	**38°055**	**(37 479;38 631)**	**18°423**	**(18 144;18 701)**	**37 280**	**(36 763;37 796)**	**18°046**	**(17°796;18°296)**

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