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The Swedish Institute for Health Economics
Institutet för Hälso- och Sjukvårdsekonomi

# Improving Efficiency and Resource Allocation in Future Cancer Care

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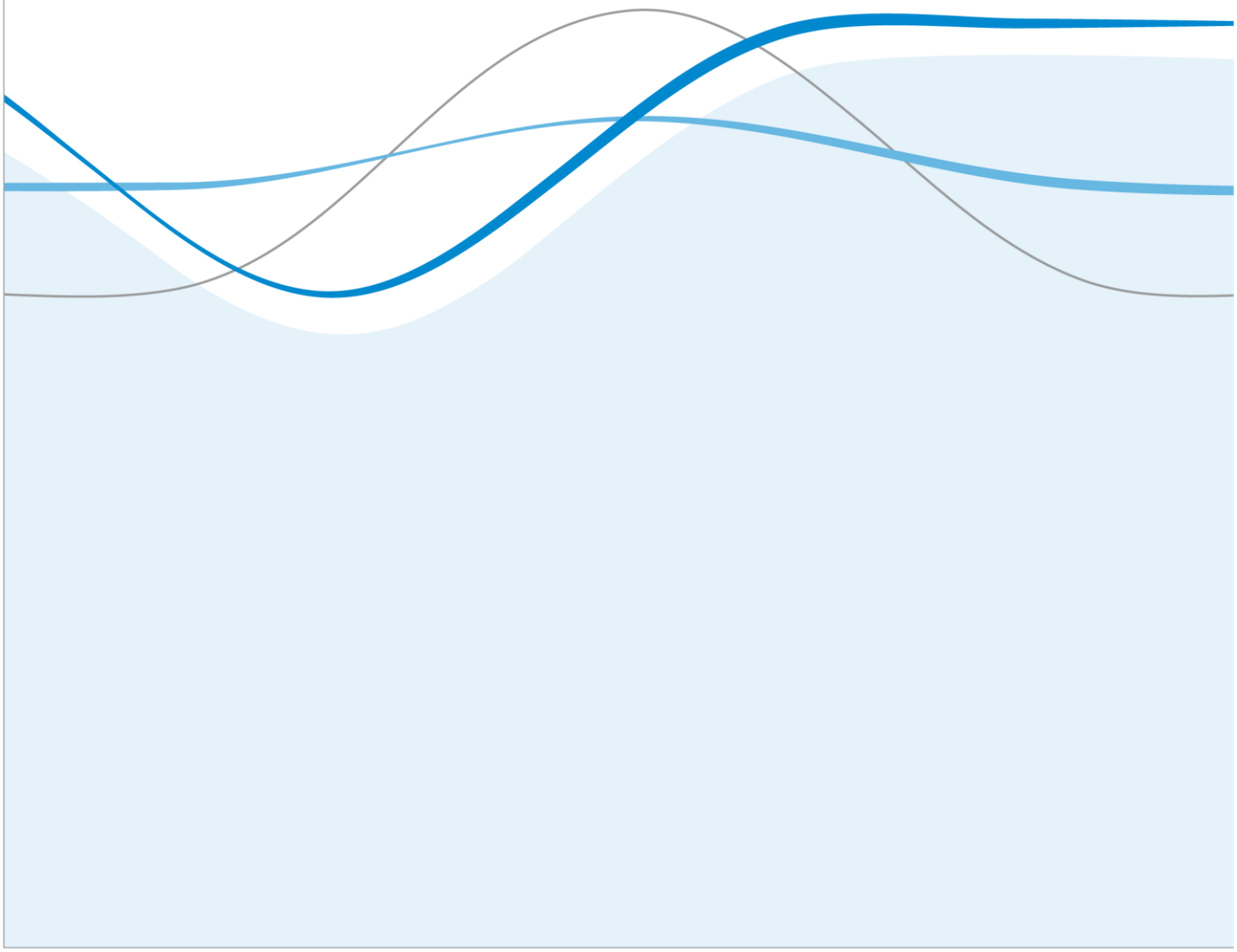
OHE and IHE



# Improving Efficiency and Resource Allocation in Future Cancer Care

Amanda Cole,[a] Adam Lundqvist,[b] Paula Lorgelly,[a] Hanna Norrlid,[b] Sarah Karlsberg Schaffer,[a] Fraser Lewis,[a] Karla Hernandez-Villafuerte,[a] Peter Lindgren,[b] Martina Garau,[a] Karl-Olof Welin,[b] Simona Bianchi,[a] Rikard Althin,[b] Phill O'Neill,[a] Ulf Persson[b] and Adrian Towse[a]

[a] Office of Health Economics, UK; [b] The Swedish Institute for Health Economics, Sweden

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**Submitted by:**

OHE Consulting Ltd (a registered company number 09853113)
Southside, 7th Floor
105 Victoria Street
London SW1E 6QT
United Kingdom

**For further information please contact**

Adrian Towse
Director
Tel: +44 (0) 20 7747 1407
Or: +44 (0) 7801 142 472
atowse@ohe.org

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# FOREWORD

The primary purpose of this report is to collate and examine the evidence regarding efficiencies and inefficiencies in cancer care in Europe, specifically considering whether health care systems are utilising their resources in the best possible way, and whether (and where) there are opportunities to create savings or efficiencies by reallocating resources. The report undertakes a synthesis of the evidence base regarding health care expenditure, health care outcomes and health care interventions specific to cancer control and cancer care in Europe.

By developing this evidence base the report can be used to support policy discussions on the future delivery of oncology services across Europe, enabling health care systems more efficiently deliver current health care and provide new innovative treatments.

In writing the report we utilised a number of health economics experts across Europe: Adam Martin and Jon Sussex (UK); Paolo Pertile (Italy); Michael Thiede (Germany); Cécile Rémuzat and Mondher Toumi (France and Belgium); Anders Green, Sabrina Imeroski, Mary Emneus and Tine Bjerregaard Kryger (Denmark); Dávid Dankó, Nóra Páll and Tomasz Macioch (Poland); Margreet Franken (Netherlands); and Ulla Wilking (Sweden). Their insight and expertise were invaluable in gaining a wider understanding of country-specific issues. We have received extensive comments from Titta Rosvall-Puplett (BMS), Anouk De Vroey (BMS), Wioletta Niznik (BMS), Michael Lees (BMS), Bill Malcolm (BMS), Shravan Kumar Kotakonda (IMS Health), Suzanne Wait (Health Policy Partnership), Vernon Bainton (Havas Lynx Group), Bengt Jönsson (IHE) and Nils Wilking (Karolinska Institute) on earlier versions, and this final report is much improved due to their expertise and insight. We are grateful to Bristol-Myers Squibb (BMS) for commissioning this report. The authors remain solely responsible for the content and the conclusions.

Adrian Towse, on behalf of OHE and IHE

London, 23rd September 2016

# ABBREVIATIONS AND DEFINITIONS

| | |
|---|---|
| CDF | Cancer Drugs Fund |
| | The CDF was introduced in 2011, as a means by which the English National Health Service could provide cancer drugs that were not routinely available in the NHS. This fund is being reformed in 2016. |
| DALY | Disability Adjusted Life Year |
| | A measure of disease burden, which quantifies the impact of a disease from mortality (death) and morbidity (ill health and disability). This means that DALYs represent the number of years lost of "healthy life" because of someone dying early and/or experiencing poor quality of life because of their condition. |
| EU27 | European Union – 27 countries (excludes Croatia, which joined the EU in 2013) |
| EU28 | European Union – 28 countries |
| GBD | Global Burden of Disease |
| | The Global Burden of Diseases, Injuries, and Risk Factors Study measures epidemiological levels and trends worldwide. |
| GDP | Gross Domestic Product |
| | This is the monetary value of all the finished goods and services produced within a country within a given time period. |
| HICP | Harmonised Index of Consumer Prices |
| | This is an indicator of inflation and price stability for the European Central Bank. It is a consumer price index which is compiled using a harmonised methodology across European countries. |
| ICD | International Classification of Diseases |
| | This is standard diagnostic tool for epidemiology, health management and clinical purposes. |
| PPP | Purchasing Power Parity |
| | This is a means of adjusting prices across countries. Rather than use the exchange rate (as this does not reflect relative purchasing power), prices are converted into a common currency which reflects the relative purchasing power – that is, the cost of living – in each country. By equalising purchasing power of different currencies, PPP has the dimension of an exchange rate as well as a price index. |
| QALY | Quality Adjusted Life Year |
| | This is a measure which combines quality of life weights (based on societal preferences for health states) with the length of life. |

# EXECUTIVE SUMMARY

The economic burden that cancer poses on our society is staggering – 25 million years of healthy life lost, at cost of €126 billion including €52 billion in lost productivity – and continues to grow with the ageing of the population. It is imperative, in light of growing financial pressures on our health care systems, that we find ways to make the best use of available resources to deliver high quality cancer care to patients.

This report explores possible ways to make this happen. Built on qualitative and quantitative research for nine countries and the European Union as a whole, it provides a comprehensive overview of the costs of cancer, the health burden (both morbidity and mortality) and resources devoted to its care, culminating in case studies of where efficiencies could be made across the system.

Future cancer care needs to deliver better outcomes to patients by making the best use of available resources.

# INTRODUCTION

**Cancer is the most common cause of death and morbidity in Europe after cardiovascular disease – and causes the equivalent of 25 million years of healthy life lost due to ill-health, disability and death across the European population** (Murray et al., 2015a)**.** The economic burden of cancer is also substantial and has been estimated at **€126 billion in the European Union (EU) every year** (Luengo-Fernandez et al., 2013). With the ageing of the population and changing lifestyles, the prevalence of cancer and the consequent demand for cancer services is predicted to increase further – and with it, the burden on patients, their families and society in general (World Health Organization, 2016).

**At the same time, financial constraints on healthcare systems have focused the attention of governments on ways to cut costs** – and access to some of the most basic forms of cancer care, not to mention new treatments and diagnostics, is often not available or restricted, with significant inequities in access arising as a result.

**Within this context, this report tries to address the following question: how can we best use available resources for cancer care to obtain the best outcomes possible for cancer patients?** Or put differently, how can we make the most efficient use of resources within cancer care – where efficiency is not merely measured in terms of potential cost savings, but in terms of the value derived by both patients and society from given investments across all aspects of cancer care.

To help provide a comprehensive starting point to address the above questions, the report looks at a number of questions in turn:

- **What is the current burden of cancer?**
- **How much do we currently spend on cancer, and how much do we spend relative to other chronic conditions?**
- **What are opportunities to create greater overall efficiencies and reduce inefficiencies in cancer care?**

It is hoped that this compendium of evidence will help inform future debate on how to focus resource allocation towards practices that have the greatest impact on patient outcomes and may help reduce inefficiencies within cancer care and beyond.

## *A few notes on the methodology used in the development of the report*

- Findings are based on both **qualitative and quantitative analysis** research, using a combination of literature reviews, consultation of experts, and our own economic analyses.
- **For each piece of evidence provided in the report, we have used the most recent set of available data, which allows for comparative analyses across Europe.** As a result, the reference years for different pieces of information featured in the report may vary.
- This report aims to present a European overview of existing evidence but also looks at country-level data from **9 countries:** Belgium, Denmark, France, Germany, Italy, the Netherlands, Poland, Sweden, and the United Kingdom (UK).
- **To allow for comparability across countries, country-level data have been adjusted for purchasing power parities (PPP)** – a common technique in economic research to make sure differences in individual countries' are not confounded by different spending levels within each country.
- **All cost estimates have been inflated to 2015 prices.**
- **The burden of cancer and other conditions is reported in DALYs (disability-adjusted life years).** DALYs are a widely used measure that incorporates both the impact of mortality (death) as well as morbidity (ill-health) on individuals (World Health Organization, 2002). They provide information on burden at a population level.[1]
- **Health care expenditure data** were sourced from either peer-reviewed publications or official public data sources such as EuroStat, the official statistics database for the EU. The main source of data for the costs of cancer was a study by Luengo-Fernandez et al. (2013), for which the data relate to 2009. Whilst prices have been inflated to 2015 in calculations of economic burden, the fact that the original estimates date back to 2009 should be taken into consideration. In addition, the methodology used in that analysis uses a bottom-up (rather than top-down) costing approach,[2] which is known to lead to under-estimates of total costs. **As a result, compared with other sources, the direct health care costs for cancer may be underestimated in this report. However, the estimates from the above-mentioned study were used as they allow for robust comparisons between cancer types and with other major diseases, which was a key ambition of this report**.
- **Examples of areas where potential efficiencies could be made in cancer care were obtained from consultation with health economic experts from a number of countries**, who completed a detailed pro-forma. These findings were complemented with a review of the published literature.
- **The potential savings and health gains from smoking cessation and biosimilars are based on modelling** – and assumptions used in these models are described in detail in this report.

[1] DALYs are thus a composite score that considers both the number of years lost of healthy life because of someone dying early and/or experiencing poor quality of life because of their condition.
[2] A top-down costing approach divides the total expenditure on a service by units of activity (e.g. the cost per cancer patient). A bottom-up approach is more comprehensive and involves more detailed costing of all the elements used to cost the service. The different resources used to deliver the service are identified and a value is assigned to each (e.g. the cost of an outpatient attendance by a cancer patient, the cost of an inpatient stay for a cancer patient), these values are then summed and linked to an appropriate unit of activity to generate the unit cost.

## CANCER: A SIGNIFICANT BURDEN TO OUR SOCIETIES

**Despite advances in diagnosis and care and improved prognosis over the past few decades, cancer continues to represent a considerable burden on our societies, accounting for 25 million years of life lost due to ill-health, disability and death in the European Union every year (Murray et al., 2015a).**

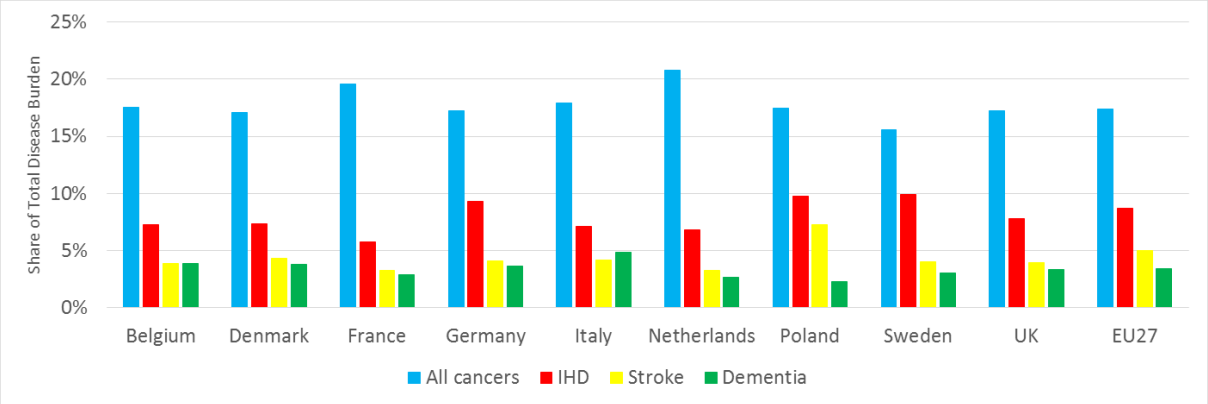
The ageing of the population and the adoption of certain lifestyle factors have contributed to a growing prevalence of cancer in Europe – even if the incidence for certain cancers, for example breast cancer, is decreasing in some countries due to advances in screening and earlier diagnosis.

**In addition, cancer is, in the case of many patients, becoming a chronic condition.** This has two important implications. Advances in diagnosis and treatment have transformed how many patients live 'with and beyond' their cancer, allowing them to live for many years with good quality of life and return to active, productive lives. However, at the same time, many cancer patients who have 'survived' their active treatment still require care and support, and are often dealing with other long term conditions**. This evolution in the nature of cancer thus has important implications for the way we consider the distribution of resources towards cancer care.**

**Cancer represents 17% of the total burden of disease in Europe (EU27) as measured in DALYs – double the share of ischaemic heart disease, over three times that of stroke and five times that of dementia.**

This proportion varies somewhat between countries, as does its relative share compared to other conditions – this is illustrated in the figure below.

**Relative share of total disease burden for all cancers, ischemic heart disease (IHD), stroke and dementia in 2013 (measured in DALYs)**




### *Cancer is not just a health care issue*

**Whilst most policy discussions focus on the direct costs of cancer to our healthcare systems – data suggest that the economic burden of cancer reaches far beyond the confines of the healthcare system, with non-health care costs accounting for 60% of the total cost of cancer (Luengo-Fernandez et al., 2013). Limiting our focus to direct costs of cancer thus underestimates the toll it places on our society.**

Luengo-Fernandez et al.'s analysis of the total economic burden of cancer in Europe found that non-health care costs associated with cancer accounted for the majority of the total cost of cancer. These included productivity losses (€52 billion per year) and informal care (€23 billion per year). By comparison, direct health care costs amounted to €51 billion.

Using those figures as a starting point and adding the costs of long-term care and unpaid work through volunteering and care giving, cost analyses were performed for 9 countries. Findings are presented for Germany as an example in the table below (results for other countries are presented in the data compendium).

**Cost distribution for cancer in Germany, all cancer types combined**

| | Costs included | Total costs per year | % of total economic burden of cancer |
|---|---|---|---|
| Direct health care costs | Primary care, outpatient and inpatient care, emergency care, long-term care and drug costs | €16.85 billion | 40% |
| Production losses | Loss of paid work for patients because of their condition in terms of morbidity and mortality[3] | €15.02 billion | 35% |
| Informal care | Costs of caregivers providing support to cancer patients | €6.97 billion | 16% |
| Unpaid work | Loss of unpaid work which would normally be undertaken by patients (e.g. caregiving and volunteer work), loss due to mortality only | €3.50 billion<br>411 million hours (59% of which are in the voluntary sector) | 8% |
| Total costs | All of the above | €42.34 billion | 100% |

Although the exact distribution across the above components varies between countries, key findings emerged across several countries:

- **The direct costs of cancer to the healthcare system represent less than half of the total costs of cancer** – from 27% of total costs in Denmark to 42% in Italy
- **Of the four main cancer types (lung, breast, colorectal and prostate), lung cancer has the largest economic burden**
- **In all countries, cancer causes a considerable labour market fall out** – and the costs associated with this lost production account for between a third and half of the total economic burden of cancer depending on the country.

[3] Please note our analysis only included unpaid work related to mortality, not morbidity, from cancer.

The evidence is clear that cancer is not just a health care issue, it is a societal issue impacting far beyond an individual patient.

## *How does the amount spent on cancer compare to other conditions?*

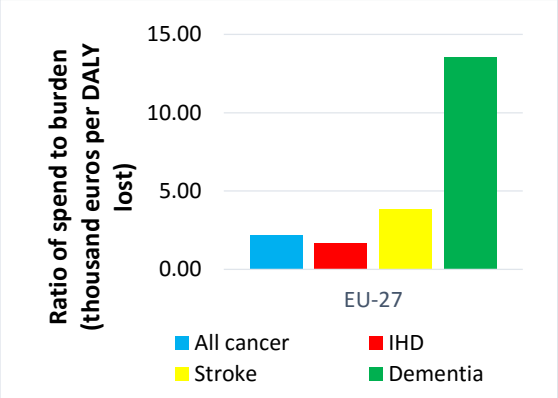
**Across the EU, approximately 5% of all health expenditure goes on cancer, although this varies between countries.**

We compared the ratio of health expenditure to disease burden (as measured in DALYs) for cancer compared with three other conditions: ischaemic heart disease, stroke and dementia.[4]

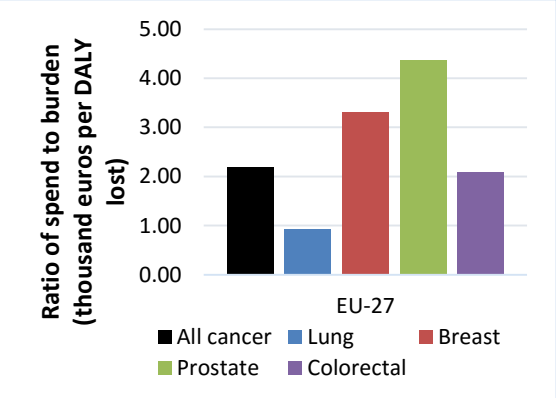
**Overall, this analysis suggests that the relative amount spent compared to its burden is lower for cancer than for some of the other chronic conditions studied (left hand figure below).**

**There are, however, significant differences in terms of how much is spent on each cancer type relative to its burden** – with the spend to burden ratio, for example, being much lower for lung cancer than for breast, prostate or colorectal cancer on average (right hand figure below).

**Spend relative to disease burden (thousands Euros per DALY lost) by disease; EU27 average**




**Spend relative to disease burden (thousands Euros per DALY lost) by cancer type; EU27 average**




**In addition, the amount spent on cancer relative to its burden (measured in DALYs) differs substantially between the countries studied**. The figure below illustrates how the ratios for each country for lung, breast, prostate and colorectal cancer compare to the EU average. Each country ratio has been standardised against the EU average, using the EU average (as presented in the graph above right) as a reference.

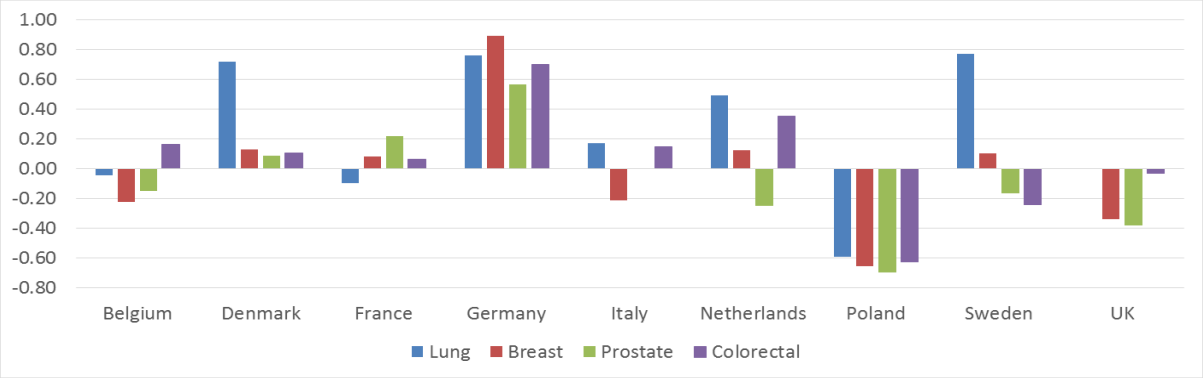
[4] This estimate is subject to the limitations of the data described in our methodology described above (cancer costs may be underestimated). However, this underestimation is similar across the tumour types and conditions included in the analysis, as the same methodology was used to capture costs in each case.

To interpret this graph:

- bars below the line suggest less spend relative to burden compared to the EU average
- bars above the line suggest more spend relative to burden compared to the EU average
- countries where no bar is visible (e.g. Italy for prostate cancer or the UK for lung cancer) indicate that the spend to burden ratio is the same as the EU average.

These comparative ratios do not assume that the EU average is the 'ideal', just a reference. For example, we see that Poland spends much less than the EU average given its cancer burden, while France spends more than the EU average given its burden in all cancers except lung cancer. Denmark and Sweden spend more than the EU average given their lung cancer burden.

**Spend relative to disease burden compared with the European average for each tumour type. A negative number indicates lower spend to burden ratio than the EU27 average.**



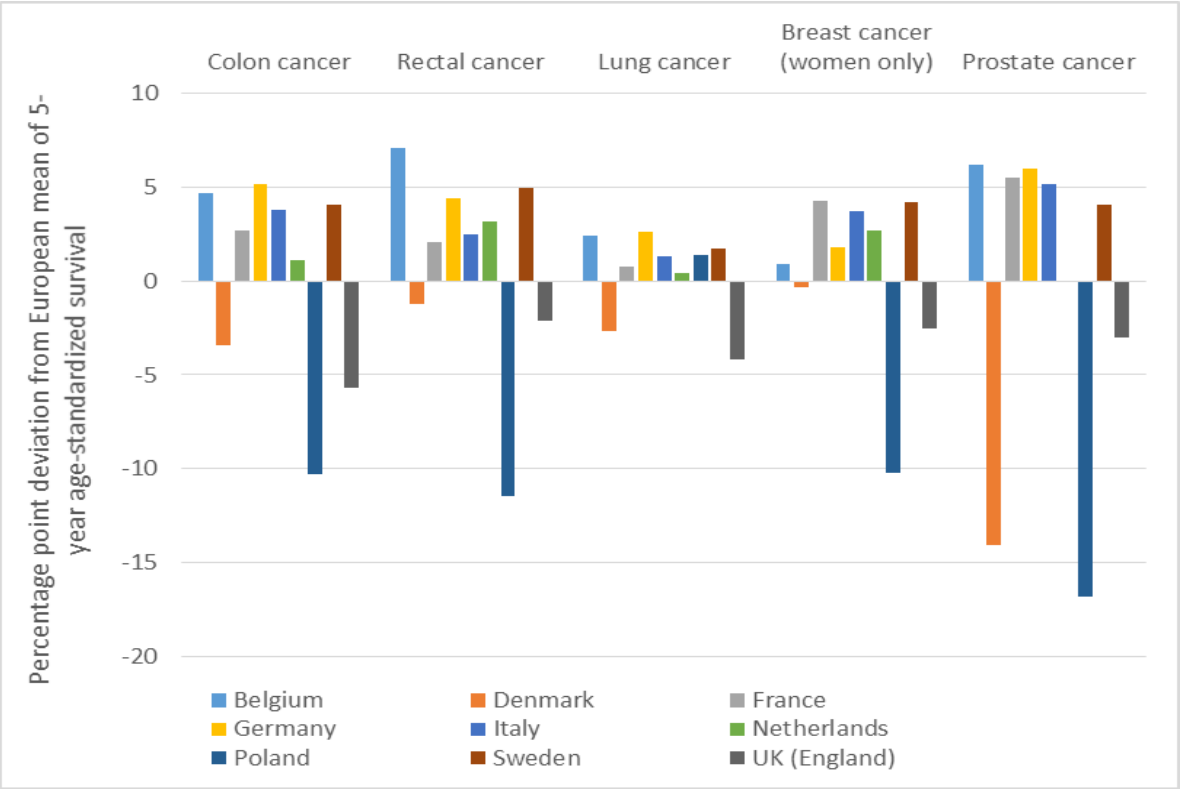

Note: the EU27 average spend relative to disease burden for lung cancer is 0.92; breast cancer is 3.31; prostate cancer is 4.37; and colorectal cancer is 2.08.

## *Is current expenditure on cancer achieving the best possible outcomes for patients?*

**Although survival rates are generally high for cancers in Europe, there are considerable differences in survival rates from different cancers between EU countries, suggesting room for improvement.**

Using the most comprehensive set of European cancer survival data, the Eurocare-5 study, it was found, for example, that the UK and Denmark have worse five-year survival rates relative to the EU average for all five cancer types studied (colon, rectal, lung, breast in women, prostate) and Poland also has worse survival rates for all cancer types other than breast cancer in women (De Angelis et al., 2014).

**5-year age-standardized relative survival for each country relative to the European average (De Angelis et al., 2014). A negative number indicates lower survival rates than the European average.**




Note: the European mean 5-year age-standardised survival for colon cancer is 57.0; rectal cancer is 55.8; lung cancer is 13.0; breast cancer is 81.8; and prostate cancer is 83.4.

It should be noted that these data are illustrative and that relations of causality, for example comparing spending and outcomes, are complex and involve multiple factors. For example, it can be noted that whilst spending on lung cancer in Denmark is high relative to burden compared with the EU average, 5 year survival is poor. Further research is required to understand the relationship between these; whilst the efficiency of spending could be a factor, so too could other issues such as lifestyle factors and late diagnosis (noted to be important in Denmark, for example).

## ACHIEVING GREATER EFFICIENCY: A KEY REQUIREMENT FOR THE FUTURE OF CANCER CARE

The large differences in the outcomes achieved for cancer patients across the EU as well as the inequalities in access to cancer care between countries suggest that much more can be done to improve how resources are devoted to cancer.

**In fact, given the financial pressures on our healthcare systems coupled with the growing prevalence of cancer, finding ways to improve the appropriate allocation of existing resources to achieve the best possible outcomes for patients will be key to the sustainability of our healthcare systems.**

This question is at the heart of the notion of **efficiency** – and concurs with the economic view that resources are scarce, and therefore need to be used in the most effective and efficient way possible.

It is important to note that 'efficiency' should not be viewed as synonymous with 'inducing cost savings': **what is critical is to achieve the best outcomes possible for patients within the resources available.**

## *What are the opportunities to create greater efficiencies in cancer care?*

There is a strong desire across healthcare systems to identify areas where the efficiency of spending can be improved, and there are several examples in the literature where these have been quantified for health care in general. For example, in acute hospitals in England, it has been estimated that if variations across hospitals were eliminated, such that all hospitals performed in line with the best, £5 billion could be saved (Carter, 2016). Whilst the European Federation of Pharmaceutical Industries and Associations (EFPIA) estimates that non-adherence to prescription medicines costs around €125 billion per year in Europe and causes nearly 200,000 premature deaths (EFPIA, 2012). It is also estimated that reducing adverse drug reactions could lead to substantial savings (e.g. up to £466 million a year through reduction in bed days (Academy of Medical Royal Colleges, 2014)).

Further research is required to understand potential efficiency gains for cancer care specifically as there is a paucity of literature that quantifies such inefficiencies. We undertook to identify possible areas where efficiencies could be made in the planning, organisation, funding and delivery of cancer care – or conversely, where inefficiencies could be reduced and resources used more effectively.

Summary findings are outlined in the table below and then described in more detail thereafter.

| Area of cancer care | Examples of where efficiency could be improved |
|---|---|
| Organisation and planning of services | 1. The development and implementation of evidence-based National cancer control plans (NCPPs) |
| | 2. The centralisation of cancer care into high-volume centres – this is particularly critical in the case of rarer cancers |
| | 3. Using multidisciplinary care teams (MDTs) offering a person-centred approach to care |
| Prevention and early diagnosis | 4. Integration of primary prevention strategies targeting alcohol consumption, smoking and obesity into health care pathways |
| | 5. Implementation of quality screening programmes – particularly against breast, cervical and colorectal cancer |
| | 6. Promoting early diagnosis of cancer with training of primary care physicians and provision of good diagnostic testing infrastructure |
| Treatment and care | 7. Reducing inequalities in access to treatment, including innovative therapies |
| | 8. Provision of appropriate care and support to patients beyond the initial phase of treatment |
| Greater efficiency in the assessment and uptake of new medicines | 9. Reduced delays between regulatory approval and national-level access to new medicines through the use of managed entry agreements and greater exploitation of real-world evidence |
| | 10. Prioritisation of interventions which offer the greatest value to patients and society – by considering the full societal impact of new medicines in Health Technology Assessment (HTA) and similar access decisions |
| Greater efficiency in the use of existing medicines | 11. Appropriate use of generics and biosimilar versions of medicines when available |

### *a) The development of national cancer care plans (NCCPs)*

**Although most countries have developed and implemented NCCPs, 20% have insufficient funds to implement them properly.**

A core recommendation of policy frameworks on cancer - e.g. the 2009-2013 European Partnership for Action Against Cancer and the current European Joint Action on Cancer Control (CanCON) - is that all Member States should develop and implement comprehensive National Cancer Control Plans (NCCPs) as an instrumental tool to reducing mortality from cancer across the EU (EPAAC, 2015). However, it is believed

that only Denmark and France have been allocated specific additional funds for all aspects of their programmes (EIU, 2015).

***b) Specialisation and centralisation of cancer care***

**Centralisation of cancer services into specialised centres is regarded as essential to ensure patients receive appropriate diagnosis and high-quality care, and thus achieve optimal outcomes – particularly for rare cancers.**

Different countries have varying degrees of centralisation of cancer care, and in many countries, fragmentation of care has contributed to the inefficient delivery of care to patients.

In France, the notion of centralisation has been a priority in recent cancer care reforms. Since 2009, health care facilities must have specific permission issued by their regional health authority ('*Agence Régionale de Santé*') to treat cancer patients (INCa, 2015a). They have to demonstrate that they meet minimum activity thresholds, measured in terms of annual activity levels for surgery, radiotherapy, and chemotherapy. In addition, networks linking regional cancer facilities have been established, with designated centres of reference and other accepted centres ('*centres de compétence*').

It should be mentioned that the evidence supporting the impact of centralisation of care on patient outcomes is mixed, with results often varying depending on the type of cancer and the national context of each study. However, centralisation of care in high-volume hospitals has been shown to be critical in the case of rare cancers, where it has a marked impact on patient outcomes.

***c) A multidisciplinary, person-centred approach to diagnosis and care***

**Appropriately funded multi-disciplinary care teams are central to providing patients with person-centred care throughout all phases of their disease.**

It is widely recognised that cancer care should ideally be organised around the individual needs of the patient, and delivered by a multidisciplinary care team which includes the appropriate combination of professionals to be able to address the physical, emotional and psychological needs of cancer patients along the entire care pathway.

Implementation of multidisciplinary care teams (MDTs), however, often falls short due to limited resources, embedded professional hierarchies, and lack of information exchange between professionals (KCE, 2015).

Belgium provides a promising example in this regard: The NCCP for Belgium calls for all cancer care programmes to have a multidisciplinary team available to support cancer patients, and provides specific remuneration to hospitals to fund extra manpower to fulfil key roles, including oncology nurses, psycho-oncologists, social workers and data managers. In addition, specialist oncology nurses coordinate the care and support for patients throughout all stages of care (KCE, 2015).

***d) Integration of prevention strategies targeting alcohol consumption, smoking and obesity into health care delivery***

**Public health and health promotion efforts should particularly target more deprived populations, who have higher cancer incidence rates.**

In England for example, if socio-economically deprived groups (that is the most deprived) had the same incidence rates as the least deprived, there would be 15,300

fewer cancer cases per year (of which 11,700 are lung) and 19,200 fewer deaths (Independent Cancer Taskforce, 2015).

***e) Implementation of quality screening programmes – particularly for breast, cervical and colorectal cancer***

**There are significant differences in levels of uptake of all three types of cancer screening programmes between countries – for example, only 21% of Polish women had cervical cancer screening (Ministerstwo Zdrowia, 2015) as compared to 80% of Swedish women in 2013 (Eurostat, 2016).**

Although there is some debate as to the impact of screening on reducing mortality rates, particularly for breast cancer, greater uptake of high-quality screening programmes is likely to have a positive impact on the burden of cancers amenable to screening in future, particularly if screening tests become more advanced and greater risk stratification is achieved for target populations. Note that the European Commission's *Action Against Cancer* (European Commission, 2009) targets achieving 100% population coverage of screening for breast, cervical and colorectal cancer.

***f) Earlier diagnosis***

**Training of primary care physicians (GPs) and provision of good diagnostic testing infrastructure are key to allow for early and accurate diagnosis of patients presenting with any possible cancer symptoms.**

In England for example, 38% of lung cancer cases, 25% of colorectal cancer cases and 4.6% of breast cancer cases present as an emergency presentation – often at an advanced stage where prognosis is already severely compromised (Elliss-Brookes et al., 2012). This late diagnosis has a detrimental impact on survival. For example, one-year survival for patients diagnosed through emergency presentation for lung cancer is 11% as compared to 28.6% for patients identified through other routes of diagnosis (Elliss-Brookes et al., 2012).

To try to improve early diagnosis of cancers by GPs, the National Institute for Health and Care Excellence (NICE) has developed guidance on 'Suspected cancer: recognition and referral' to help improve recognition and referral of suspected cancer cases. Also, infographics have been distributed to GPs in England and published in the *British Medical Journal* (Stahl-Timmins, 2015).

***g) Reducing inequalities in access to care – for example, ensuring greater use of radiotherapy in accordance with evidence-based recommendations***

**One area of treatment which is known to be under-utilised for many cancers is radiotherapy – there is wide variability in access to radiotherapy machines between countries and median utilisation across Europe is 70% of optimal usage as predicted by evidence-based estimates (Borras et al., 2015).**

Under-provision of radiotherapy is a significant problem globally – and a recent analysis suggested that scaling up radiotherapy capacity from 2015-2035 could result in a net monetary benefit of up to $239.3 billion in upper-middle income countries alone (equivalent to €217.5 billion), and save the equivalent of 10.7 million life-years (Atun et al., 2015).

***h) Provision of appropriate care and support beyond the initial phase of treatment***

**With a growing number of patients living longer with cancer, the care and support needs of patients beyond their initial phase of treatment need to be addressed in cancer care pathways.**

**For example, a recent UK report estimated that investing in appropriate follow-up care for cancer patients through personalised care planning may result in savings of €542 million per year,** as supporting people with cancer beyond their initial treatment costs the NHS in England at least €1.8 billion per year, excluding end-of-life care (Macmillan Cancer Support, 2015). At least €168 million was spent on inpatient hospital care, when patients should instead be receiving long-term support and management which may have prevented the need for emergency hospital admissions.[5]

***i) Greater efficiency in the assessment and uptake of new drugs***

**Significant delays between the time of regulatory approval by the European Medicines Agency (EMA) and national 'access' for patients are evidenced in many countries – frequently exceeding the recommended 180 day limit set by the European Commission.**

Observed delays are due in part to different evidentiary requirements and processes for pricing and reimbursement, as well as HTA, and decentralisation of these decisions to the regional level in many countries (e.g. Italy and Spain). Delays in access may also result from certain practices, for example lack of integration of a new treatment into clinical pathways – and these access delays may thus also vary between cancer types within the same country.

**Managed entry agreements are increasingly being explored as a way to provide early access to patients to promising new medicines**, whilst providing an opportunity to collect real-world evidence of the impact of these new interventions on patient outcomes and the use of resources.

In addition, **early access schemes** such as the Autorisation Temporaire d'Utilisation (ATU) scheme in France have been shown to advance access to patients to given treatments by up to 3 years (Degrassat-Théas et al., 2013). A different approach, which is currently being piloted by the EMA, is the 'Adaptive Pathways' programme. This scheme involves the iterative expansion of license based on the collection of further data, often in real-world settings. It has the potential to provide earlier access to patients in the greatest need who are most likely to benefit.

**Finally, HTA and similar agencies need to consider the full societal value of new medicines in their evaluation, that is not just clinical outcomes but also the impact on quality of life, lost productivity and caregiver time.**

Better integration of patients' perspectives in HTA decisions is notably key to ensuring that new medicines that may meet patients' needs are prioritised.

[5] Original figures were cited in Pounds sterling and have been converted into Euros. The original figures were: £420 million of savings through appropriate investment in follow up care, £1.4 billion currently spent supporting people with cancer beyond their initial treatment phase, and £130 million spent on inpatient hospital care.

# QUANTIFYING POTENTIAL EFFICIENCIES TO BE MADE – CASE STUDIES OF SMOKING CESSATION AND INCREASING THE USE OF BIOSIMILARS AND GENERICS

As part of this report, we also performed a number of case studies to try to quantify the impact of possible measures that may help generate savings that could be reinvested within the healthcare system – and cancer care in particular, or achieve greater patient outcomes. These included: reducing smoking prevalence and increasing the appropriate use of biosimilars[6] and generics.[7]

**Summary findings:**

- A 25% reduction in smoking prevalence in the 9 target countries would result in total cost savings of €6 billion, of which the largest economic gains are from lung cancer treatment costs and production gains for individuals.
- Total savings of €7.1 billion could be made through increased generic and biosimilar competition in the oncology market – of which €4.5 billion are attributable to greater appropriate use of generics and €2.6 billion of biosimilars.

These two case studies are described in more detail below.

## *Case study: Quantifying the impact of reducing the prevalence of smoking*

Tobacco use, particularly cigarette smoking, is one of the leading causes of cancer. Although most commonly thought of as being the main cause of lung cancer, there are in fact several other tobacco-related cancers (TRCs) (see table below).

A model was constructed using Excel 2013 to evaluate the impact on lung cancer of a 25% reduction in smoking prevalence in 9 target countries (note: similar percentage reductions have been seen historically in Europe (ONS, 2013)). Lung cancer was chosen as the main outcome of this model because it has the highest mortality rate of all tobacco-related cancers.

[6] It is important to note that this report in no way advocates the use of non-equivalent biosimilars or unsuitable generics – this model is a mere simulation of the impact of an increased use of biosimilars and generics but the underlying assumption would be that only biosimilars and generics that conform to proper regulatory guidance for development are used.
[7] It should be noted that the report also looked at a number of other case studies of measures which may help either generate cost savings or improve patient outcomes.

**Proportion of cancer cases attributed to smoking (Agudo et al., 2012)**

| Tobacco Related Cancer (TRC) | Attributable Fraction [a, b] |
|---|---|
| **Larynx** | 84% |
| **Lung** | 82% |
| **Lower urinary tract** | 50% |
| **Oropharynx** | 49% |
| **Oesophagus** | 35% |
| **Oral cavity** | 33% |
| **Liver** | 25% |
| **Stomach** | 21% |
| **Colon and rectum** | 14% |
| **Uterine cervix** | 14% |
| **Pancreas** | 13% |
| **Myeloid leukemia** | 13% |
| **Kidney** | 8% |

[a] The attributable fraction measures the public health burden of a risk factor by estimating the proportion of cases of a disease that would not have occurred in the absence of this risk factor.
[b] Estimates were adjusted for sex, age, education, body mass index, physical activity, alcohol consumption, total energy intake, and consumption of fruit and vegetables, assuming a population equally distributed by sex.

Because smoking is a known risk factor for lung cancer, fewer active smokers would be expected to result in lower lung cancer incidence and mortality. These health gains would translate into less health care use, less informal care and production gains in terms of both paid and unpaid work. It is important to note that a proportion of lung cancer patients are non-smokers/have never smoked, such that this intervention would not affect them.

According to the model, a 25% reduction in smoking prevalence in the 9 target countries would result in:

- 43,000 fewer cases of lung cancer (a 15-20% decrease in incidence) per year
- 36,700 fewer deaths from lung cancer (a 15-20% decrease in mortality) per year
- Over 600,000 life years gained per year
- Total cost savings of €6 billion, of which the largest economic gains are from lung cancer treatment costs and production gains for individuals.

**It should be stated that the potential health gains and cost savings associated with a reduced prevalence of smoking will not be limited to lung cancer** – as the incidence and mortality of other tobacco-related cancers, as well as other smoking-related diseases (e.g. other pulmonary diseases, cardiovascular and metabolic diseases) would also be expected to decrease.

**What's more, better health for individuals who would otherwise have had lung cancer generates significant economic benefits for society** in terms of production gains, increased unpaid work and reduced need for informal care.

## *Case study: Generating savings from greater appropriate use of biosimilars and generics*

We also modelled the potential impact of increasing the appropriate use of both generics and biosimilars in oncology, using two particular products as examples.

**A number of biologicals are moving off-patent in the next few years and a rise in the development of biosimilars is predicted.** Some 22 biosimilars have been approved by the EMA in three classes: erythropoietins (EPOs), granulocyte colony-stimulating factors (GCSFs) and human growth hormone.

**As with generics, one may assume that increased use of biosimilars upon patent expiry of their Reference Biologic Product (RBP) may result in savings for healthcare systems.** However, the inherent complexities in the manufacturing, development and regulation of biosimilars entail several entry barriers – and there remain considerable uncertainties as to how the biosimilar market may develop in years to come.

**As a result, the relative market share and price reductions observed with biosimilars are lower than with generics as a result.**

**Biosimilars have typically been priced 25-30% lower than their RBP (not counting rebates), whereas generics have led to price decreases of 70-80% by comparison (IMS Health, 2011; Grabowski, Guha and Salgado, 2014).**

Countries have adopted different incentives to encourage biosimilar competition, and competitive performance varies both between countries and between products within countries as a result (see table below).

**Incentives for biosimilars in different European countries (Grabowski et al., 2014)**

| | Germany | France | Italy | UK | Sweden |
|---|---|---|---|---|---|
| **High generic usage** | Yes | No | No | Yes | Yes |
| **Quotas** | Yes | No | Yes | No | No |
| **Reference price system for biosimilars** | Yes | No | No | No | No |
| **Price relative to reference brand** | Variable | Fixed | Fixed | Variable | Variable |
| **Patient co-payments** | Capped | Mixed | Mixed | No | Capped |

A model was developed in Excel to estimate the potential sales of a biosimilar (from a targeted monoclonal antibody used in breast cancer) and a generic (from a tyrosine kinase inhibitor used to treat chronic myeloid leukaemia) using two possible scenarios: one based on expected market penetration and price reductions observed with biosimilars (scenario A), and one using similar estimates as observed with generics (scenario B), see table below.

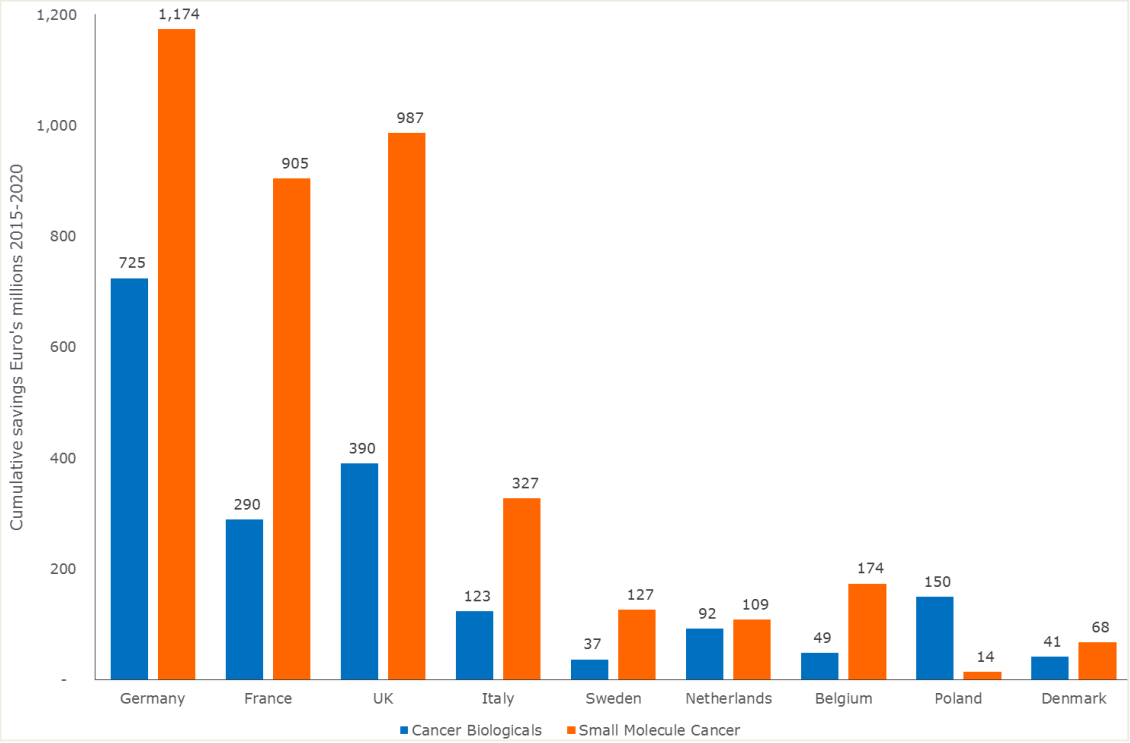
**Scenarios used to model potential savings from generics and biosimilars**

| Baseline assumptions | Scenario A | Scenario B |
|---|---|---|
| **Market share (%)** | 30% | 60% |
| **Price relative to protected original brand (without counting discounts)** | 75% | 30% |

**Both scenarios yielded significant potential cost savings, however these varied per country and, as expected, were much greater for scenario B than for scenario A**. For example, the model predicted that for the 9 countries in total annual potential cost savings of €90.8 million for the targeted monoclonal antibody could be achieved based on scenario A, and this figure rises to €508 million under scenario B. The corresponding results for the tyrosine kinase inhibitor were €66.5 million under scenario A and €372 million under scenario B.

**This analysis was extended to look at all cancer medicines that are facing loss of exclusivity (LOE) due to patent expiry between 2015 and 2020** – encompassing 7 biologicals and 17 small molecule medicines in all. These products together represented total sales for EU26 of €15.8 billion in 2015 (ex-factory prices). Assumptions are therefore based on ex-factory (list) prices; in reality discounts are often applied to these list prices so that actual savings may be lower than estimated. The figure below shows the accumulative savings that are potentially achievable in each country.

**Potential savings due to loss of exclusivity (LOE) for cancer medicines facing LOE 2015-2020, realised between 2016 and 2020, by country [Source: IMS Health, MIDAS 2015, GMI Adhoc Services]**



**It was estimated that total savings of €7.1 billion could be made through generic and biosimilar competition in the oncology market – of which €4.5 billion occur for generics and €2.6 billion occur for biosimilars.**

***An important note about biosimilars***

**Biosimilars are large molecules that are similar, but not identical, to their biological reference biological product (RBP) and have demonstrated equivalent safety and efficacy in patients.** Because they too are derived from a biological synthesis, even a small deviation from manufacturing processes may alter them and cause potential adverse events in patients. Also, biosimilars need official approval when entering the market upon patent expiry of their reference biological product and the EMA has a specific pathway for assessing biosimilars, which is more complex than for generics. Finally, the issue of patient safety is also critical with biosimilars, and investment in high-quality outcomes and safety data collection is necessary to evaluate the impact of biosimilars on patient safety and efficacy over time.

## CONCLUSION

The burden of cancer on our societies is growing, and in parallel, financial pressures on our healthcare systems are increasing, with many patients across Europe not receiving the care they need to achieve the best health outcomes.

This report was intended to explore the economic burden of cancer on our society – as well as investigate areas where more effective and efficient use of existing resources can be made. The report does not aim to answer the question of whether the amounts we are currently devoting to cancer are adequate – this depends on individual countries' available resources, prioritisation of cancer with respect to other conditions, and the societal value that governments and their populations place on different conditions.

This being said, the report does explore measures which could be taken to free up resources that could be re-invested within the system. The case studies provided are illustrative – and point to the fact that opportunities exist to increase funding for cancer care (and health more generally).

The past few decades have brought considerable advances for cancer patients – and yet the challenges remaining are real, especially as financial constraints on health care budgets drive greater inequalities in access to care both within and across countries. A solution lies in improving the allocation – and efficiency – of resources across the spectrum of cancer care, never losing sight of the goal to improve survival and outcomes for patients.

A key part of this solution is developing a better understanding of the economic data surrounding cancer. This report aims to contribute to this knowledge and hopes to move the debate forward – and help improve the care we offer cancer patients as a result.

# INTRODUCTION

It is time to transform the delivery of cancer care; change is needed to shift resources to where it matters most, providing quality care to patients to improve outcomes. There are inefficiencies and waste in all health care systems; improvements in practice and policy could release resources in order to more appropriately and address the growing health and economic burden. Some systems could benefit from doing *more* of what they are currently doing, others may benefit by doing it *better*, and all systems will need to make choices about undertaking *investments* in new innovative cancer therapies. Each of these requires new funding for health and cancer specifically, or divestment in inappropriate/inefficient practices, in order to realise efficiency savings. Given that cancer is the most common cause of death and morbidity in Europe after cardiovascular diseases (WHO, 2016), and the burden is expected to increase due to both population ageing and the increasing adoption of cancer-causing behaviours, such as smoking, physical inactivity and poor diet (WHO, 2016), change and transformation are needed now.

This report presents information on the context of cancer and cancer care in Europe, in order to inform future (and much-needed) debate on how to improve policies and practices to reduce inefficiencies and promote efficiency in the system, i.e. improve resource allocation to improve patient outcomes. The report presents statistics on the relative burden of cancer, in the context of expenditure and disease burden; qualitative discussion pertaining to the health care, cancer care and policy landscape in specific European countries and more widely in the EU; and potential scenarios where improvements in practice and/or policy could release resources in order to more appropriately and address the growing burden. While the evidence in this report comes from existing sources, the report's originality and contribution are the synthesis of the data and the correlations of different dimensions of evidence, particularly the comparisons of expenditure and burden. This report also documents, for the first time, different efficient and inefficient practices across Europe.

This report sets out the evidence base on expenditure, burden and (in)efficiencies. Results are presented at the European Union level and for nine member states: Belgium, Denmark, France, Germany, Italy, the Netherlands, Poland, Sweden and the United Kingdom (UK).

The report is structured in three sections.

- Section 1 considers the burden of cancer, in terms of government expenditure, disease burden and economic burden. It includes a comparison of health and non-health expenditure and a breakdown of total spending on cancer, and comparable spending on other diseases in each target country, as well as EU-wide totals. The analysis also includes estimates of the broader socio-economic cost of cancer, e.g. estimates of productivity loss and informal care costs.
- Section 2 sets out the country-specific information we have gathered on the health care landscape, specifically efficient and inefficient practices in nine European countries. This includes information and evidence on cancer care and patient access. The focus is the better use of interventions and processes that can deliver cost savings, thus freeing up resources to allow for the wider adoption of underutilised but effective therapies, as well as new and innovative cancer treatments. Additionally it also reviews reimbursement and funding mechanisms each country, and the

influence these have on the availability of new and innovative treatments. This section concludes with country-specific summaries for each of the nine countries.

- In Section 3 we model the potential efficiency savings that could be created by adopting three innovative cancer interventions (risk-reduction measures, screening, and biosimilars), and also discusses options for increasing the funding available to cancer by exploring alternative funding models, including ring-fenced funding and tobacco taxation. The section concludes with an example approach to estimating the efficiency of a health care system. The analysis is such that we are able to identify what countries utilise their health care resources most efficiently to achieve the best health outcomes.

# SECTION 1: THE BURDEN OF CANCER AND CANCER CARE

Cancer is the most important cause of death and morbidity in Europe after cardiovascular diseases. The burden of cancer continues to increase due to population ageing and the adoption of cancer-causing behaviours. This has resulted in growing need for oncology services in Europe and worldwide. Given the increasing demand for and spending on oncology treatments, it is important to promote the efficient delivery of cancer care, thus achieving efficiency savings within the current budget. Such savings could be used for a number of purposes, including making funding available for treatment innovations that demonstrate good value in improving quality of life and survival for cancer patients.

In this section we present both the economic burden and the disease burden of cancer, in order to gain a macro-level understanding of the magnitude of both the problem and each country's current level of effort to address it. Gaining an understanding of what countries are currently doing, with respect to how much they are spending and how much burden they are experiencing, provides the necessary context for the latter sections of the report where possible improvements in cancer care delivery and funding alternatives are discussed.

The section begins (subsection 1.1) with an assessment of government expenditure on health versus other areas of spending for governments. This provides some context to the report, and indicates the relative prioritisation of health by governments compared with other government expenditure and other European countries. We also provide a brief analysis of other sources of expenditure on health, and their relative magnitude in the countries studied (e.g. the extent of spending on health through private insurance and out-of-pocket expenditure). In subsection 1.2, we take a broader view of health expenditure (by all financing parties) and consider total expenditure on health care for cancer specifically and by cancer type. We then compare this with the burden of cancer, in terms of a metric that captures lives lost and poor quality of life. Finally, in subsection 1.3 we consider the broader economic costs that cancer imposes on society, which includes productivity losses both paid and unpaid work, and the cost of informal care (e.g. by friends and family), which are often ignored.

## 1.1. *Health and non-health government expenditure*

In order to gain insight with respect to the funding situation specifically for cancer care in Europe, in this section we describe government expenditure on health versus other government expenditure, and how this compares between countries. This provides some context on the relative prioritisation of health by governments, and sets the scene for the rest of the report, where the main objective is to outline how the efficiency of spending can be improved.

### 1.1.1. Method

Data on health and non-health expenditure analysed in this section were taken from the Eurostat database. Eurostat collects annual government finance statistics data on the basis of the European System of Accounts (ESA2010) transmission programme (Eurostat, 2015f). Member states provide data on "Expenditure of general government

by function" twelve months after the end of the reference period.[8] The functions included in the report are:

- **General public services**: including expenditure for executive and legislative organs, financial and fiscal affairs, external-affairs foreign economic aid, basic research, R & D related to general public services, public debt services, and transfers of a general character between different levels of government.
- **Defence**: including expenditure for military and civil defence, foreign military aid, and R & D related to defence.
- **Public order and safety**: including expenditure for police, fire-protection services, law courts, prisons, and R & D related to public order and safety.
- **Economic affairs**: including expenditure for general economic, labour and commercial affairs; agriculture, forestry, fishing and hunting; fuel and energy; mining, manufacturing and construction; transport; communication; other industries; and related R & D.
- **Environmental protection**: including expenditure for waste and water waste management, pollution abatement, protection of biodiversity and landscape, and related R & D.
- **Health**: including expenditure for medical products; appliances and equipment; outpatient, hospital and public health services; and health-related R & D.
- **Housing and community amenities**: including expenditure for housing development, community development, water supply, street lighting, and related R & D.
- **Recreation, culture and religion**: including expenditure for recreation and sport, cultural services, broadcasting and publishing services, religious and other community services, and related R & D.
- **Education**: including expenditure for pre-primary, primary, secondary and tertiary education; post-secondary non-tertiary education; education non-definable by level; subsidiary services to education; and related R & D.
- **Social protection**: including expenditure for sickness and disability, old age pensions and survivors' pensions, family and children, unemployment, housing, social exclusion, and related R & D.

The main reference year used in this analysis is 2013 as this is the latest year data are available for most countries.

### 1.1.2. Results

According to the Eurostat data, in 2013 EU28 general government expenditures amounted to nearly €6.6 trillion, the same level as in 2012. General government expenditures, in the same year, amounted to over €1.2 trillion for Germany and France, to nearly €1 trillion for the United Kingdom (UK) and to over €0.5 trillion on average for the nine countries included in the analysis. General government expenditures have been growing in the period 2005–13 for all nine countries included in the analysis. Table 1 shows the general government expenditure by country for the period 2005–2013.

[8] Eurostat was extracted on 6 July 2015. Data are for the period 2005 to 2013, the latest available.

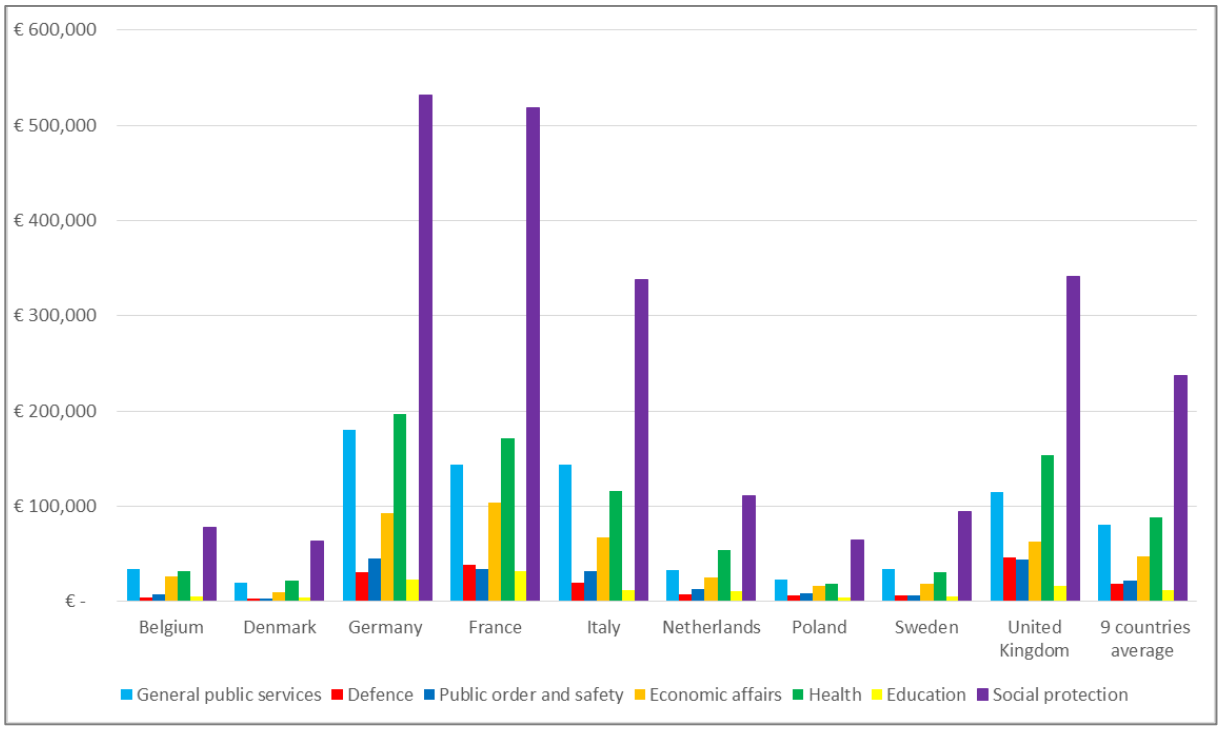
**Table 1. Total general government expenditure – €million**

| Country | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|
| EU-28 European Union | : | € 5,543,244 | € 5,794,530 | € 6,035,184 | € 6,158,827 | € 6,390,176 | € 6,392,132 | € 6,571,353 | € 6,573,141 |
| Belgium | € 158,316 | € 156,079 | € 164,154 | € 175,530 | € 186,055 | € 191,394 | € 202,282 | € 212,702 | € 215,078 |
| Denmark | € 109,059 | € 112,382 | € 115,738 | € 121,799 | € 130,756 | € 137,810 | € 139,877 | € 147,486 | € 144,371 |
| Germany | € 1,059,389 | € 1,065,651 | € 1,072,990 | € 1,112,309 | € 1,165,304 | € 1,215,270 | € 1,202,749 | € 1,215,231 | € 1,245,262 |
| France | € 936,988 | € 972,839 | € 1,016,168 | € 1,057,610 | € 1,100,609 | € 1,128,017 | € 1,151,537 | € 1,185,375 | € 1,207,492 |
| Italy | € 702,315 | € 737,532 | € 753,127 | € 780,664 | € 804,661 | € 800,494 | € 804,933 | € 820,320 | € 817,509 |
| Netherlands | € 230,884 | € 249,298 | € 260,353 | € 278,455 | € 297,536 | € 304,447 | € 302,269 | € 304,035 | € 300,788 |
| Poland | € 108,822 | € 122,166 | € 135,067 | € 161,561 | € 142,272 | € 165,073 | € 165,666 | € 165,620 | € 167,144 |
| Sweden | € 165,037 | € 171,955 | € 176,978 | € 177,342 | € 164,433 | € 188,847 | € 204,698 | € 218,731 | € 228,133 |
| United Kingdom | € 831,381 | € 884,893 | € 927,999 | € 888,691 | € 827,085 | € 883,638 | € 872,336 | € 958,865 | € 918,566 |
| 9 countries average | € 478,021 | € 496,977 | € 513,619 | € 528,218 | € 535,412 | € 557,221 | € 560,705 | € 580,929 | € 582,705 |

Source: Eurostat. Last update 6 November 2015. Accessed 18 November 2015.

Categorising the nature of the government expenditure by economic function for the EU28, more than half of government expenditure in 2013 was spent on "social protection" and "health" (over €3.6 trillion out of the nearly €6.6 trillion of total general government expenditure). Denmark spent 59.3% of the total government expenditure on "social protection" and "health", Germany 58.3%, France 57.1%, Italy 55.4%, Sweden 54.7%, the Netherlands 54.5%, the UK 53.7%, Belgium 50.7% and Poland 49.2%. Figure 1 presents the details by country for the year 2013.

**Figure 1. Total general government expenditure by function, 2013 (€million)**




Data source: Author's calculation from Eurostat data.

In the EU28 and in all the nine countries included in the analysis, "social protection" was the government expenditure function with the largest share of GDP. In 2013, government social protection expenditure in the EU28 was equivalent to 19.6% of GDP.

The next most important functions in terms of government expenditure were "health" and "general public services", amounting to 7.2% and 6.8% respectively of GDP in the EU28 in 2013, followed by "education" (5.0% of GDP) and "economic affairs" (4.3% of GDP). Denmark and the Netherlands have the highest ratio of "health" spending to GDP with 8.7% and 8.3% respectively. Table 2 shows the breakdown of each expenditure function by country for the year 2013.

**Table 2. Total general government expenditure by function, 2013 (% of GDP)**

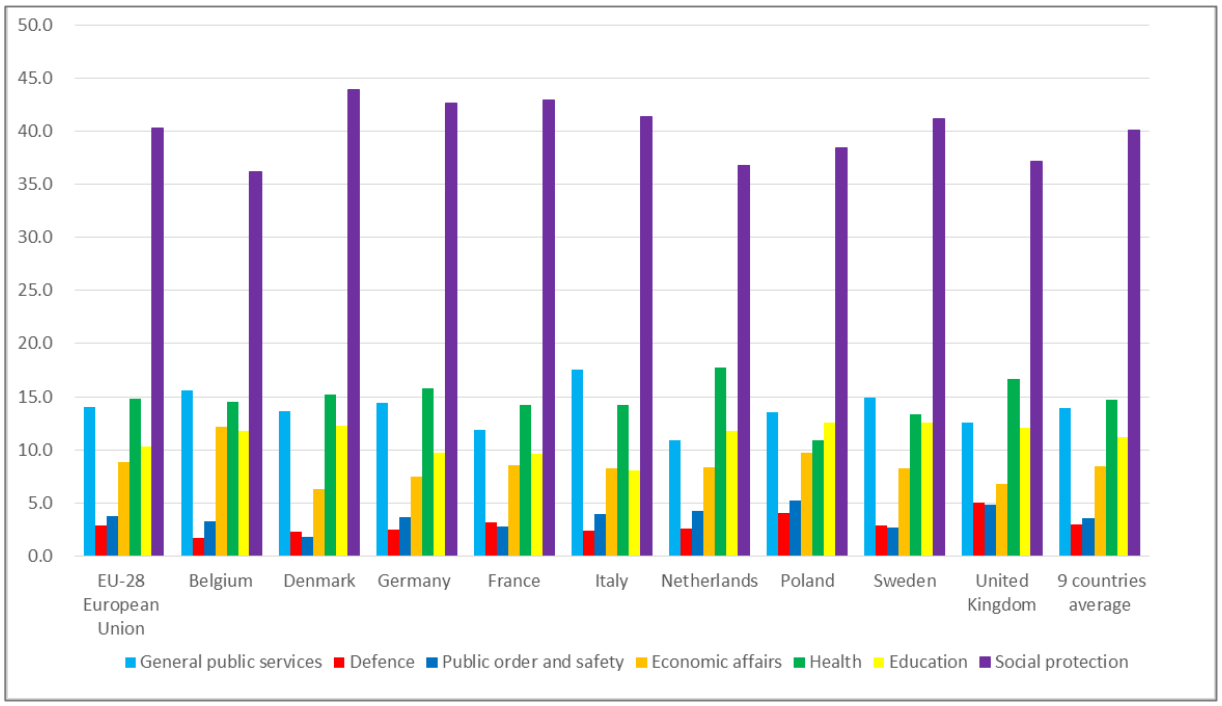
| Country | General public services | Defence | Public order and safety | Economic affairs | Environment protection | Housing and community amenities |
|---|---|---|---|---|---|---|
| **EU-28 European Union** | 6.8 | 1.4 | 1.8 | 4.3 | 0.8 | 0.7 |
| **Belgium** | 8.5 | 0.9 | 1.8 | 6.6 | 1.0 | 0.3 |
| **Denmark** | 7.8 | 1.3 | 1.0 | 3.6 | 0.4 | 0.3 |
| **Germany** | 6.4 | 1.1 | 1.6 | 3.3 | 0.6 | 0.4 |
| **France** | 6.8 | 1.8 | 1.6 | 4.9 | 1.0 | 1.4 |
| **Italy** | 8.9 | 1.2 | 2.0 | 4.2 | 0.9 | 0.7 |
| **Netherlands** | 5.1 | 1.2 | 2.0 | 3.9 | 1.5 | 0.5 |
| **Poland** | 5.7 | 1.7 | 2.2 | 4.1 | 0.7 | 0.7 |
| **Sweden** | 7.8 | 1.5 | 1.4 | 4.3 | 0.3 | 0.7 |
| **United Kingdom** | 5.7 | 2.3 | 2.2 | 3.1 | 0.8 | 0.7 |
| **9 countries average** | 7.0 | 1.4 | 1.8 | 4.2 | 0.8 | 0.6 |

| Country | Health | Recreation, culture and religion | Education | Social protection | Total |
|---|---|---|---|---|---|
| **EU-28 European Union** | 7.2 | 1.0 | 5.0 | 19.6 | 48.6 |
| **Belgium** | 7.9 | 1.3 | 6.4 | 19.7 | 54.4 |
| **Denmark** | 8.7 | 1.8 | 7.0 | 25.1 | 57.0 |
| **Germany** | 7.0 | 0.8 | 4.3 | 18.9 | 44.4 |
| **France** | 8.1 | 1.5 | 5.5 | 24.5 | 57.1 |
| **Italy** | 7.2 | 0.7 | 4.1 | 21.0 | 50.9 |
| **Netherlands** | 8.3 | 1.6 | 5.5 | 17.2 | 46.8 |
| **Poland** | 4.6 | 1.1 | 5.3 | 16.2 | 42.3 |
| **Sweden** | 7.0 | 1.1 | 6.6 | 21.6 | 52.3 |
| **United Kingdom** | 7.6 | 0.8 | 5.5 | 16.9 | 45.6 |
| **9 countries average** | 7.4 | 1.2 | 5.6 | 20.1 | 50.1 |

Source: Eurostat. Last update 6 November 2015. Accessed 18 November 2015.

In the EU28, "social protection" and "health" generally represent the highest expenditures for government; in all the countries included in the analysis, with the exception of Poland, these two categories accounted for over 50% of the total government expenditure in 2013; see Figure 2. Government "social protection" expenditure in the EU28 was equivalent to 40.3% of total government expenditure and "health" was equivalent to 14.8%. The values for the average of the nine countries are very similar to the EU28 figures, respectively 40.1% for "social protection" and 14.7% for "health".

**Figure 2. Total general government expenditure by function in 2013 as % of the total general government expenditure**




Data source: Author's calculation from Eurostat data.

Details of government expenditure by functions as a ratio of GDP and ratio of total government expenditure by country and by year are presented in Appendix I – Health and non-health expenditure.

The above analysis considers only government expenditure on health. It is important to note that the extent of private health expenditure (through either private insurance or out-of-pocket payments) which supplements government expenditure differs by country, as demonstrated in Table 3.

**Table 3. Health care expenditure by financing agent, 2012 (% of current health expenditure)**

| | General government and social security funds | Private insurance (including private social insurance) | Private household out-of-pocket expenditure | Other (non-profit institutions & corporations other than health insurance) |
|---|---|---|---|---|
| **Belgium** | 75.2% | 4.2% | 20.4% | 0.2% |
| **Denmark** | 85.2% | 1.8% | 12.9% | 0.1% |
| **Germany** | 77.2% | 9.6% | 12.2% | 1.0% |
| **France** | 77.7% | 13.8% | 7.8% | 0.6% |
| **Netherlands** | 85.8% | 5.5% | 6.0% | 2.8% |
| **Poland** | 70% | 0.8% | 24.3% | 5.0% |
| **Sweden** | 81.2% | 0.3% | 17.5% | 1.0% |

Data unavailable for Italy and the UK. Source: Eurostat (online data code: hlth_sha_hf).

In the next section we focus specifically on cancer expenditure, and compare this with the burden of disease that cancer poses across Europe.

## 1.2. *Cancer expenditure and disease burden in Europe*

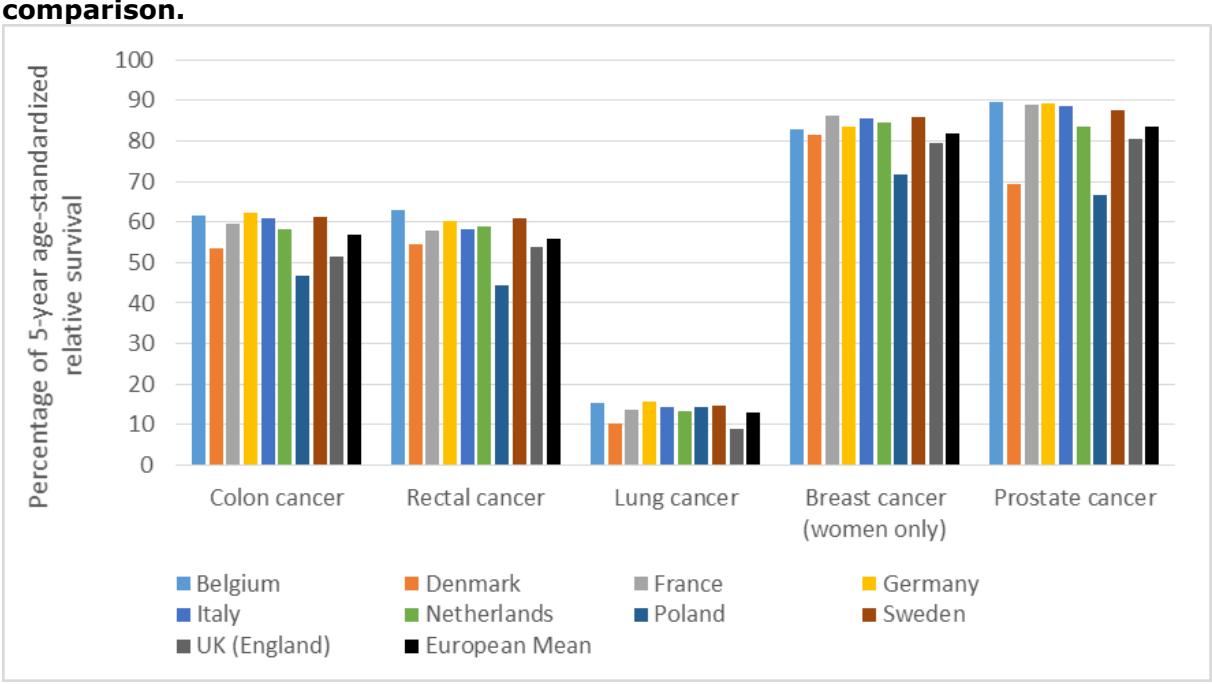
In this subsection we consider the impact of cancer on the European population, and the cost of cancer to Europe.

### 1.2.1. Background

Cancer is a major cause of morbidity and mortality across the globe; however, cancer care and its outcomes vary between countries (IARC, 2014). The five-year age-standardised survival rates per cancer type from EUROCARE-5 are presented in Figure 3 for the European mean (29 countries in Europe) and for each of the nine countries. The figure shows cancer patients diagnosed between 2000 and 2007 enlisted in EUROCARE, the largest cooperative study of population-based cancer survival in Europe with over 10 million patients across the continent (De Angelis et al., 2014). All countries displayed similar patterns regarding relative severity of the different cancer types. In terms of survival rates, Belgium, Germany and Sweden performed consistently well, whereas Denmark, Poland and the UK (England) scored below average for most cancer types. However, the relative performance of a country's cancer care in terms of survival differed between cancer types, suggesting that survival rates may be notably affected by the health care provided.

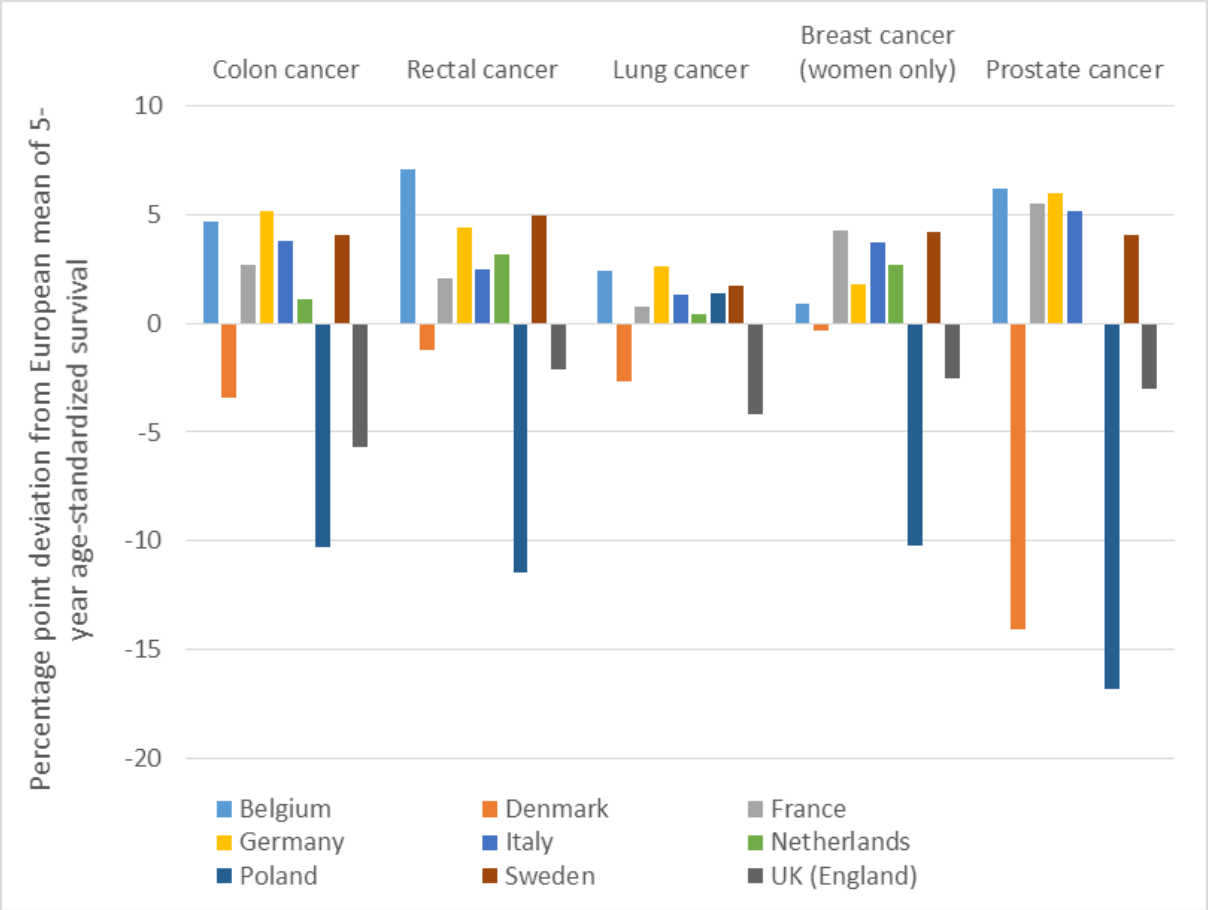
High five-year survival rates compared to their European counterparts were scarce for any cancer types. The five-year survival rate for rectal cancer in Belgium (62.9%) is the only possible exception. At the other end of the scale, some cancer-type–country combinations showed remarkably lower five-year survival, such as Denmark's five-year survival rate for prostate cancer of 69.3%. This is far below the European average of 83.4%.

**Figure 3. Five-year age-standardised relative survival for each country, sorted by cancer type (De Angelis et al., 2014). The European mean is included for comparison.**



Each of our nine countries' five-year age-standardised survival rates is compared to the European mean in Figure 4. The figure shows that most of our nine countries perform better than the European average in terms of five-year survival. Denmark and the UK perform below average in all cases, while Poland has significantly poorer outcomes for all cancers except lung cancer. The figure demonstrates particularly high five-year survival in Belgium, Germany and Sweden.

**Figure 4. Five-year age-standardised relative survival for each country relative to the European mean (De Angelis et al., 2014). A negative number indicates lower survival rates than the European average.**




It should be noted in interpreting these survival statistics that diagnosis and the collection of good-quality data play a role in the statistics that are available.

Irrespective of current national treatment outcomes, the demand for cancer treatment is rising across Europe. Against the backdrop of high and increasing global prevalence of cancer, coupled with important improvements in earlier detection and treatment initiation, and the development of innovative new medicines to improve outcomes, it is perhaps unsurprising that spending on one element of treatment – cancer drugs – has been rising. In 2014, global oncology drug spending rose to $100bn for the first time (Aitken, Blansett and Mawrie, 2015). Whilst the US maintains dominance in the oncology market, spending on cancer drugs in the EU5 (Germany, France, Italy, Spain and the UK) is growing at an annual rate of nearly 6%, and accounts for around 15% of total drug spending in these countries.

Setting priorities in health care is one of the greatest challenges faced by modern societies. Available prevention, screening, diagnosis and treatment options far outstrip

current health care budgets and so priorities have to be set. Advances in innovation are increasing the health benefits potentially available. This inevitably results in competition for resources between different therapy areas, as well as between treatments within a therapy area.

Given the increasing demand for and spending on oncology treatments – notably drugs – it is increasingly important to understand whether or not these treatments provide value and to identify and promote the efficient delivery of cancer care, thus increasing the headroom within budgets to spend more on treatments that improve quality of life and survival for cancer patients at a price that provides value. This report considers the efficiency of spending on cancer care in Europe and the potential avenues for improvements in the allocation of resources in cancer care, with a particular focus on nine European countries – Belgium, Denmark, France, Germany, Italy, the Netherlands, Poland, Sweden and the UK – and the EU as a whole (EU27[9]). Note that EU27 does not refer to the average of the included countries but to all of the 27 member states in the European Union except for Croatia, who joined the union in 2013.

In order to describe the funding situation for cancer care in Europe, this section maps out current spending levels of cancer as well as a set of comparator disease areas, in order to show the relative share of the health budget spent on each disease area as compared with their relative share of the total disease burden.

### 1.2.2. Method

Data on disease burden and health care expenditure were collected for all cancers aggregated and for the four most common cancer types separately (lung, breast, prostate and colorectal cancer) in each of the nine countries and for EU27.

Matching data were collected for three comparator diseases. The three comparator diseases were selected based on availability of high-quality comparable data. The same data source was available for both cancer and the comparator diseases, enabling consistent comparisons. The three comparators are:

- ischaemic heart disease (IHD),
- stroke,
- dementia.

#### *Health care expenditures*

Data on national and European health care expenditure were collected in order to map out current spending levels of cancer and the comparator diseases. These comparator diseases – IHD, stroke and dementia – are, together with cancer, chronic diseases which collectively share a large burden of disease, particularly with an ageing population. In addition, total health care expenditure was also collected in order to calculate the relative share of the expenditure for each disease in each country. Data were collected for our nine countries and for EU27.

Data on health care expenditure for all cancers, and separately for lung, breast, prostate and colorectal cancer, were collected from a recent study of the economic burden of

[9] Countries included in EU27: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden and the United Kingdom.

cancer in the European Union (Luengo-Fernandez et al., 2013). Data were collected for each country and all costs were expressed in euros at 2009 price levels.

Health care expenditure data for IHD and stroke in each country were collected from studies by the same research team as for the cancers above (Leal, Luengo-Fernandez and Gray, 2012), applying an identical methodological framework. The same data sources were used for information on health care expenditures associated with dementia for eight of the nine targeted countries (Luengo-Fernandez, Leal and Gray, 2011), and, when needed, supplemented with data from Alzheimer Europe (Wimo, Jönsson and Gustavsson, 2009), based on the Dementia Worldwide Cost Database (DWCD), for Poland and EU27. The cost for IHD and stroke were already expressed in 2009 euros, while the costs for dementia were expressed in 2007 and 2008 euros, adjusted to the 2009 price level using the Harmonised Index of Consumer Prices (HICP) (Eurostat, 2015c).

Data on total health care expenditures as a portion of GDP in 2010 were published by the European Commission (Lipszyc, Sail and Xavier, 2012), both for EU27 and for each individual country. Country-specific GDPs for 2009 were collected from Eurostat (Eurostat, 2015b) to calculate absolute health care expenditures in 2009. The share of GDP allocated to health care was assumed to be similar in 2009 and in 2010, and no adjustments were made of the raw data.

The collected data on health care expenditures for dementia included long-term care costs, e.g. costs of nursing homes, a significant cost category for dementia. Long-term care costs were, however, not included in the studies of cancer (all, lung, breast, prostate and colorectal), IHD or stroke. Therefore attempts to add such costs are made in the present analysis. The research group who calculated health care expenditures for cancer have also published a study measuring long-term care costs in the UK for cancer, IHD and stroke (Luengo-Fernandez, Leal and Gray, 2010). In order to estimate the spending on long-term care for cancer, IHD and stroke in the remaining countries, data on total expenditures on long-term care in each country were extracted from the European Commission (Lipszyc et al., 2012). The relation between total spending on long-term care in each country and the UK was then used to weight the long-term care costs from the UK pro rata to estimate costs in each of the other countries.

It should be noted that all analyses in this section relating to relative spend among countries studied are using expenditure data from 2009. This is due to the availability of data that were required to be combined for this analysis, available by tumour type, and available across all of the countries studied, in order to facilitate comparison. The primary purpose of this analysis is to offer a comparative picture of relative spend and relative burden across Europe; whilst more recent data would clearly be preferable, for comparative purposes it is most important that the reference year is consistent across all countries. However, we recognise that the age of the data may impede interpretation of results, particularly in assessing spend between tumour types, the balance between which may have altered with the availability of new therapies. Therefore results should be interpreted with this limitation in mind.

In addition, there are two approaches when estimating costs; top-down and bottom-up. A top-down approach entails multiplying total expenditure (e.g. health expenditures) in a given area by the proportion of that expenditure allocated to certain sub-areas (e.g. cancer care). Typically this approach uses aggregate, budgetary data (Larg and Moss, 2011; UK Cabinet Office, 2016). The estimated costs are often grouped into large

categories (e.g. all cancer) as the proportion allocated to a specific disease (e.g. prostate cancer) may be harder to find. By contrast, a bottom-up cost estimation involves identifying all of the resources used to provide a service (e.g. cancer care) and assigning a value to each of those resources. These values are summed and linked to a unit of activity to derive a total unit cost (Larg and Moss, 2011; UK Cabinet Office, 2016). The bottom-up approach provides a greater level of detail than the top-down method. However, the bottom-up approach risks excluding other relevant cost categories, such as disease prevention or screening, which leads to an underestimation of the true costs.

The Luengo-Fernandez study, applied in this report, follows a bottom-up cost-of-illness approach with five predefined cost categories: drugs, inpatient care, outpatient care, accident and emergency, and primary care (Luengo-Fernandez et al., 2013). The failure to include all relevant costs when using a bottom-up approach will result in lower cost estimates than studies using a top-down approach. Other studies might also report higher costs if they are based on data including non-malignant cancers (ICD-10 D00-D48) in addition to the malignant cancers (ICD-10 C00-C97) included in the Luengo-Fernandez study. Yet the detailed data in the Luengo-Fernandez study allows comparison between diseases and cancer types, and enables economic modelling. In addition, the present report focuses on comparisons between countries and between diseases where detailed and comparable estimates for each country and/or disease are of the essence. Thus, at the time of writing this report, the Luengo-Fernandez study was the most relevant report for the scope of our analyses.

In addition, it should be noted that the Luengo-Fernandez study has various limitations, which are indeed cited by the authors. These should be taken into account in interpreting the data presented in this section. Limitations relate mainly to the quality and availability of evidence available to the authors, particularly deficiencies in the epidemiological data for cancer and in information relating to resource use and unit costs. Assumptions and extrapolations were made to compensate for lack of data, for example in the number of primary-care, outpatient-care and emergency-care visits attributable to cancer specifically. Data around cancer treatments were scarce, as were data on drug expenditure by type of cancer (see the article for a full list of limitations). Interpretation of our results should bear these limitations in mind, alongside the likely underestimations mentioned.

### *Disease burden*

Disease burden data for all cancers; for lung, breast, prostate and colorectal cancer; and for IHD, stroke and dementia were collected from the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) based on 2013 data (IHME). In addition, the total disease burden for all diseases was also collected in order to calculate the relative share of the total disease burden for each disease in each country. Data were collected for our nine countries and for EU27.

The GBD is to date the largest and most comprehensive effort to measure epidemiological levels and trends worldwide. It brings together all epidemiological data using a coherent framework to allow for comparative assessments of broad epidemiological patterns across countries and time (IHME). One particularly relevant publication is the GBD study by Murray et al. (Murray et al., 2015a) which estimates mortality and morbidity across 306 diseases in 188 countries from 1990 to 2013. This study provides a rich source of information when estimating and comparing disease

burdens across different disease areas, and is well suited to the scope of the present analyses.

In order to estimate and compare disease burden across countries, it is important to utilise a measure that captures both the extent and the impact of the disease on the population – such as disability-adjusted life years (DALYs). The DALY "extends the concept of potential years of life lost due to premature death … to include equivalent years of 'healthy' life lost by virtue of being in states of poor health or disability" (World Health Organization (WHO), 2002).

DALYs are a widely used metric of disease burden, first developed for the World Bank and subsequently adopted by the WHO. DALYs quantify the impact of a disease from mortality (death) and morbidity (ill health and disability). This means that DALYs represent the number of years lost of "healthy life" because of someone dying early and/or experiencing poor quality of life because of their condition. The sum of DALYs across a population (the "burden of disease" in a country) represents the total number of DALYs lost because of disease across the whole population (which means it accounts for the prevalence of the disease). It is for this reason that the DALY is the most commonly used metric for population health; it essentially measures the gap between the current health status of a country and the ideal health situation, where the whole population would live to an advanced age, free of disease and disability. The DALY is the core measure used in the Global Burden of Disease study, first published in 1990, which is a comprehensive and ongoing global research programme.

DALYs are calculated as the sum of the impact of premature death, years of life lost (YLL), and the quality of life/disability adjustment through years lived with disability (YLD) to incorporate non-fatal health outcomes, according to the equation

$$\mathrm{DALY} = \mathrm{YLL} + \mathrm{YLD}$$

The "incident" stream of lost years of life due to death is used to calculate YLL. In the 2010 GBD study, the number of prevalent cases was used to calculate YLD.

The DALY is the predominant metric used to assess the burden of disease across countries, particularly for low- and middle-income countries. DALYs are also becoming an increasingly common measure in the field of public health and health impact assessment in high-income countries. Moreover, DALYs are presented as outcomes in the GBD paper (Murray et al., 2015a). Therefore this study applies DALYs to measure disease burden.

The differences in absolute disease burden will vary by country size. This is controlled for relative disease burden, i.e. the burden of one disease relative to the burden of another disease within a defined country or region. Variations in relative disease burden will instead depend on varying incidence, prevalence and clinical practice between countries. Measures of relative disease burden are thus used to compare disease burdens across countries in the report.

### *ICD-10 codes*

When collecting data from different sources in order to compare the disease burden of a certain diagnosis with its health care expenditure, it is crucial that consistent definitions are used. The disease definitions applied in the various sources utilised here are generally consistent. The definitions used in the GBD study of DALYs lost to various diseases are based on International Classification of Diseases (ICD-10) codes (IHME). When examining all cancer types, the GBD study excludes some minor codes perceived as irrelevant for the results and includes codes of benign tumours. The ICD codes used in the studies for health

care expenditures, on the other hand, include all malignant tumours, but do not consider benign tumours (Luengo-Fernandez et al., 2013; Leal et al., 2012; Luengo-Fernandez et al., 2011; Wimo et al., 2009). The supplementary study of health care expenditures for dementia did not define the ICD codes evaluated (Alzheimer Europe).

For the individual cancers the applied ICD codes cover the full subgroup of malignant tumours in both sources for disease burden and health care expenditure. The study examining disease burden included benign tumours. Both sources apply identical ICD codes when evaluating IHD, while there are slight differences for stroke and dementia regarding the inclusion of benign codes (IHME; Luengo-Fernandez et al., 2013; Leal et al., 2012; Luengo-Fernandez et al., 2011; Wimo et al., 2009).

The differences in included ICD codes are assumed not to significantly influence the present analysis. First, benign tumours were primarily used in mortality calculations and should for obvious reasons therefore have a very limited impact on the estimate. Second, the codes excluded from the estimate of disease burden of all cancers refer to rare diseases which should also have a limited effect on the estimates.

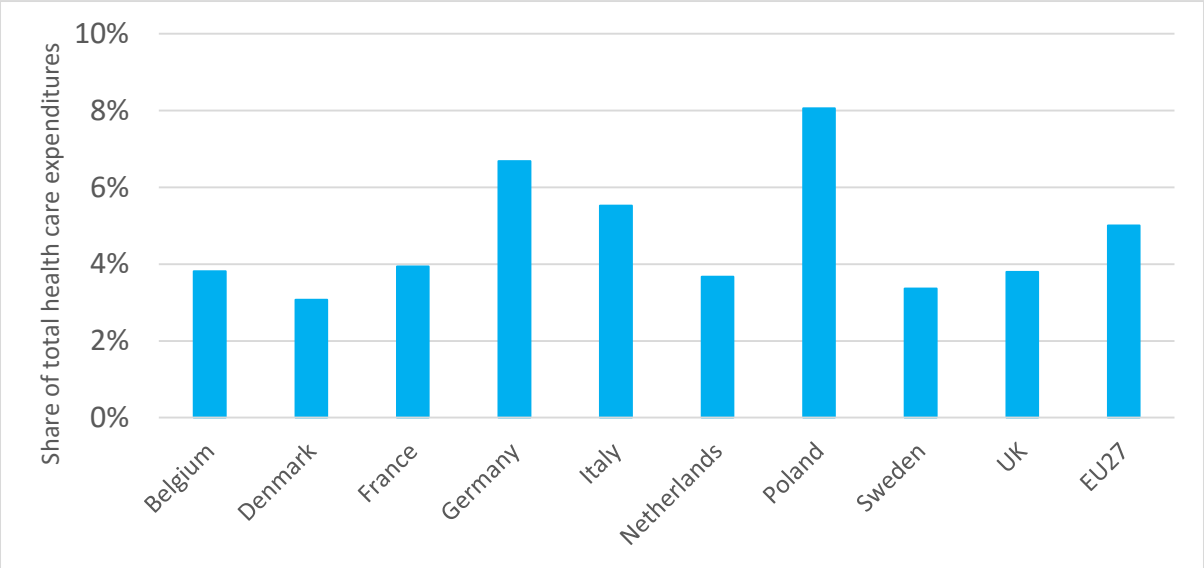
### 1.2.3. Results

#### *Health care expenditure*

Health care expenditures differ substantially between countries and types of cancer. For all cancer types some countries have twice the relative health care expenditures of others (Figure 5). This may be attributed to differences in disease burden, but is also, in part, due to different spending patterns.

In general, the included countries' expenditures on cancer care as a share of total health care expenditures are low compared with the rest of Europe. Only three countries – Germany, Italy and Poland – have higher relative expenditures on cancer care than EU27 (5.0%). Poland (8.1%) and Germany (6.7%) have the highest relative expenditures on cancer care, while Denmark (3.1%) and Sweden (3.4%) have the lowest. Note that Poland spends a relatively low proportion of GDP on health and that the large share directed to cancer care should not be interpreted as Poland allocating large funds to cancer. See Table 77 in the Appendix for absolute total health care expenditure in millions of euros. Whilst it can be seen that, as a proportion of total health care expenditure, Poland spends relatively more on cancer than do other countries, total health care spending is very low in Poland. For example, in Sweden (which has one of the lowest proportions of health spend allocated to cancer), absolute spending on cancer was €1,182 million in 2009, compared with €1,438 million in Poland, which has a population roughly four times that of Sweden. This means that, per capita, spend on cancer in Poland is only roughly 30% of that in Sweden. A more sophisticated variant of this analysis is presented shortly, where we compare spending relative to disease burden.

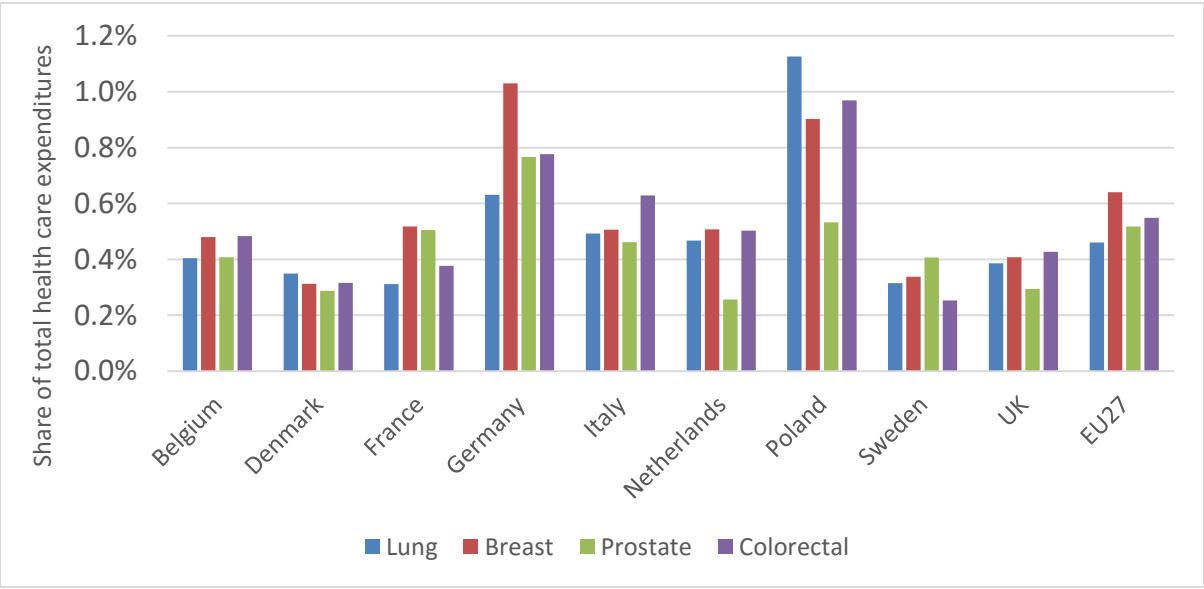
**Figure 5. Relative share of total health care expenditures spent on all cancers combined, in 2009**




The relative shares of health expenditure devoted to individual types of cancer also differ considerably between countries. Whilst there are some general trends, each country displays a unique pattern of relative spending between the different cancer types. The relative expenditures per country and cancer type are shown in Figure 6.

Breast cancer generally receives the largest relative expenditures (0.3–1.0%) of the cancer types. Lung cancer has the lowest relative spending for all countries except the Netherlands and Poland, where the latter has a remarkably high relative spending (1.1%) compared with the other countries.

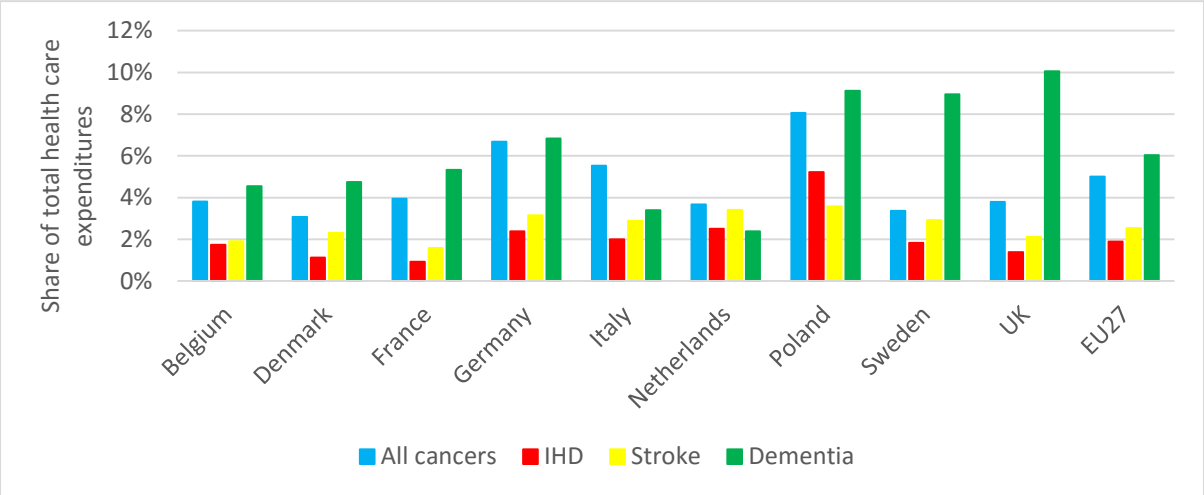
**Figure 6. Relative share of total health care expenditures per cancer type, in 2009**




To better understand the size of health expenditures for cancer, comparisons can be made with the other diseases. Here too the relative share of the health budget allocated to each diagnosis differs significantly between countries; see Figure 7. The figure

displays a trend where the relative spending on dementia is substantially higher than that of the other comparator diseases and higher than the combined spending on all cancer types for all countries, except in Italy and the Netherlands. However, the relative spending on both cancer and dementia varies widely between countries. Poland, Sweden and the UK show around four times as high relative spending on dementia compared with the Netherlands, while Poland and Germany spend significantly more (as a proportion of their health spending) on cancer compared with Denmark and Sweden. The high relative expenditure for dementia may be partly explained by different ways of calculating costs for dementia compared with other diseases, especially in Poland, for which a different data source was used. Stroke receives a larger portion of the health care budget compared with IHD in all countries but Poland.

**Figure 7. Relative share of total health care expenditures for all cancers, IHD, stroke and dementia, in 2009**




All of the individual cancer diagnoses received a significantly lower portion of the total health care expenditure compared with the comparator diseases in all countries and in EU27 (compare Figure 6 and Figure 7).

Whilst it is interesting to consider relative spending on cancer and other diseases and how this differs between countries, interpretation is difficult without knowing how big an impact (in terms of incidence and severity) those diseases have in a country. For example, if the incidence of breast cancer in a particular country is very low, then it may well be completely justified for spending on breast cancer to be low in that country. In the remainder of this chapter we assess spending *in relation* to the impact of disease ("disease burden"), which we measure in DALYs (see previous explanation).

### *Disease burden*

As described, we measure disease burden in DALYs, which accounts for incidence as well as mortality and quality of life. See Table 76 in the Appendix for total disease burden in DALYs as well as a breakdown by disease and cancer type. Relative disease burden is the DALYs lost because of cancer as a proportion of total disease burden in the country. The relative disease burden for all cancers combined is fairly similar across all countries, although there are some exceptions (Figure 8). The Netherlands (20.8%) has the highest relative disease burden for all cancers combined, followed by France (19.5%). The lowest disease burden for all cancers combined is found in Sweden (15.6%), followed by Denmark (17.1%). This may be attributable to differences in incidence but may also be due to differences in health care. The relative disease burden of all cancers

combined in the remaining five countries (17.3–17.9%) is close to the relative disease burden in EU27 (17.4%).

**Figure 8. Relative share of total disease burden for all cancers combined, in 2013**

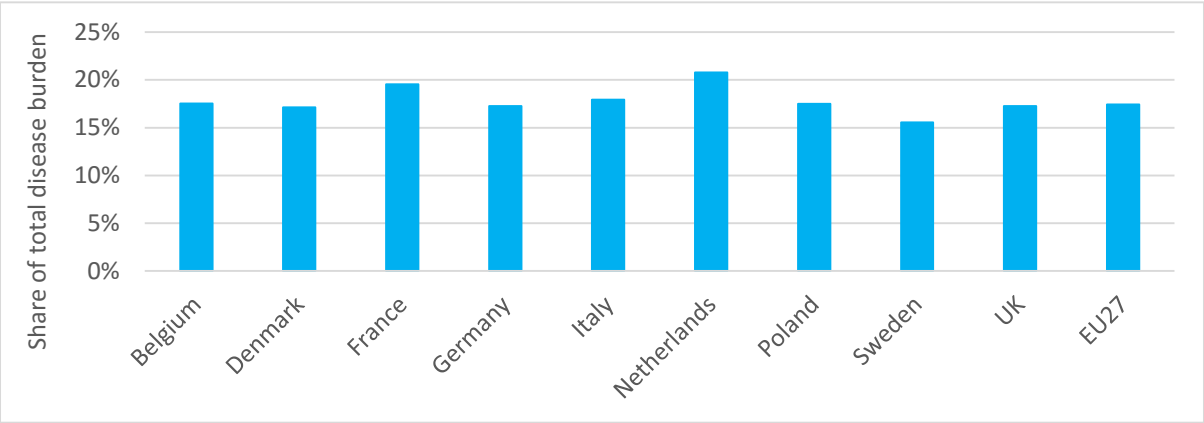
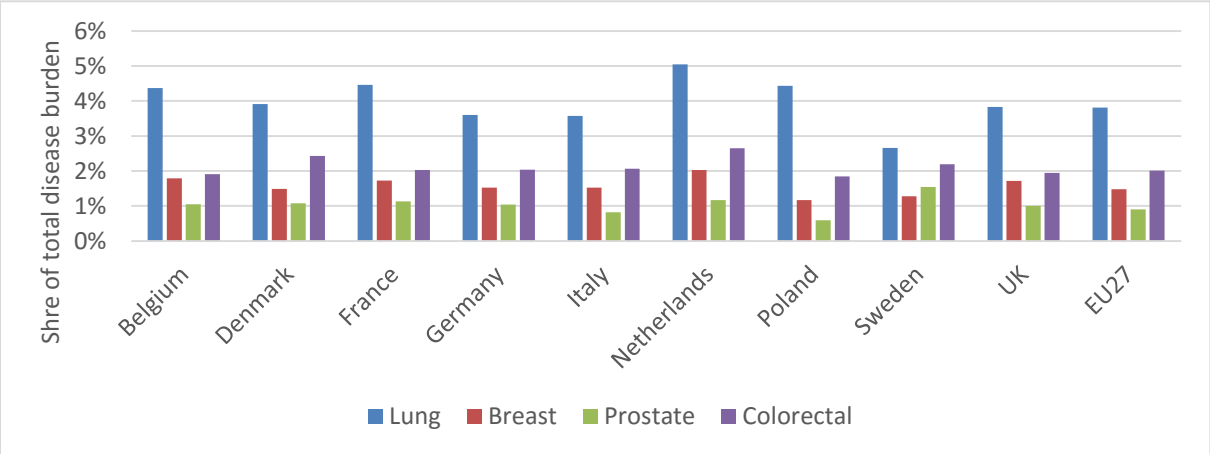



Figure 9 demonstrates the relative share of total disease burden among our four cancers in our nine countries and EU27. Lung cancer presents the highest relative disease burden in all included countries and in EU27 (2.7–5.0%), followed by colorectal cancer (1.8–2.6%). The relative disease burden of breast cancer (1.2–2.0%) is higher than for prostate cancer (0.6–1.2%) in all countries except Sweden, where the relative burden of prostate cancer (1.5%) exceeds that of breast cancer (1.3%).

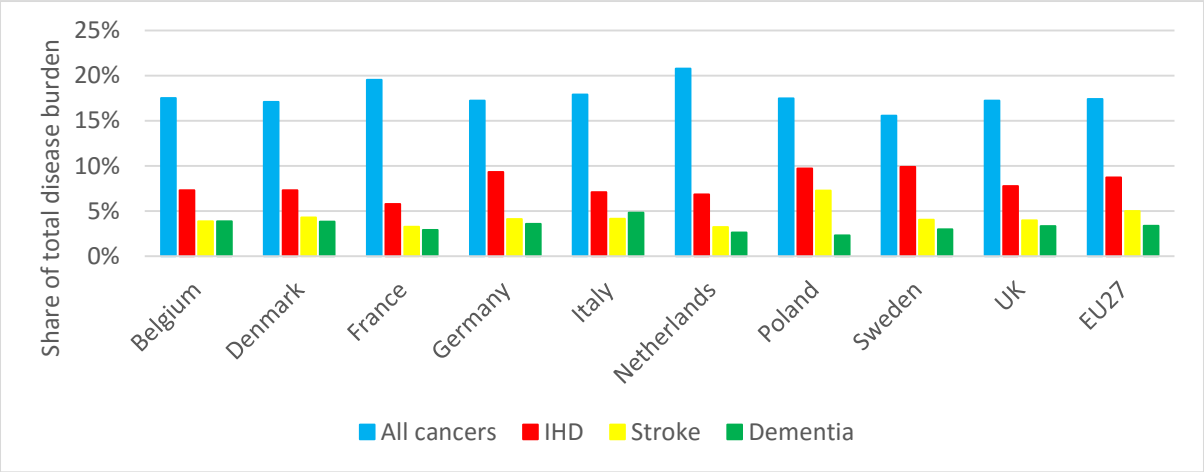
Within countries, the relative disease burden of lung cancer is generally twice as large as that of colorectal cancer. Once again Sweden stands out as its relative disease burdens of lung and colorectal cancer are similar in magnitude. This deviation is primarily explained by a low relative burden of lung cancer compared with the other countries rather than a high relative disease burden of colorectal cancer.

**Figure 9. Relative share of total disease burden for lung, breast, prostate and colorectal cancer in our nine countries in 2013**




Comparing the relative disease burden of cancer to that of the comparator diseases – IHD, stroke and dementia – shows that cancer represents the highest disease burden (Figure 10). As demonstrated in Figure 10, the relative disease burden for all cancers (17.1–20.8%) is about twice as large compared with that of IHD (6.4–10.9%), which in turn represents twice the share of total disease burden compared with stroke (3.5–5.0%) and dementia (2.6–5.2%).

**Figure 10. Relative share of total disease burden for all cancers, IHD, stroke and dementia in 2013**




When evaluating individual countries it was previously mentioned that the relative share of total disease burden in Sweden stands out. In general, Sweden seems to have a relatively low disease burden for lung and breast cancer, as well as for all cancers combined. The relative disease burden for colorectal cancer in Sweden is in line with the other eight countries, while the burden of prostate cancer is the highest among the included countries. One explanation for this could be the high frequency of opportunistic screening for prostate cancer in Sweden (Schroder et al., 2014) which could lead to over-diagnosis of prostate cancer.

The Netherlands has the highest individual relative disease burdens for lung, breast and colorectal cancer, as well as for all cancers combined. The relative disease burden of prostate cancer is, however, more in line with the other countries. The Netherlands' relative disease burdens for the comparator diseases are in the low to medium range compared with the other countries, implying that it is the relative disease burden of cancer that stands out. These results are in line with previous findings that show that the Netherlands has a high cancer incidence compared with other western and northern European countries (Arnold et al., 2015).

### *Ratio between expenditures and disease burden*

The ratio between *absolute* health care expenditure and *absolute* disease burden is estimated in each country and compared with the European average, i.e. the ratio for EU27. This expenditure-to-disease ratio represents the amount in euros spent per DALY lost to the disease. In other words, a lower ratio compared with other countries (or diseases) means that fewer euros are spent on health care in that country (or allocated to that disease) relative to the burden of disease. To demonstrate how the countries compare, the EU27 ratio of absolute health care expenditures and absolute disease burden is set to zero and the country-specific ratios are presented as a deviation from the European average. A country that spends less than the European average will thus score below zero, a country that spends relatively more scores above zero, and a score of zero indicates that the country's spending is in line with the European average.

Figure 11 presents the expenditure-to-disease ratios of all cancers compared with the European average. Belgium and the UK spend somewhat less on cancer than EU27 relative to the burden that cancer represents in those countries, but Poland is the country with by far the lowest spending on cancer relative to its disease burden. In contrast, Germany and Denmark spend well above the European average on cancer.

**Figure 11. A comparison, with the European average, of country-specific ratios between absolute health care expenditures and absolute disease burden, for all cancers combined. Presented as deviation from the EU27 ratio.**

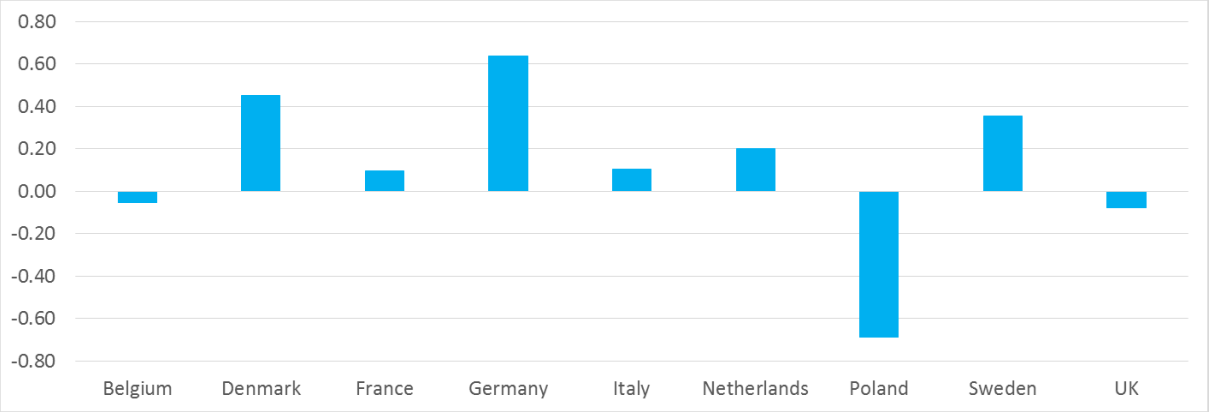
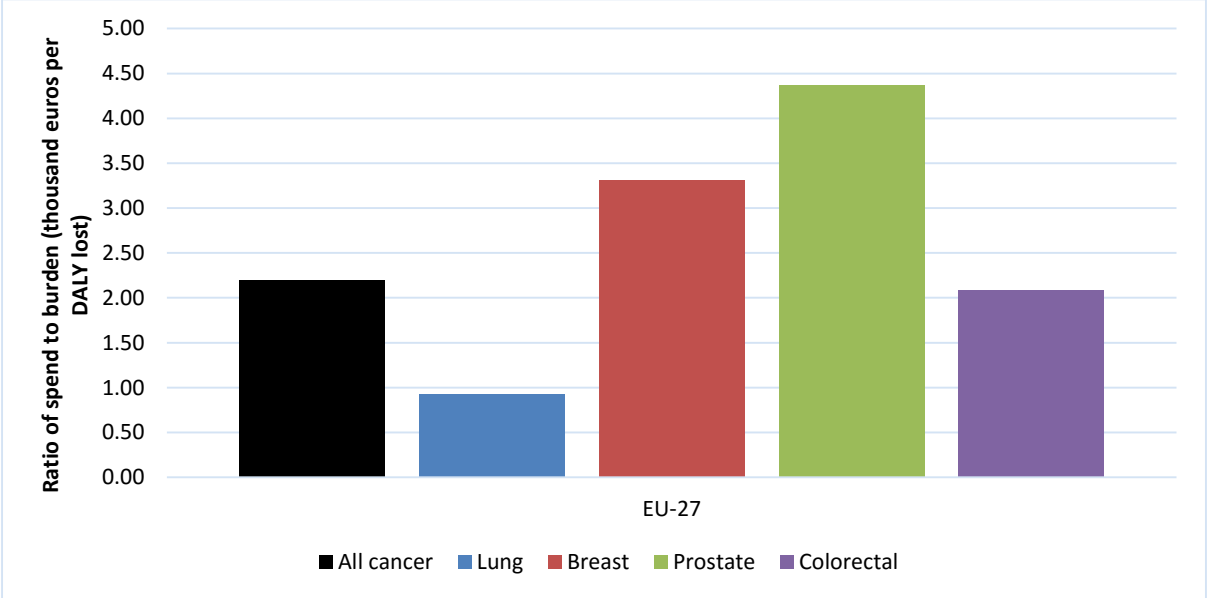



Figure 12 shows spend relative to burden in absolute terms for EU27. This demonstrates the expenditure in the EU on the four major cancers, relative to the burden those cancers pose to the European population (measured in DALYs).

**Figure 12. Spend relative to disease burden (thousand euros per DALY lost) by cancer type – average in EU27**




These results in terms of a precise euro-per-DALY spend should be interpreted with caution, as we may have underestimated the spend that is attributable to cancer. However, the comparison is robust, and this demonstrates that, compared with the high impact of lung cancer on the population (from lives lost and poor quality of life), less money is spent at the moment on lung cancer than on the other major cancers. This does not automatically suggest that we should spend more on lung cancer, as this depends on whether there is anything worthwhile and cost-effective to spend additional money on. Rather, it shows that if we can find cost-effective ways to spend additional money, then there may be justification for this, as patients suffering from lung cancer may be currently less well served than those suffering from other cancers. However, it should be noted that the spend data are from 2009.

Comparison of the country-specific expenditure-to-disease ratios for the four major cancers relative to the European average is presented in Figure 13. The estimates differ considerably both between countries and between different cancers within countries.

A clear trend is that Poland spends significantly less on all four cancer types relative to the other countries and compared with the European average, while the opposite is shown for Germany. Denmark spends more on each cancer type, compared with the European average, but the deviation is significantly higher for lung cancer. Sweden spends well above average on lung cancer and just above average on breast cancer, but below average on both prostate and colorectal cancer. Health care expenditures allocated to the four major cancers are below the European average for most cancers in both Belgium and the UK.

Note that Italy spends the equivalent to the European average on prostate cancer, similarly for lung cancer in the UK, and that these observations therefore lack visible bars in the figure.

**Figure 13. Comparisons, with the European average, of country-specific ratios between absolute health care expenditures and absolute disease burden, for the four major cancers. Presented as deviation from the EU27 ratio.**

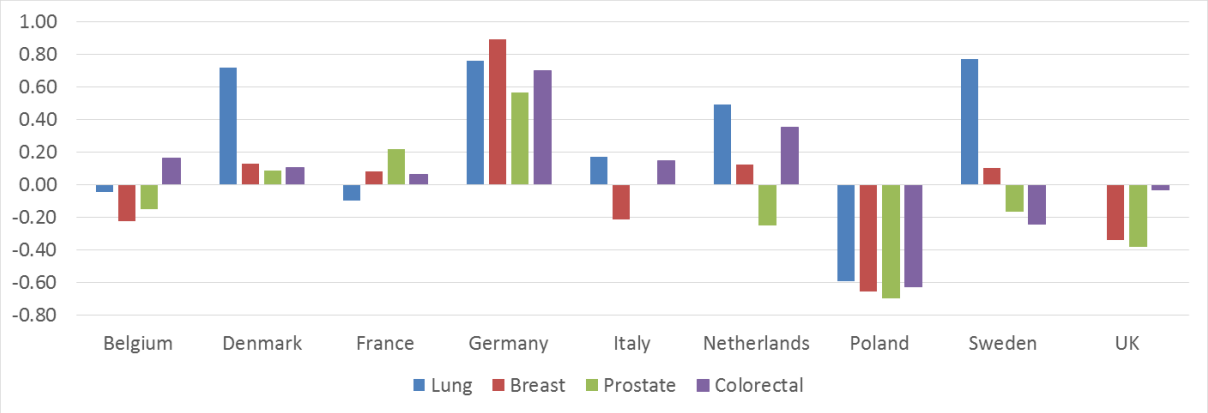
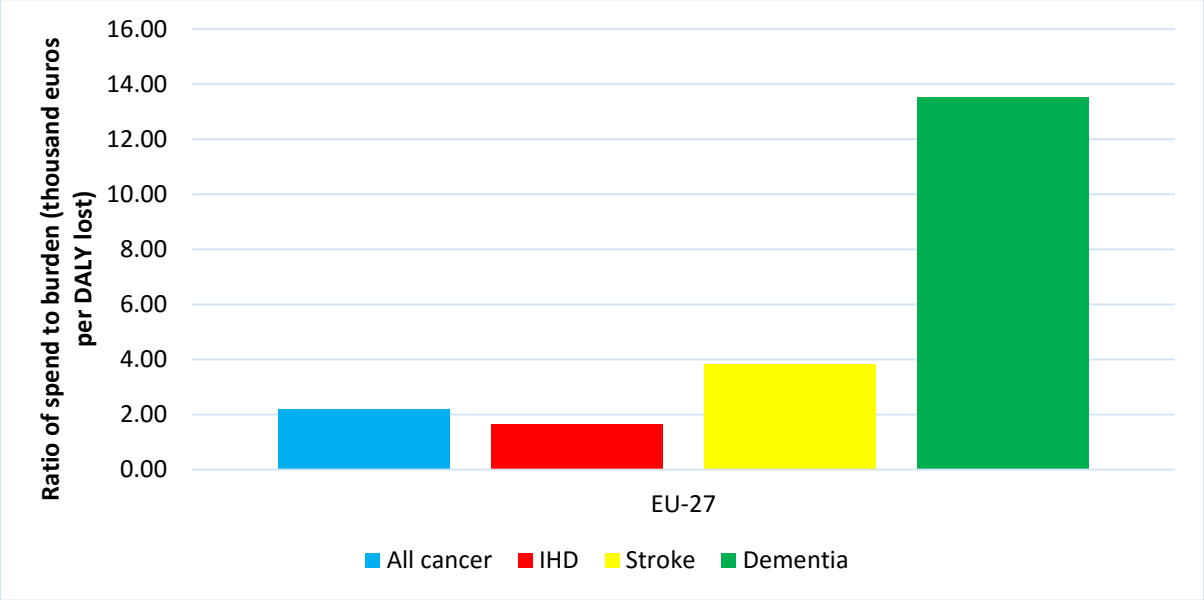



Figure 14 shows spend relative to burden in absolute terms for EU27. This demonstrates the expenditure in the EU across the four major diseases for comparison, relative to the burden those diseases pose to the European population (measured in DALYs). It demonstrates that, compared with the burden of cancer, spending on cancer is lower than for stroke and dementia, but slightly higher than for IHD. This indicates that, relative to its burden, cancer does not appear to attract a higher spend than other major diseases, and in some cases spend appears to be lower. It should be noted, however, that the question whether or not more money should be spent in a particular disease area is dependent upon the context of current spend, and the availability of cost-effective treatments. Such decisions should be informed through an analysis of costs and benefits at the margin. This point is emphasised by many, who highlight that, no matter the current expenditure or cost burden levels, future funding decisions on the allocation of scarce resources must be made based on the availability of treatment options, their cost and their effectiveness (Drummond, 1992).

It can be observed through the analysis presented that expenditure on cancer is not equal or equitable among European countries. In addition, expenditure is not driven solely by wealth, which is apparent, for example, when we compare spend relative to burden between Germany and the UK. Whilst this information cannot be used to inform decisions about the efficient allocation of resources (which will be the subject matter of

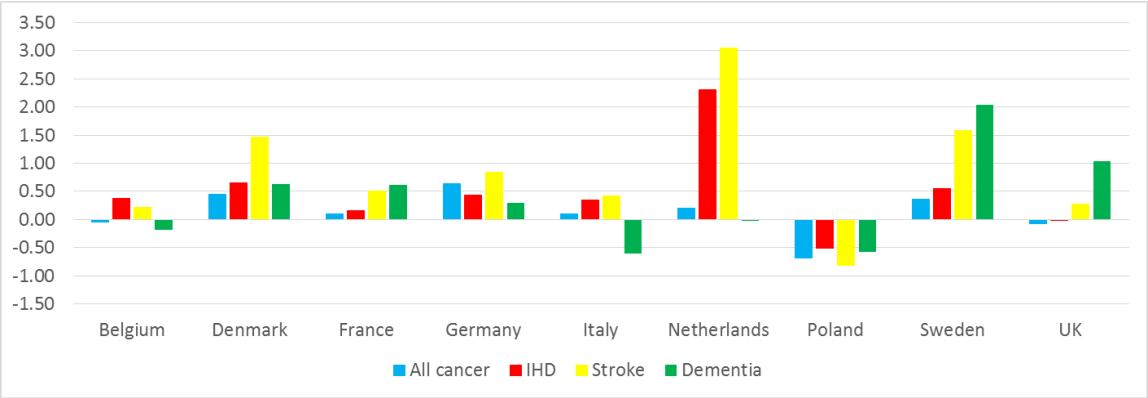
Section 2 of this report), it is useful in setting the context in terms of current resourcing levels.

**Figure 14. Spend relative to disease burden (thousand euros per DALY lost) by disease – average in EU27**




Comparisons of the country-specific expenditure-to-disease ratios for all cancers, IHD, stroke and dementia relative the European average are presented in Figure 15. A general finding is that comparatively less health care expenditure is allocated to cancer in relation to the disease burden of cancer, relative to other diseases. Again, Poland stands out with significantly lower spending per level of disease burden, both compared with the European average and compared with other included countries. The within-country variations are particularly large in the Netherlands, where the expenditure-to-disease ratios are well above average for IHD and stroke but approximately in line with the average for cancer and dementia. Figure 15 presents results for all cancers, IHD, stroke and dementia as deviation from the EU27 ratio.

**Figure 15. A comparison, with the European average, of country-specific ratios between absolute health care expenditures and absolute disease burden**



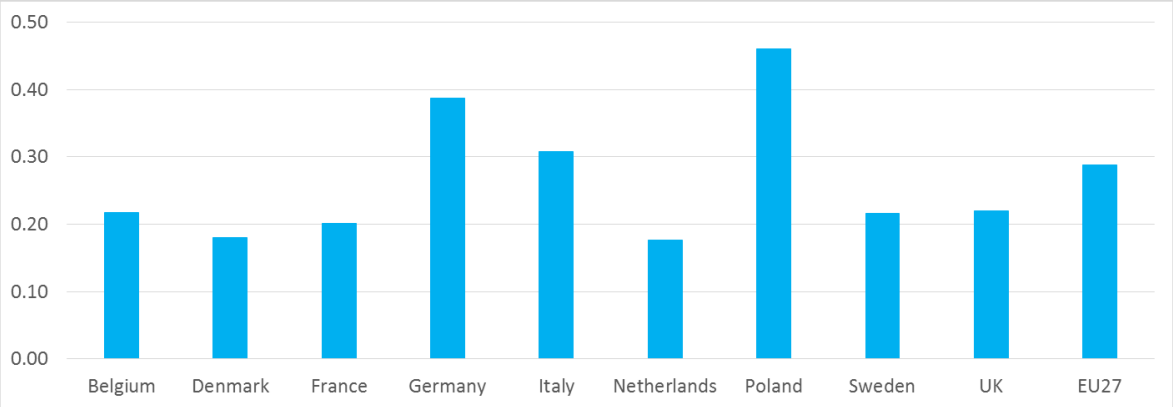

In addition to analysing absolute health care expenditure in relation to absolute disease burden, the ratio between *relative* health care expenditure and *relative* disease burden is estimated in each country and in EU27. This means comparing disease-specific burden as a proportion of total disease burden, and disease-specific expenditure as a proportion

of total health care spending. A lower ratio of relative expenditure to relative disease demonstrates that, within health care spending, less money is spent on a particular disease relative to its health impact on the population. A higher ratio indicates that a relatively larger amount of health care spending is directed to a particular disease compared with its burden. In other words, the ratio of relative health care expenditure and relative disease burden may be interpreted as a measure of prioritisation within the health care budget. Such ratios can only be indicative. From an economic perspective, it only makes sense to spend money in a particular disease area when it can be used efficiently to tackle the disease burden, by investing in effective and cost-effective interventions or practices.

Whilst a ratio of one would suggest that relative expenditure (the amount of money spent on a disease as a proportion of total health care spending) matches relative burden (the disease burden relative to total disease burden), we offer caution in this interpretation. Most notably, we think that the expenditure attributable to particular diseases has been underestimated (see limitations in the methods section), thereby leading to nearly all ratios being below one. Therefore, whilst the interpretation of the numbers should be considered in this light, the comparisons between diseases and countries are robust, as the data sources utilised are consistent.

The resulting ratios of relative expenditure to disease for all cancers combined are shown in Figure 16 and they differ considerably between both countries and diseases. The highest ratio of relative expenditure to disease is found in Poland (0.46), followed by Germany (0.39) and Italy (0.31). The remaining six countries all have expenditure-to-disease ratios below the EU27 average of 0.29, and the lowest ratios are found in Denmark (0.18) and the Netherlands (0.18). Again, note that Poland spends a relatively low proportion of GDP on health and that Poland's high expenditure-to-disease ratio should not be interpreted as Poland allocating large funds to cancer, but rather as cancer being a priority within Poland's limited health care budget.

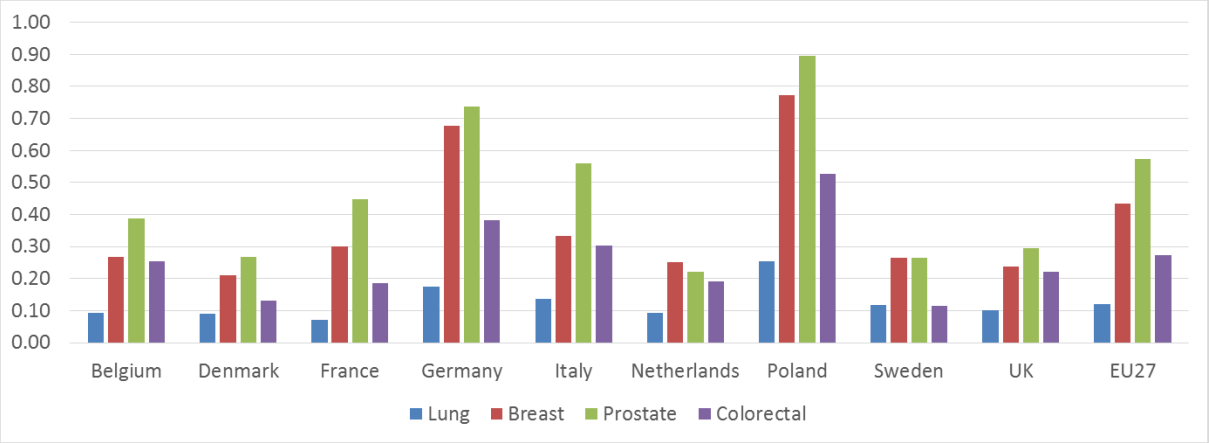
**Figure 16. Ratios between relative share of health care expenditure and relative disease burden for all cancers combined**




The ratios of relative expenditure to disease for lung, breast, prostate and colorectal cancer are presented in Figure 17 and differ considerably between both countries and diseases. In general, the pattern of relative ratios largely resembles that of the relative health care expenditures. Poland and Germany are generally the only countries with higher expenditure-to-disease ratios than EU27, indicating that the major cancer types are prioritised within these health care budgets, while the opposite is true for Denmark, the Netherlands, Sweden and the UK.

Prostate cancer is the cancer type with the highest ratio of relative expenditure to disease, but it is also the cancer type with the biggest between-country spread (0.21–0.80). By contrast, lung cancer (0.08–0.23) is the cancer with the lowest expenditure-to-disease ratio.

**Figure 17. Ratios between relative share of health care expenditure and relative disease burden per cancer type**




The ratios of relative expenditure to disease for all cancers combined and the comparator diseases are presented in Figure 18. The results show that all cancer combined has a low ratio of relative expenditure to disease in comparison with stroke and dementia, but is at parity with IHD. Dementia has a significantly higher ratio of relative expenditure to disease compared with the other diseases in most countries, indicating that it receives relatively high expenditure. This is true in all countries but Italy and the Netherlands, where the relative ratio for stroke is similar to dementia. As noted earlier, the high ratio relative expenditure to disease for dementia in Poland may be partly explained by the different data sources used for calculating costs for dementia compared with other countries.

**Figure 18. Ratios between relative share of health care expenditure and relative disease burden for all cancers, IHD, stroke and dementia**

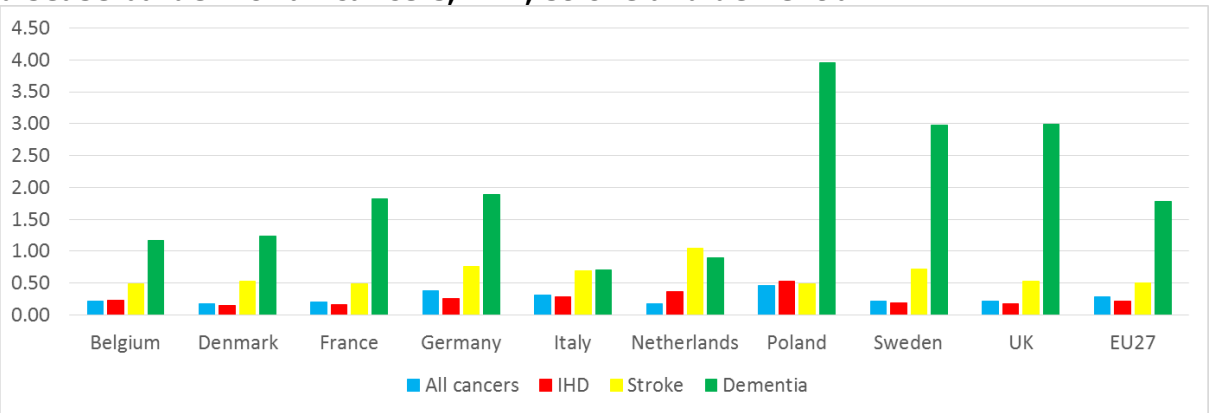
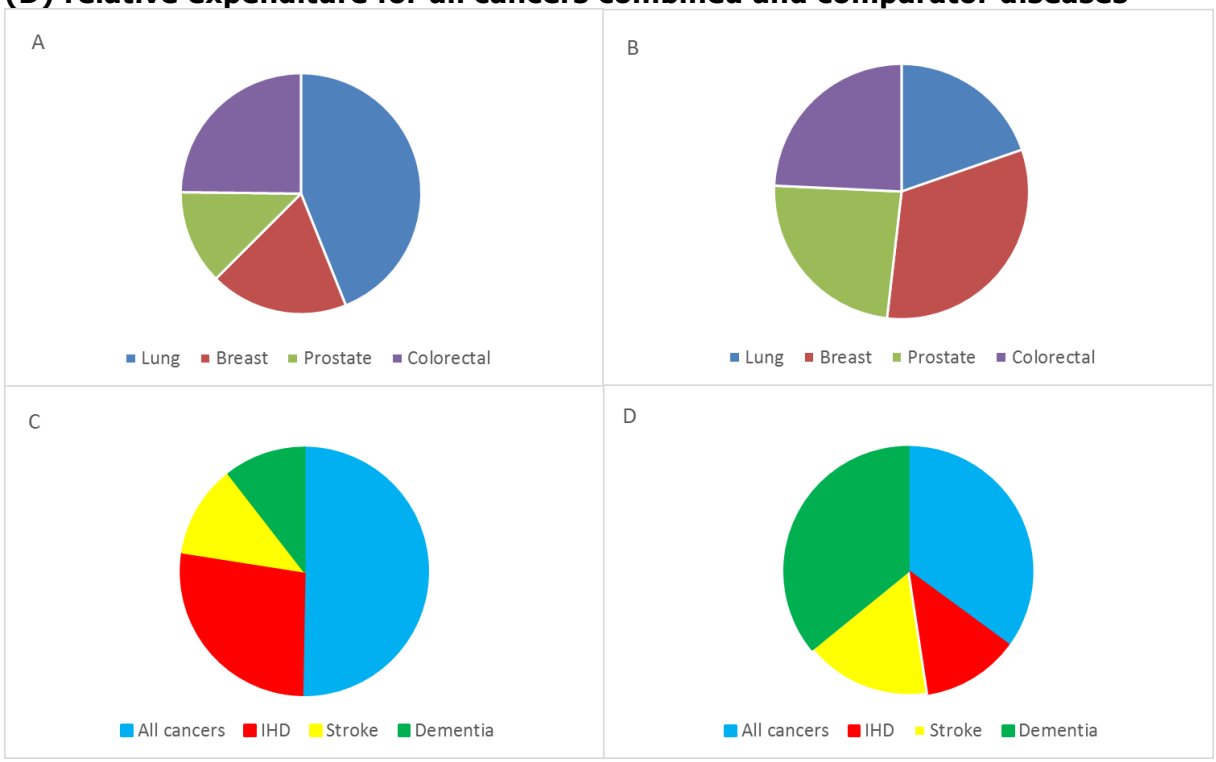



Figure 19 displays a case study of Germany, the largest country in Europe. The pie charts on the left compare relative disease burden while the charts on the right compare the corresponding relative health care expenditures. The upper pie charts compare lung, breast, prostate and colorectal cancers while the lower pie charts compare all cancers combined with IHD, stroke and dementia.

Despite representing well over 40% of the disease burden of the four major cancers, lung cancer accounts for less than 20% of the health care expenditure of the same cancers in Germany. A possible explanation for the discrepancy between expenditure and disease burden is the lack of effective and novel therapies for lung cancer. Meanwhile, the relationship is reversed for both breast and prostate cancer, with higher relative expenditure than disease burden. This may be explained by greater access to innovative therapies within breast and prostate cancer. Another possibility in the case of breast cancer is that it could be linked to population-based mammography screening. While this increases diagnosis rates, it may also push up expenditure given the availability of effective treatment. For the other diseases, dementia claims a higher portion of health care expenditure compared with its disease burden, while the reverse is true for cancer, IHD and stroke.

**Figure 19. The case study of Germany: (A) relative disease burden for individual cancers, (B) relative expenditure for burden for individual cancers (C) relative disease burden for all cancers combined and comparator diseases, (D) relative expenditure for all cancers combined and comparator diseases**

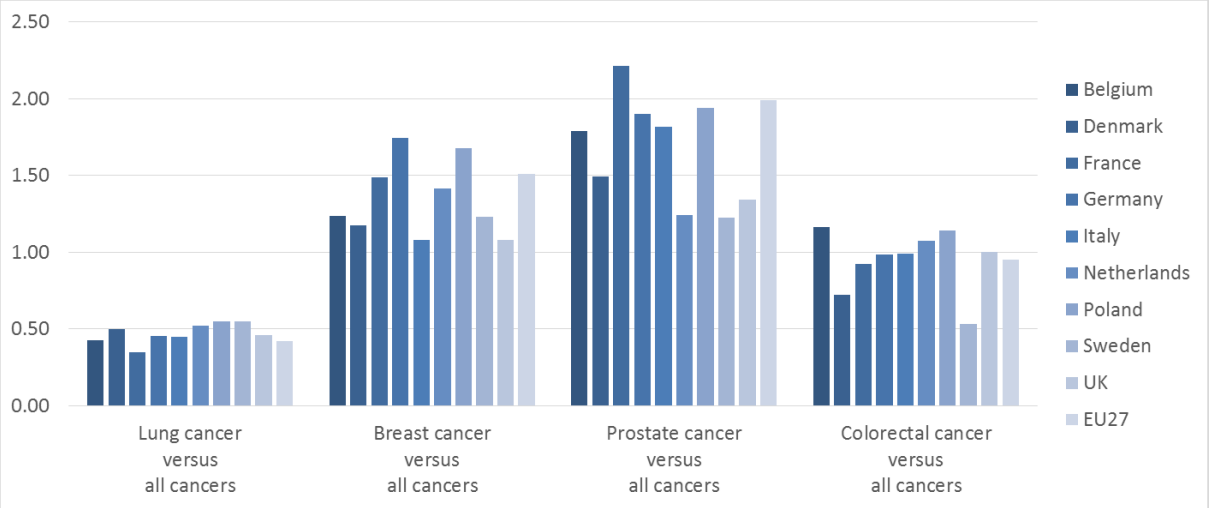



### *Ratio-of-ratios*

Comparison of ratios of relative expenditure to disease between diseases enables the calculation of "ratios-of-ratios" that may be used to evaluate the relative financing of specific cancer types, in relation to the relative financing of "all cancers" (which is anchored at 1).

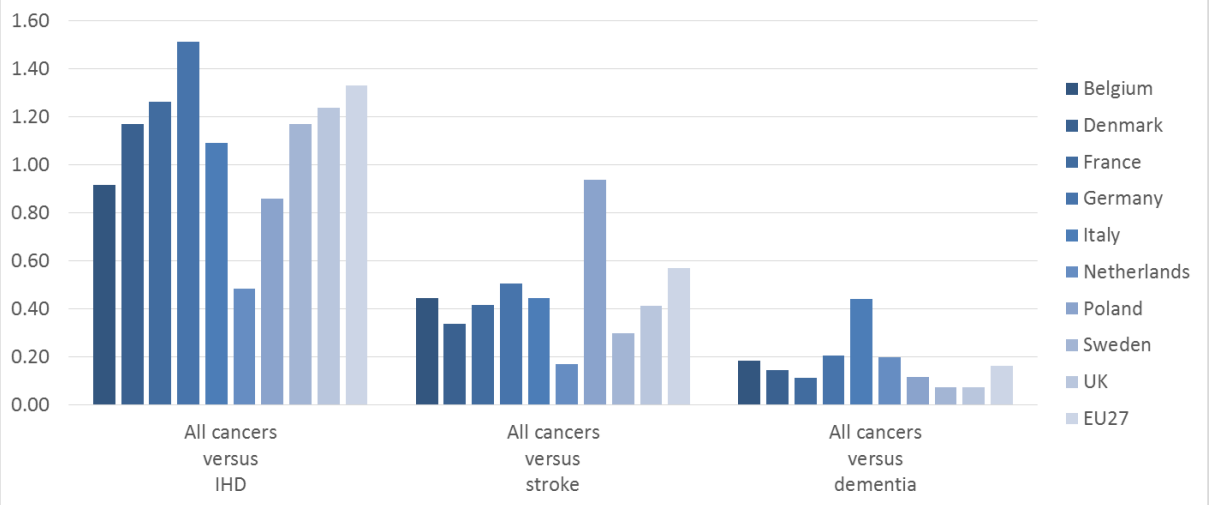
A comparison between lung, breast, prostate and colorectal cancers in comparison with all cancers combined by country is presented in Figure 20. Prostate cancer (1.22–2.22) and breast cancer (1.08–1.75) receive relatively higher funding in relation to other cancers in all nine countries. In contrast, lung cancer tends to receive lower funding as compared with other cancers in all included countries (0.35–0.55). The corresponding indication for colorectal cancer is proportionate funding, with most countries in the range of 0.92–1.17, with the exceptions being Sweden (0.53) and Denmark (0.72).

**Figure 20. The relative funding of specific cancer diagnoses compared with the relative funding of all cancers, per country**




A similar ratio-of-ratios approach is used to compare overall cancer financing to that of IHD, stroke and dementia (Figure 21). Whilst there are indeed country-specific spending patterns between the different cancer types, these differences appear modest compared with the differences in spending between different diseases. The results indicate that cancer receives relatively higher funding compared with IHD in EU27 (1.33). The results vary by country, with cancer receiving especially more funding in relation to IHD in Germany (1.47) and relatively less in the Netherlands (0.48). The results show that cancer receives more funding in relation to stroke in all countries (0.17–0.57), except for Poland (0.94). Cancer receives significantly less funding compared with dementia in all countries (0.07–0.44).

**Figure 21. The relative funding of all cancer compared with the comparator diseases, per country**




## 1.3. *Economic burden of cancer*

### 1.3.1. Background

This section evaluates the total economic burden, as opposed to the disease burden, of cancer for each of the nine countries, as well as the sum of the nine – in this section referred to as EU9. Economic burden comprises both direct costs and indirect costs. The

direct costs include health care costs and informal care costs. The indirect costs include production losses in the market as well as unpaid activities (e.g. volunteering and care giving). As above, three non-cancerous diseases (IHD, stroke and dementia) are included to allow for a more exhaustive comparison and framing of the burden of cancer.

### 1.3.2. Method

The following cost categories were identified as parameters of the total economic burden for both cancer and the comparator diseases: health care costs (including primary care, outpatient care, inpatient care, emergency care, long-term care and drug costs), informal care costs and productivity losses (lost market production due to mortality and morbidity, as well as lost unpaid work due to mortality[10]). These were then summed and presented as the total economic burden of each disease.

The data used to estimate the economic burden of the diseases were collected according to a similar approach to that for collecting health care expenditures in subsection 1.2. Data on national health care expenditure was collected from the study of the economic burden of cancer in the European Union (Luengo-Fernandez et al., 2013). Apart from health care expenditures (primary care, outpatient care, inpatient care, emergency care and drugs) the study also presented estimates of informal care and production losses. Production losses, in this case, refer to the loss of market production caused by both mortality and morbidity, while informal care consists of care provided to the patient by his or her family and friends.

Health care expenditure for IHD and stroke were collected from studies applying an identical methodological framework conducted by the same research team (Leal et al., 2012). Matching data sources were used for information on health care expenditures associated with dementia for eight of the nine targeted countries (Luengo-Fernandez et al., 2011), supplemented with data from Alzheimer Europe (Wimo et al., 2009) for Poland, which reported aggregate health care expenditures.

The measures of the economic burden of dementia in Luengo-Fernandez et al. (2011) included long-term care costs (e.g. residential and nursing care homes), which was not the case for cancer, IHD or stroke. Therefore long-term care costs were estimated and added for these diseases. Estimates on UK long-term care costs have been reported for cancer, IHD and stroke (Luengo-Fernandez et al., 2010). National data on total long-term care costs (Lipszyc et al., 2012) were collected for each of the nine countries and calculated as a proportion of this figure for the UK. These proportions were then used to scale the data on UK long-term care costs by disease from Luengo-Fernandez et al. (2010) to derive country-specific long-term care costs for each disease. For dementia, there was no production loss caused by morbidity but by mortality (Luengo-Fernandez et al., 2011). Some inconsistencies were found in the source of these estimates, but they are not addressed further in the present analysis.

In addition to loss of market production, i.e. paid work, mortality and morbidity also result in loss of unpaid work, such as care giving and volunteer work. It is particularly important to include estimates of unpaid production losses because many cancers affect individuals later in life when they may no longer be active in the formal labour market. In addition, the ability to provide voluntary work and to look after children is an important element of quality of life. There is a double benefit – for the individual and for society. The estimates of unpaid production include volunteer work and informal care

[10] We did not have a basis for calculating unpaid labour losses from morbidity.

provided to others by the patient, including both childcare and elderly care. Domestic work (cooking, cleaning, gardening, etc.) was excluded as the societal benefit of such production is more complex to assess empirically.

Unpaid work losses were derived by multiplying expected annual unpaid work hours (by sex and age group) by years of life lost due to disease. These lost hours of unpaid work were then quantified using data on minimum wages in each country. Expected unpaid work in hours by age, sex and country were derived from the Multinational Time Use Study (MTUS) (Centre for Time Use Research at the University of Oxford, 2016) for the latest year available (see Table 4). Whilst these time-use studies were conducted many years ago, they represent the best available data that has been collected consistently across countries, and gives us an indication of time spent by people undertaking unpaid work.

**Table 4. Time-use data available by country**

| Country | Data source | Latest year available |
|---|---|---|
| **Belgium** | MTUS France | 1998 |
| **Denmark** | MTUS Denmark | 2001 |
| **France** | MTUS France | 1998 |
| **Germany** | MTUS Germany | 2000 |
| **Italy** | MTUS Italy | 2002 |
| **Netherlands** | MTUS Netherlands | 2005 |
| **Poland** | MTUS Slovenia | 2000 |
| **Sweden** | MTUS Denmark | 2001 |
| **United Kingdom** | MTUS United Kingdom | 2000 |

The MTUS data do not include Belgium, Poland or Sweden. For these countries, this report uses time-use data from, respectively, France, Slovenia (the only Eastern European country available) and Denmark.

In order to value these hours of unpaid work, this report uses a "replacement-cost" approach, which involves estimating the cost of a paid professional supplying the unpaid services using information on average national wages. This is in contrast to an "opportunity-cost" approach, which involves estimating the cost of the patient themselves supplying the unpaid services (Miranda, 2011). We assume that the wages a professional would receive for this type of work (volunteer work, elderly care and childcare) were equal to the country-specific minimum wage.

Minimum wages for most countries were collected from Eurostat (Eurostat, 2015g). Three countries do not have a statutory minimum wage (Denmark, Italy and Sweden). For the Nordic countries it was set to the agreed-upon minimum wage in collective agreements between employers and large labour unions (The Confederation of Danish Industry, 2014; Kommunal - the Swedish Municipal Workers' Union, 2013). For Italy it was assumed to equal the minimum wage debated for implementation (The Local, 2015). All minimum wages were converted into hourly rates using an assumed 37-hour working week. No production loss of unpaid work was assumed for individuals over the age of 80.

The total economic burdens of all cancer, the four specific cancers and the comparator diseases were then calculated as the sum of all of the cost categories mentioned. All costs and wages were adjusted to 2015 price levels using HICP where required

(Eurostat, 2015d). The most recent Eurostat population data, from 2014, was used to calculate cost per 100,000 population (Eurostat, 2015j).

In the primary analysis unit costs are not adjusted for the varying price levels across Europe. Therefore an additional analysis considers the results when translated into national price levels using Purchasing Power Parity (PPP) indices from Eurostat (Eurostat, 2015k) (PPP indices report in Appendix, Table 94).[11] The indices are based on the index value for EU27, which was also used as a proxy for the target countries combined, i.e. the target countries were assigned an index of 1 when combined.

We regard the results in relation to unpaid work to be conservative, as (1) we have excluded domestic work, (2) we have only looked at the impact of mortality and not of morbidity, and (3) we have not excluded any unpaid labour from people aged over 80.

### 1.3.3. Results

The economic burden of all cancer as well as of each of the four individual cancers is presented per 100,000 population, for each country and for this EU9 average, in Figure 22. The economic burden is divided into cost categories of health care costs, costs of informal care given to the cancer patients, and production loss of both paid and unpaid work. Both the total economic burden and the allocation between cost categories vary across countries as well as between cancer types. Rational explanations of differences in economic burden may be variations in disease incidence or prevalence, existence and scale of screening programmes, availability and efficacy of treatment, and participation in paid and unpaid activities.

Vast differences in the total economic burden of cancer between countries are demonstrated in Figure 22 (note that the steps on the vertical axis differ between the individual cancer types and the combined result for all cancers). For all cancers, Denmark presents the largest economic burden of €50 million per 100,000 population, closely followed by Germany and the Netherlands, while the corresponding economic burden in Poland seems to be one-fifth as large. The same countries demonstrate a high economic burden in all of the four individual cancer types, accompanied by Sweden in prostate and colorectal cancer. Poland has a significantly lower economic burden of all cancers and of the individual cancers compared with its European counterparts. These variances may, at least in part, be explained by differences in wage rates.

The magnitude of the economic burden of cancer varies between the individual cancer types. The largest burden is associated with lung cancer, the economic burden of breast and colorectal cancer are approximately equivalent, and prostate cancer has the smallest economic burden. These differences may be related to relative incidence; the use of screening programmes that induce early detection, which in turn improves survival; and/or the availability of efficient treatments.

Production loss of paid work seems to be the main cost of all cancer in most countries, except in Italy, where the largest cost category is health care costs (this may be a function of Italy having lower levels of average earnings). Production losses range from €1.5 billion in Sweden to €15 billion in Germany. For the individual cancers, however,

[11] Purchasing Power Parity (PPP) is a means of adjusting prices across countries. Rather than use the exchange rate (as this does not reflect relative purchasing power) prices are converted into a common currency which reflects the relative purchasing power, – that is, the cost of living, – in each country. By equalizing purchasing power of different currencies, PPP has the dimension of an exchange rate as well as a price index.

the relationship varies. Production loss of paid work exceeds health care costs for lung cancer in all countries and the reverse is true for prostate cancer, while the relationship differs between countries for both breast and colorectal cancer.

Production loss of unpaid work is reported in Table 92 (Appendix III – Economic burden of cancer). This report estimates that all cancers result in losses of between 26 million (Denmark) and 411 million (Germany) hours of unpaid work per year, where around 42% of these losses are in the voluntary sector and the remainder are in supply of informal care.

Production loss of unpaid work seems, in broad terms, proportionate to the economic burden of each cancer. It varies significantly between countries, where the general trend seems to be that the Nordic countries, especially Denmark, and the Netherlands suffer relatively large production losses of unpaid work while Germany reports relatively low losses of unpaid work among the countries with high economic burdens of cancer. Meanwhile, the production losses of unpaid work are almost insignificant in Italy and Poland, who generally report relatively low economic burdens of cancer, as well as relatively low average levels of unpaid work per person (see Table 93: Appendix III – Economic burden of cancer).

The economic burden of all cancer and the comparator diseases is presented per 100,000 population, for each country and their average, in Figure 23. Again, both total economic burden and the allocation between cost categories vary across countries and between diseases.

The figures imply that the economic burden of dementia is about twice as large as that of all cancers in some countries (e.g. Denmark, Sweden, Italy) and comparable in other countries (e.g. Belgium, Germany), while the relationship is reversed in some (the Netherlands, Poland). The economic burden of IHD seems comparable to that of stroke.

Germany and the Netherlands have high economic burdens relative to their populations in all diseases but dementia. Denmark and Sweden have relatively high economic burdens in all cases but stand out significantly more regarding dementia. Poland presents relatively small economic burdens of all four diseases.

Notably, production loss, of both paid and unpaid work, is a significant component of the total cost for cancer, while its contribution of productivity loss to the burden of other diseases, IHD and stroke is less significant, and close to zero for dementia. This may be because dementia affects a relatively old population who are less likely to provide either type of work (we assume no production loss of unpaid work for unhealthy individuals over the age of 80). Production losses are often overlooked in assessments of value; efficient health care delivery should consider savings (or cost reductions) across the spectrum.

Note that some inconsistencies were found in the source of the estimates of production loss for dementia (Luengo-Fernandez et al., 2011), but they were not addressed further in the present analysis and should therefore be interpreted with caution. For dementia, the allocation of the economic burden differs from that of the other diseases as the primary cost falls on informal care. This is reasonable as dementia to a relatively larger extent require less-skilled care that could be provided informally, e.g. by family members. The vast majority of the total economic burden of stroke consists of health care costs.

In terms of unpaid care hours, the loss of unpaid care for all cancers is larger than the losses for IHD, dementia and stroke combined in all nine countries (see Table 92, Appendix III – Economic burden of cancer). Again, this may be explained by a large and also relatively young population for cancer relative to the other diseases. As discussed above, addressing the cancer burden represents an economic opportunity, in this instance in young productive individuals, which is often overlooked by policy makers.

**Figure 22. Economic burden of all cancers and individual cancers – lung, breast, prostate and colorectal – by country, in 2015. Presented in €million per 100,000 population.**

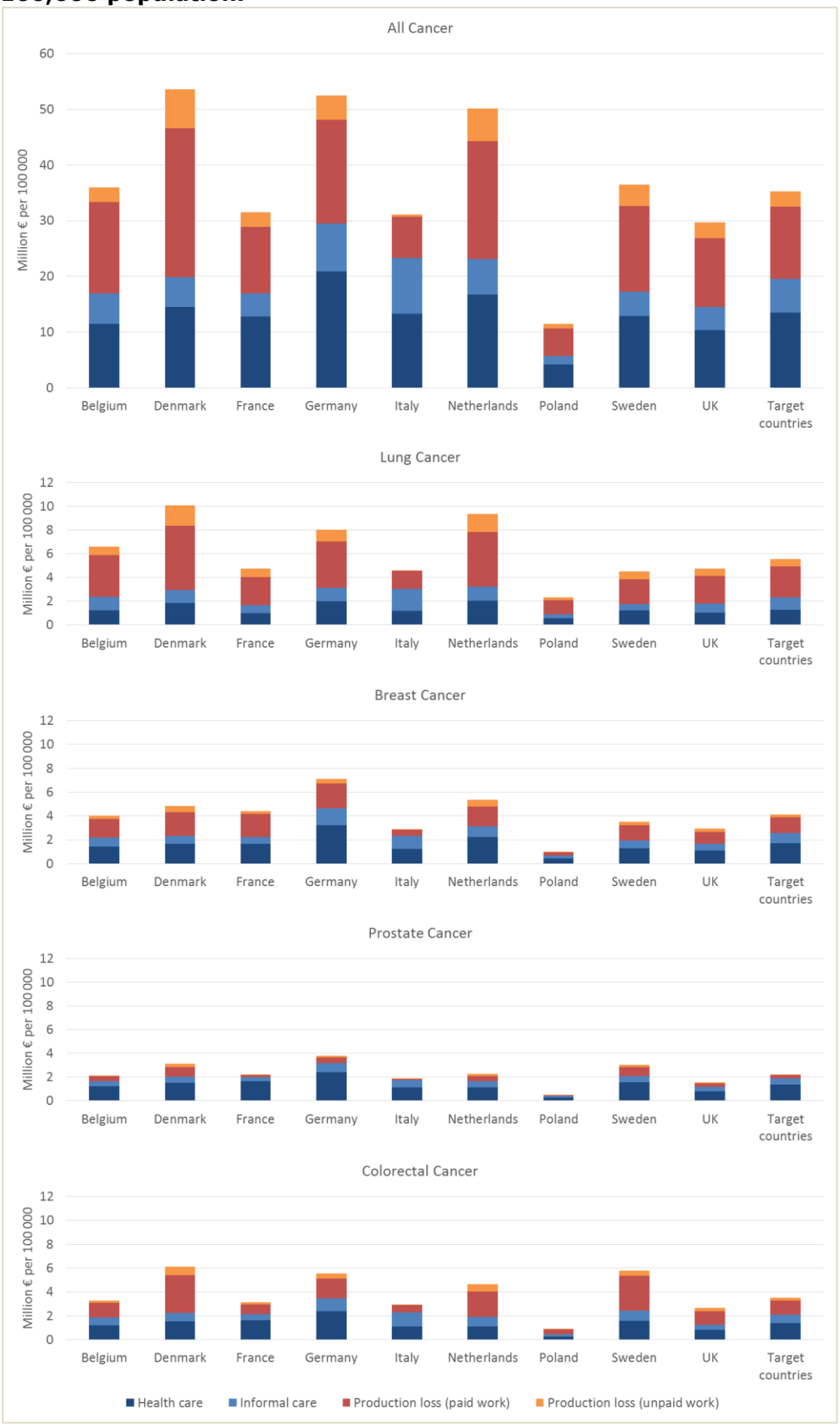


**Figure 23. Economic burden of all cancers, IHD, stroke and dementia in the nine countries (Belgium, Denmark, France, Germany, Italy, the Netherlands, Poland, Sweden, the UK) and the average for the target countries, by country, in 2015. Presented in €million per 100,000 population.**

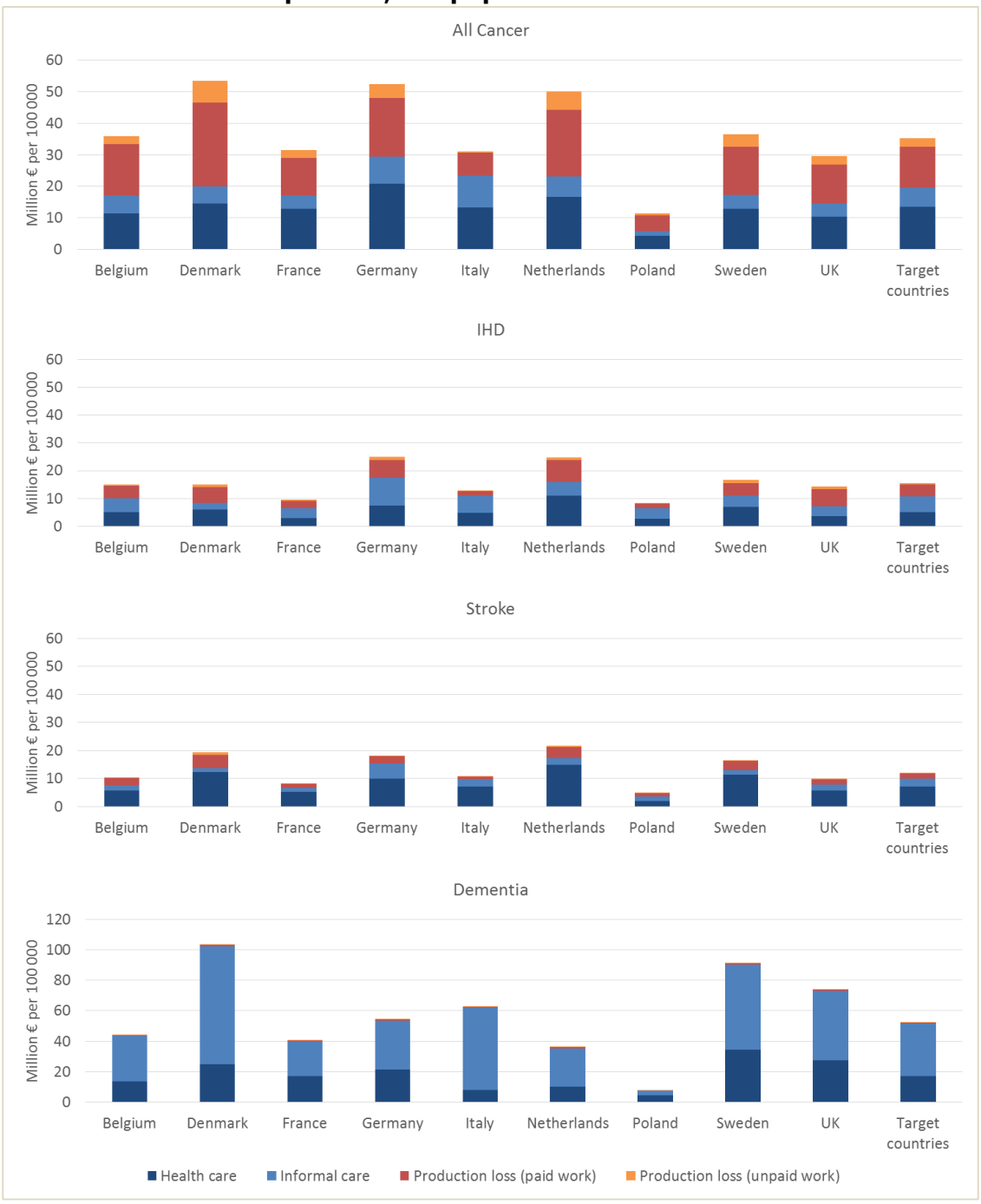


Figure 24 confirms the within-country differences in economic burden resulting from individual cancer types, as was partially observable in Figure 22. Lung cancer represents the largest economic burden in all countries. In contrast, prostate cancer represents the smallest economic burden between the four cancer types, while breast and colorectal cancer are found in the mid-range. The economic burden of lung cancer is relatively low in Sweden, where there is a slightly larger economic burden of colorectal cancer, possibly explained by a relatively low disease burden of lung cancer in Sweden. In contrast, prostate cancer represents a relatively large economic burden in Sweden compared with other countries, reflecting the relatively high disease burden we identified earlier in this report.

Lung cancer is the cancer where the largest component of its economic burden consists of production loss of paid work. In most countries, lung cancer also stands out as the individual cancer with the largest relative burden caused by production loss of unpaid work. A possible explanation for this is that lung cancer is a relatively severe cancer, often diagnosed at a late stage, that leads to higher morbidity and higher mortality rates compared with the other cancers. New efficacious treatments for lung cancer that could reduce this burden, by improving patients' morbidity and increasing their life expectancy, would result in productivity gains, thereby reducing the indirect costs of cancer.

Again, there are large between-country variations where the production loss of unpaid work is large in the Nordic countries and the Netherlands, but small in Poland and almost non-existent in Italy, where informal care is a more crucial aspect. Overall it is clear that health care expenditures account for only a limited part of the total economic burden of cancer and that other economic parameters are of great significance when evaluating the same. Instead of comparing various cancers, Figure 25 relates all cancers to the comparator diseases within the countries.

As previously stated, dementia seems to be the disease with the largest economic burden in most countries and is, by far, the disease with the largest burden of informal care. The second-largest burden is associated with cancer, which in turn is associated with large productivity losses. The results imply that cancer causes a larger labour market fallout compared with the other diseases. The same is true for the unpaid-labour market of volunteering and care giving.

IHD and stroke both represent a significantly smaller economic burden compared with dementia and cancer in all countries but Poland. Again, it should be noted that a different data source was used to estimate the economic burden of dementia in Poland.

There are large within-country variations where the production loss, for both paid and unpaid work, is significant for cancer but less so for the other diseases. Dementia is characterised by a high informal-care burden, while the burdens are generally distributed evenly between health care, informal care and production loss for IHD. Overall it is clear that health care expenditures only account for a limited part of the total economic burden of both cancer and the comparator diseases.

**Figure 24. Economic burden of lung, breast, prostate and colorectal cancer in the nine countries (Belgium, Denmark, France, Germany, Italy, the Netherlands, Poland, Sweden, the UK) and the average for the target countries in 2015. Presented in €million.**

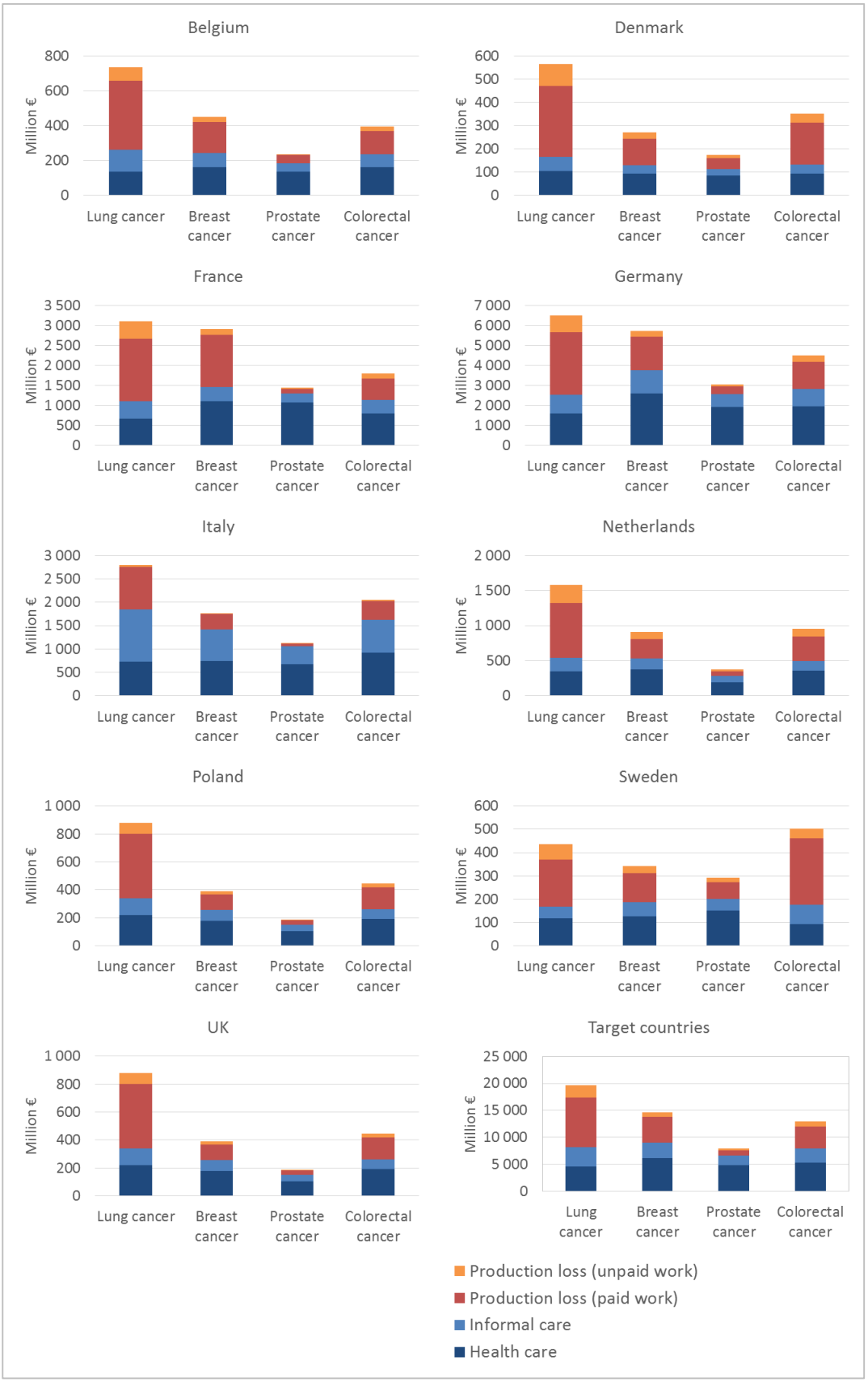


**Figure 25. Economic burden of all cancers, IHD, stroke and dementia in the nine countries (Belgium, Denmark, France, Germany, Italy, the Netherlands, Poland, Sweden, the UK) and the average for the target countries, in 2015. Presented in million.**

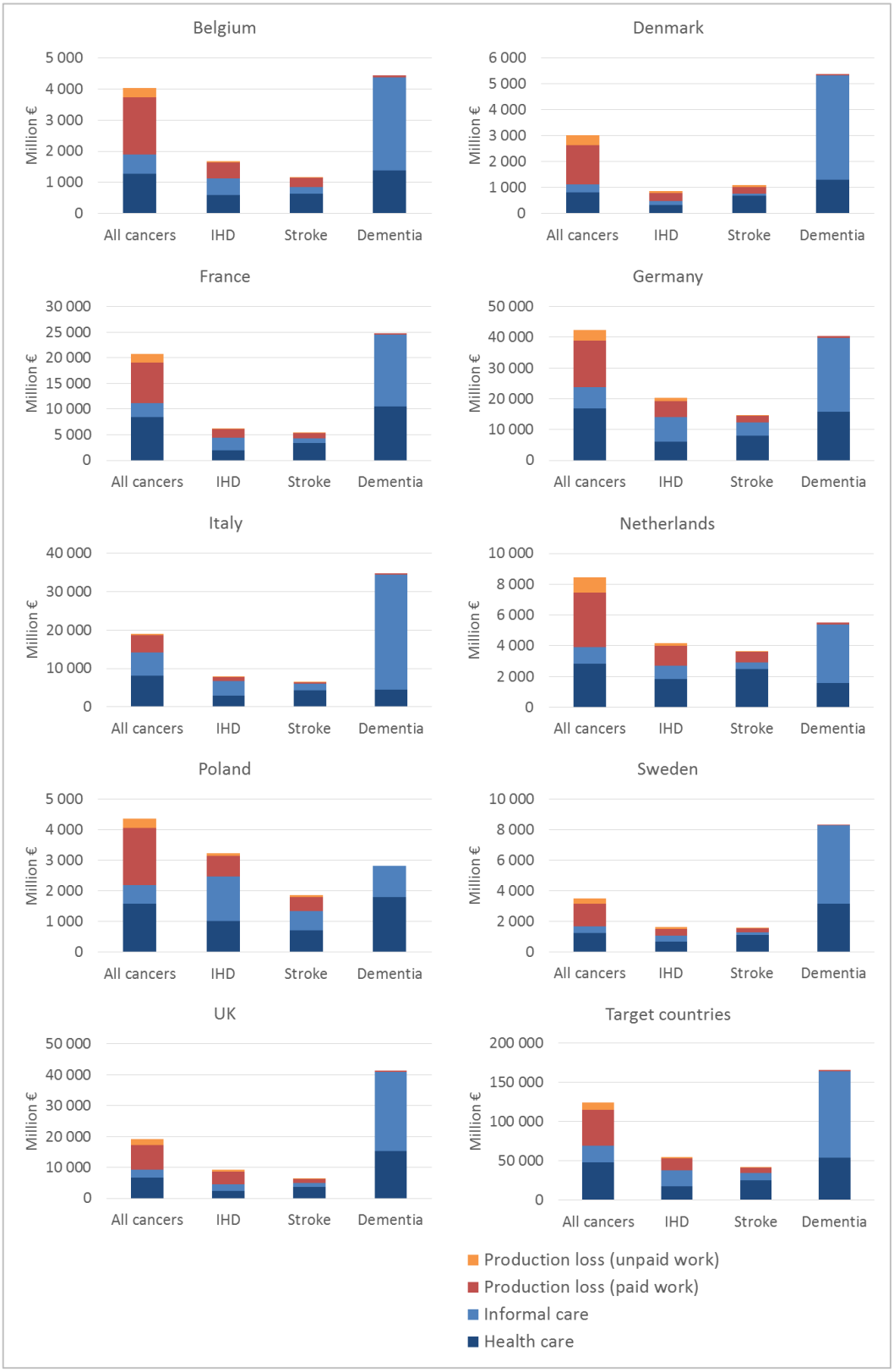


Figure 26 and Figure 27 translate the results using national price levels. As the price-level adjustment does not affect the relative levels of economic burden of the various diseases within a country or the relationship between different cost categories, this section focuses on the between-country analyses.

Similar to the untranslated results, significant differences in total economic burden of cancer between countries are detected in Figure 26, but the relationships differ somewhat. Again, note that the steps on the vertical axis differ between the individual cancer types and the combined result for all cancers. Now, Germany presents the largest economic burden of cancer per 100,000 population, followed the Netherlands and then Denmark. Poland still presents the lowest economic burden of cancer among the countries, but the relationship has leveled out significantly. The same countries demonstrate a high economic burden in all of the four individual cancer types, accompanied by Sweden in prostate and colorectal cancer. Poland has a significantly lower economic burden of all individual cancers compared with its European counterparts, with the exception of lung cancer, where Sweden presents the lowest economic burden.

The relative magnitude of the economic burden between cancer types remains unchanged, where the largest burden is associated with lung cancer, the economic burdens of breast and colorectal cancer are approximately equivalent and prostate cancer has the smallest economic burden. As previously stated, these differences may be related to relative incidence; the use of screening programmes that induce early detection, which in turn improves survival; and/or the availability of efficient treatments.

The price-level adjusted economic burden of all cancers and the comparator diseases is presented in Figure 27. Again, the economic burdens vary both across countries and between diseases.

Germany and the Netherlands suffer high economic burdens of all diseases but dementia, where Denmark and Sweden present the highest burdens. Poland presents relatively small economic burdens for all four diseases, although the PPP price-level adjustment reduced these differences.

**Figure 26. The PPP-adjusted economic burden of all cancers and the individual cancers – lung, breast, prostate and colorectal cancer – by country, in 2015. Presented in million per 100,000 population**

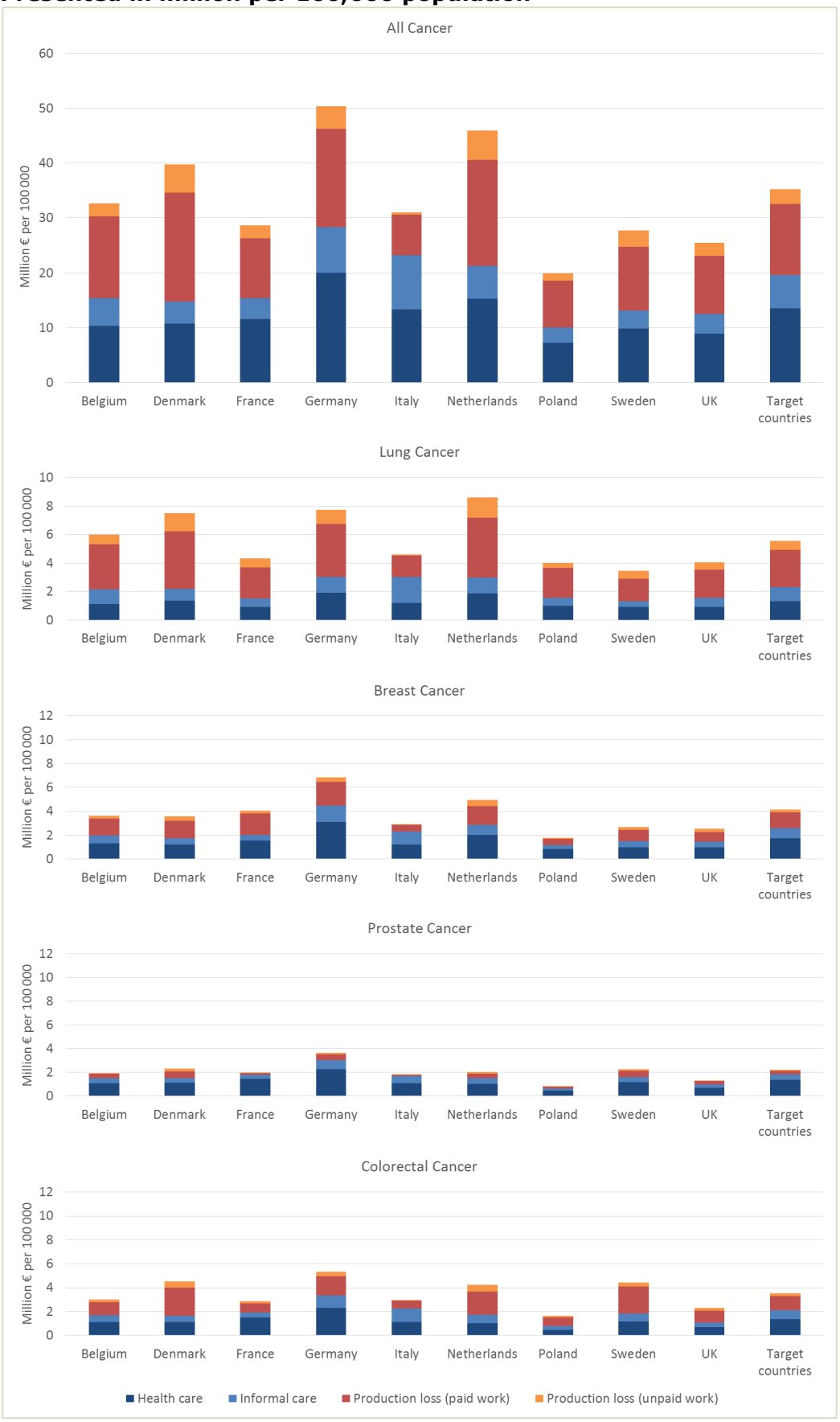
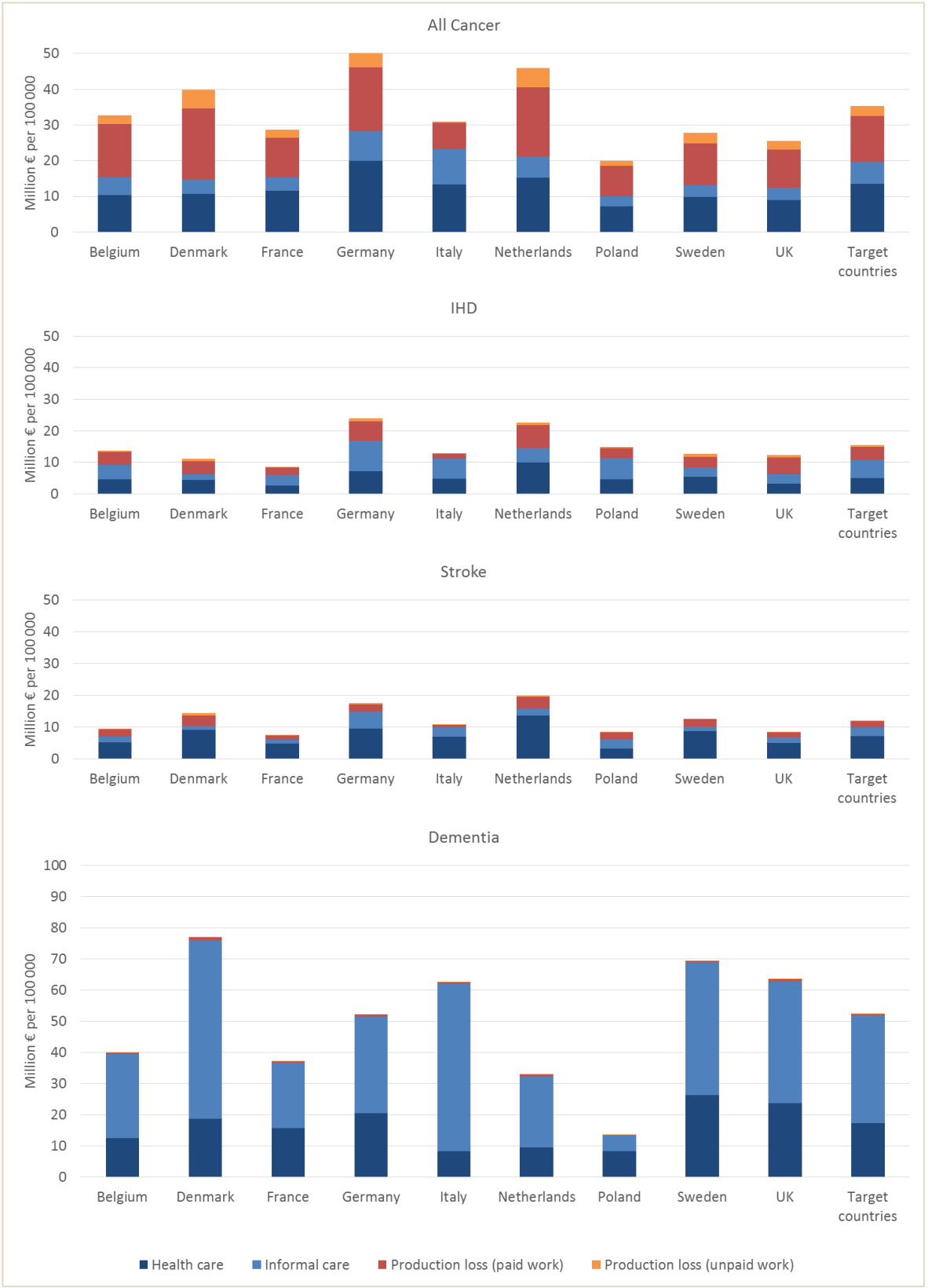


**Figure 27. The PPP-adjusted economic burden of all cancers, IHD, stroke and dementia in the nine countries (Belgium, Denmark, France, Germany, Italy, the Netherlands, Poland, Sweden, the UK) and the average for the target countries, by country, in 2015.**



# SECTION 2: THE CANCER CARE LANDSCAPE

## 2.1. *Efficiency of cancer care provision and patient access*

By describing the current landscape for spending on cancer, we have described the extent to which cancer care has been prioritised by governments – in terms of money spent – and how this relates to its health burden for patients. However, money spent does not translate automatically into better outcomes for cancer patients, as spending on some aspects of patient care may achieve much better outcomes than spending on others. In this section we describe and compare cancer care provision across our nine countries, and by doing so highlight examples of efficient and inefficient practices.

### 2.1.1. What do we mean by efficiency?

An economist's approach to the issue of resource allocation in health care is grounded on the notion of resource scarcity: there are simply not enough resources to achieve all desirable objectives. Within the context of an ageing European population, rising expectations, and a high rate of innovation, our demands for health care are high and increasing; health care budgets struggle to keep up to support these demands.

Efficiency can be described using many terms (e.g. allocative efficiency, technical efficiency, productive efficiency, social efficiency). Knapp (1984) defined efficiency as "the allocation of scarce resources that maximises the achievement of aims". In health economics we generally consider the primary (but not the only) aim of health care to be the improvement in health of the population. Efficiency involves, amongst other things, getting the best outcomes from any given level of health expenditure.

This therefore raises two fundamental and separate questions:

1. Are we getting the most out of the resources available, and spending the health care budget on those services with the highest positive impact?
    a. Are resource inputs (e.g. staff, equipment, etc.) being used effectively to achieve the highest outputs possible? This could mean, for example, cutting out waste and streamlining management or delivery (technical efficiency). It is important to remember, however, that implementing an efficient approach may take time, and many resources in the short-run are difficult to reallocate.
    b. Are we investing in the services and treatments which provide the best value for money? (High impact on patient health relative to cost). This is grounded in the notion of opportunity cost: spending on one thing means we have less to spend on another – making optimal choices around resource allocation means that we need to be confident that the money spent couldn't achieve more if it were spent elsewhere.[12] This means directing resources to achieving outcomes that society values most (allocative efficiency).
2. Is the level of resourcing available for health care sufficient?

Whilst we aim to address the first of the questions stated above, "Are we getting the most out of the resources available?" we will also touch on the adequacy of funding for

[12] It is for this reason that in health economics we generally use a generic measure of health – the quality adjusted life year (QALY) – which captures both morbidity and mortality impact, and allows for comparisons between disease areas.

cancer care by considering mechanisms that could increase the level of spending on cancer.

Another relevant concept is "dynamic efficiency", which is concerned with productive efficiency (producing goods and services with the optimal combination of inputs to produce maximum output for the minimum cost, i.e. producing on a production-possibility frontier) over a period of time. To be dynamically efficient, the system will be reducing its costs by implementing new production processes. This is relevant for the health care sector, as the introduction of new technologies and knowledge will shift the capabilities of the health service in providing better care to patients.

This section is organised as follows. First, in subsection 2.2 we summarise our methods for this part of the project. Subsection 2.3 begins with an EU policy overview and then sets out our analyses of clinical pathways and care delivery in each country studied. Subsection 2.4 assesses the role of drug reimbursement and regulatory mechanisms in striving for improved efficiency, and includes discussion of the health technology appraisal (HTA) process for cancer drugs, and early-access and managed-entry schemes that exist for drugs in Europe. The generics market is discussed in subsection 2.5. Headline efficiency and inefficiency issues are highlighted in subsection 2.6.

## 2.2. *Methods*

The process by which we collected evidence and analysed results for this section can be summarised in five main phases.

### 2.2.1. Development of a pro-forma for data collection

A study of the provision of cancer care across Europe encompasses a broad and extensive field of research. In order to focus our investigation, and to maintain a level of consistency across individual country analyses, we developed a pro-forma for data collection. The pro-forma was created to elicit information around the organisation and delivery of cancer care and treatment pathways, and to identify comparable information around good and bad practices, and how more efficient practices have been or could be identified and implemented. Questions were organised into six themes: (1) HTA and funding of cancer drugs, (2) organisation of services and cancer care commissioning, (3) cancer prevention and early diagnosis, (4) diagnosis and delivery of cancer treatment, (5) intervention-specific questions and (6) additional examples of innovative or inefficient practices in cancer care. Sub-questions were included in order to focus responses and generate comparable information, but were broad enough to capture information that would be particularly pertinent to the country context.

### 2.2.2. Selecting and liaising with country experts in their completion of the pro-forma

Country contacts based in or very familiar with the countries of study were established through our network of health economic experts. These country experts completed the pro-formas. Kick-off meetings were held with each contact or team individually to ensure that each was aware of the relevant perspective and had the opportunity to ask questions. Regular catch-up meetings were held, draft pro-formas were assessed by the OHE team before revisions, and then final drafts were submitted.

### 2.2.3. Qualitative synthesis and analysis of results

Analysis and assimilation of country information was through the thematic analysis of reported findings. Under each question topic, insights were grouped into complementary themes and assessed.

Given the breadth of the topic, we did not expect the country pro-formas to be completed comprehensively and comparably, particularly as they were completed by experts with different backgrounds and/or particular research interests. However, this provided the opportunity to raise a wide range of issues, which we summarise in this report and organise into themes. Further detail can be found in the relevant pro-forma, available as a separate annex (from the authors). They contain details of particular patient pathways for four types of cancer, and intervention-specific questions which we do not summarise here, but which can offer for those interested a direct comparison of specific treatment approaches across the countries of interest.

### 2.2.4. Literature search to validate, consolidate and contribute to our findings

In order to interpret findings and provide further cohesive evidence of the European situation, literature searches were undertaken on the emergent themes, which we describe in relation to their contribution to the efficient or inefficient delivery of health care for cancer.

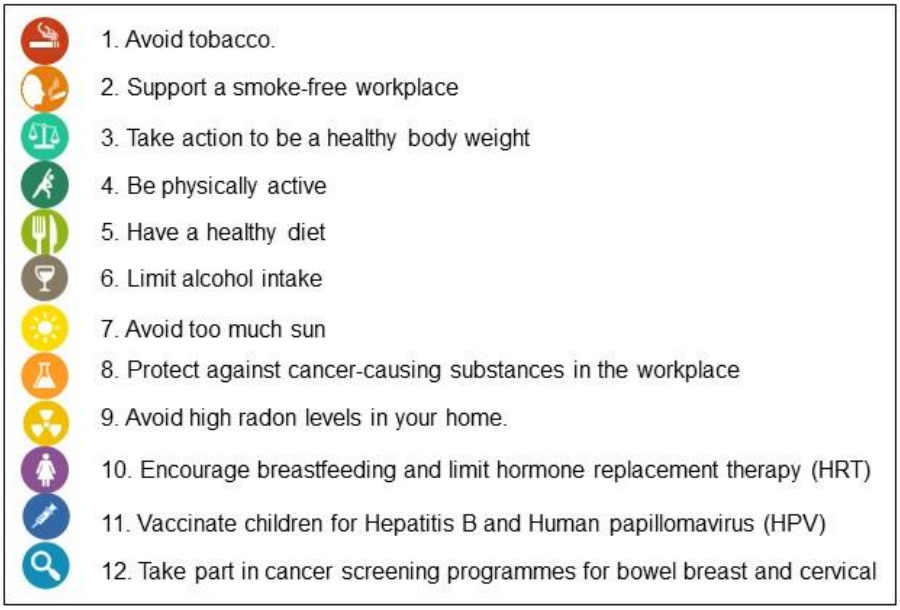
## 2.3. *Clinical pathways and care delivery*

### 2.3.1. Europe's role in the fight against cancer

Whilst the formulation of health policy and delivery of cancer care lies primarily with individual countries, organisations at the European level increasingly have a role both in assessing member states' performance and in setting the agenda for best practice in health care, setting goals, and making recommendations for change.

The most significant early action the EU took in the fight against cancer was the initiation of the "Europe against Cancer" programme in 1985 by the European Council, which published its first action plan in 1987 (European Commission, 1995). A significant output of this collaboration has been the development and publication of the "European Code against Cancer", first published in 1987 to focus on prevention and now in its fourth edition (European Commission, 2014a). Figure 28 summarises the latest code, which was published in 2014.

**Figure 28. European Cancer Code: 12 ways to reduce your cancer risk**




Adapted from European Commission (2014a)

In 2009, the European Commission published its Communication on Action against Cancer: European Partnership (European Commission, 2009). This set out five major objectives, outlined in Table 5. Alongside these we present an assessment of progress to date against these objectives.

**Table 5. Action against Cancer: European Commission objectives and progress**

| **Major objectives** from Action against Cancer: European Partnership: 2009 | **Progress since 2009** |
|---|---|
| • Reducing cancer burden by achieving **100% population coverage of screening for breast, cervical and colorectal cancer** by 2013: 125 million examinations per year | **Across the EU less than half** of the necessary number of examinations for the screening of breast, cervical and colorectal cancer are undertaken; **less than a quarter** of the target 100% coverage is achieved through publicly mandated programmes.<br>An anticipated 500 million screening examinations for breast, cervical and/or colorectal cancer will have been performed by publicly mandated programmes in the EU between 2010 and 2020: well below the target of 125 million per year |
| • Develop a **coordinated approach to cancer research**; achieve coordination of one-third of research from all funding sources | The Commission has invested €1.4 billion in cancer research. More than half of this budget – €770 million – was on collaborative research projects.<br>Important projects developed: European cancer research coordination, European platform for cancer outcomes research, European knowledge hub for epidemiology and public health research on cancer |
| • Ensure **accurate and comparable data on cancer** incidence, prevalence, morbidity, cure, survival and mortality in the EU by 2013 | Major data collection efforts for cancer registration at the EU level. However, **barriers persist in data access and coordination of comparable data sets**. Registries are underfunded and understaffed.<br>Important EU-level projects: European Network of Cancer Registries (ENCR), Europe Cancer Registry-based study on survival and care of cancer patients (EUROCARE), EUROSTAT, European Cancer Health Indicators Project (EUROCHIP) and European Cancer Observatory (ECO) |
| • Achieve a **70% reduction in existing cancer mortality inequalities** between member states by 2020 | Assessment not available |
| • Ensure that **all member states implement integrated cancer plans by 2013** | **24 out of 28 member states** implemented a National Cancer Control Plan by 2013 (those without: Austria, Bulgaria, Luxembourg and Slovakia).<br>Austria and Luxembourg both published their first Cancer Control Plan in 2014. Austria is the first to include in their plan a "Survivorship Passport": an innovative solution to maintaining adequate follow-up and data capture, particularly important for young cancer survivors (around 80% now survive) (SIOP, 2015) |

Adapted from (European Commission, 2009; 2014b) and OHE/IHE analysis.

The most significant action from this was to set up the European Partnership for Action against Cancer (EPAAC) for the period 2009–13, whose primary purpose was to ensure that all member states implemented integrated national cancer control plans (NCCPs) by 2013. In putting these plans into action, the European Commission proposed one major goal: reducing the burden of cancer in the EU by 15% by 2020.

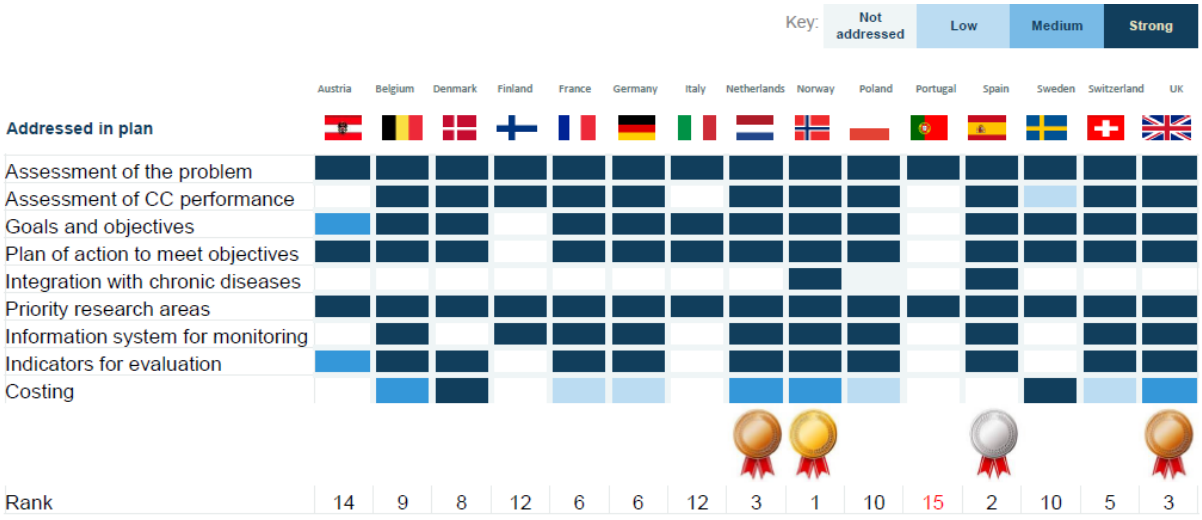
A NCCP is a public health programme which aims to reduce the number of cancer cases and improve quality of life through evidence-based strategies for the prevention, early

detection, diagnosis, treatment and palliation of cancer. Plans to control cancer and implement cost-effective strategies are tailored specifically to the national context in order to reflect local demography, health service organisation, leadership and resourcing (EPAAC, 2015). In 2004, the World Health Organisation (WHO) published a report demonstrating major performance gaps in cancer control programmes across Europe, finding in particular that whilst strong emphasis was given to diagnosis and treatment, national plans often neglected prevention, early detection and palliative care (WHO, 2004).

In describing a health systems approach to NCCPs, EPAAC lay out four pillars of cancer control: primary prevention, secondary prevention (screening), integrated care (including psychosocial care and palliative care) and research (including surveillance and cancer registries) (Gorgojo, Harris and Garcia-Lopez, 2012). EPAAC found that multiple stakeholders were involved in the development of the NCCPs, including patients, professionals, government and payers. In five of our nine countries of study – France, Germany, the Netherlands, Sweden and England – patients were as involved or almost as involved as other stakeholders in the development of national NCCPs.

The WHO developed a tool for a qualitative assessment of NCCPs. The Economist Intelligence Unit's (EIU) application of this tool to European NCCPs is summarised in Figure 29. According to the EIU, European cancer plans vary in the way they describe integration of activities with plans for other chronic diseases, and the cost and resources needed for successful implementation of the plan. Of the countries assessed in these reports, UK and the Netherlands are ranked highly, whereas Poland and Italy, according to the EIU's assessment, leave most room for improvement.

**Figure 29. National cancer control programmes core capacity: assessment by EIU**




Source: EIU (2015) Controlling Cancer in Europe: Budgets, Planning and Outcomes. Presentation by Annie Pannelay. War on Cancer 2015, 2015 London. *The Economist*.

Critical to the implementation of NCCPs is adequate funding for delivery of its recommendations. In Table 6 we summarise the funding situation in the nine countries of our study. Three are reported as having inadequate funding to implement their NCCPs.

**Table 6. Cancer plans: additional funding**

| Country | Specific budget allocation to implementation of different measures within plan? | | Specific activities to receive additional funding |
|---|---|---|---|
| | Yes/No | Sufficient? | |
| Belgium | Yes | Yes | Screening programmes, and cancer care: personnel, innovation, paediatric oncology, reimbursement of medicines, rehabilitation, research and innovation |
| Denmark | Yes | Yes | More or less all initiatives in the plan are followed by additional funding to cover development and implementation of the initiative |
| England | Yes | Yes | Increased radiotherapy capacity, improvements in screening programmes, improved primary-care access to diagnostics and publicity campaigns to improve public awareness of symptoms, data collection |
| France | Yes | Yes | All 30 measures were allocated specific additional financial resources for their implementation |
| Germany | Yes | Unsure | Additional funding for organisation/administration, and for research |
| Italy | No | No | Budgeting procedures do not allow earmarking of budgets for specific diseases or actions |
| Netherlands | No | No | All actions and activities must be financed from the relevant organisations' own strategy and annual budgets |
| Poland | Yes | Yes | Equipment replacement |
| Sweden | Yes | No | Building regional cancer centres, pilot projects to improve processes and reduce waiting times, anti-smoking activities, improved information collection and dissemination, promoting concentration of cancer care |

Source: Adapted from (Gorgojo et al., 2012).

Only Denmark and France reported that all aspects of their programmes had been allocated specific additional funds. Of all 28 member states, 20% indicated that there were insufficient funds to implement the NCCPs as drafted (Gorgojo et al., 2012).

Where cancer plans exist, the level of funding to implement plans can be inadequate in some countries. This, combined with the broad constraints on health care spending across Europe, makes it even more important that we find ways to improve practice within cancer care, and to find savings that can, in principle, be reinvested into more effective treatments and practices.

The level of activity in the organisation, implementation and evaluation of cancer care across Europe is vast; to map out the entire landscape would be a huge undertaking, and one to which others are better suited (see, for example, the final deliverables of EPAAC: (EPAAC, 2014; Albreht et al., 2014; Gorgojo et al., 2012), and new joint initiatives such as CANCON (CANCON, 2015). Our evaluation, undertaken with the primary objective of identifying efficient and inefficient practices in cancer care,

investigates some specific aspects of service organisation and delivery, and, by comparing practice across countries, highlights where they could be improved.

### 2.3.2. Organisation of services and cancer care commissioning

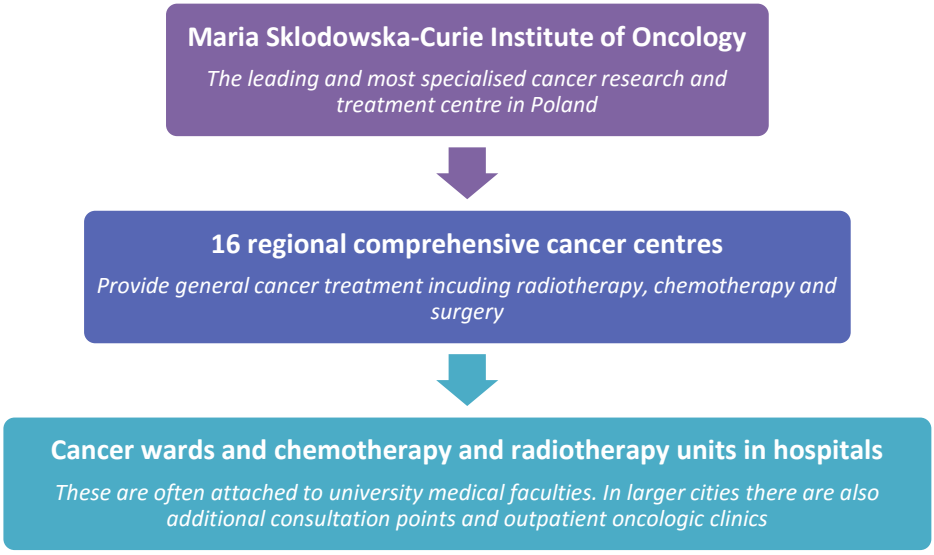
In assessing the organisation of cancer care services, two main themes arose: specialisation of cancer services and coordination to ensure multidisciplinary patient-centred care.

There is great variation in the way that health care services are organised and funded across the countries studied. Whilst some countries have introduced reforms with the aim of improving the efficiency of health care delivery (e.g. managed competition for health insurers in the Netherlands), each country has a very different context, and it is both very difficult and beyond the scope of this report to comment on the optimal organisation and funding model for health care across Europe. Rather, we set out below some key elements of cancer care delivery, which contribute to the efficient delivery of cancer services no matter how those services are organised or funded. By doing so, we highlight examples of good and bad practice, an understanding of which can help us to promote and recommend key actions to improve cancer care delivery across Europe.

#### *Centralisation of specialised cancer services*

A major theme that arose from our country experts was the centralisation of specialised cancer services. For example, in the Polish health insurance system, provision of oncology care is based on a three-tier system, as outlined in Figure 30.

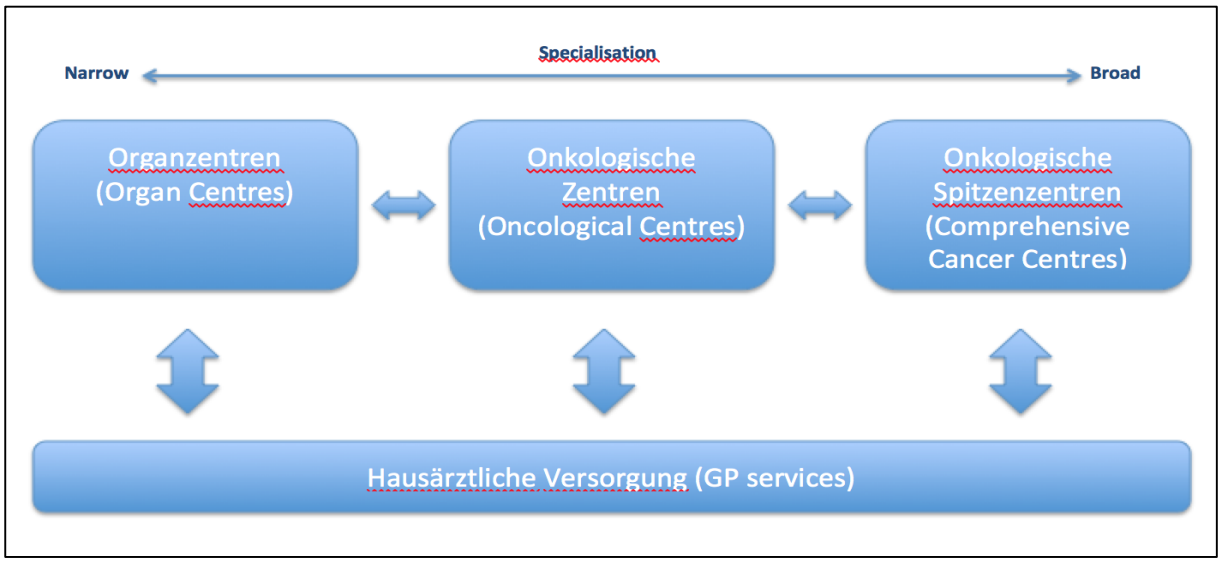
**Figure 30. Organisation of cancer care provision in Poland**




Polish cancer care is financed primarily through the national system of guaranteed health benefits. People are entitled to health services free at the point of use, provided by contracted health care providers from one of 16 branches of the National Health Fund in every voivodeship (region). Services provided by the private sector are increasing, although this is usually based on agreements with the National Health Fund and financed from public funds. Access to cancer care was noted to vary significantly across regions. Access to radiation therapy is noted to be particularly restricted (we assess this further in subsection 2.3.4).

In Germany, care is similarly organised according to a specialisation hierarchy, at the top of which are "organ centres" which provide state-of-the-art specialised care and are mainly located in academic hospitals. Next, "oncological centres" represent cooperation programmes which bundle competence and equipment at dedicated centres; they coordinate overlapping functions such as palliative care, supportive care, management of pain and rehabilitative care. Finally, "comprehensive cancer centres" combine all aspects of cancer care, such as patient treatment, research and training. There are currently 13 of these in Germany. General practitioners (GPs) lie at the heart of the interaction between these services.

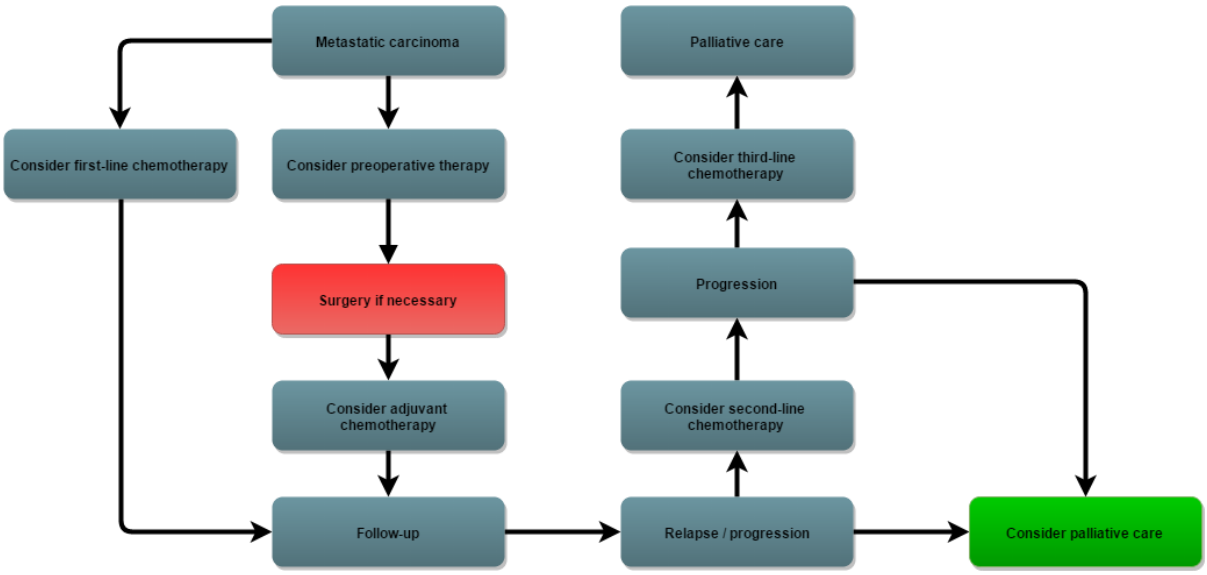
**Figure 31. The three-step model of cancer care delivery in Germany**




In addition to these, "German tumour centres" function as regional networks of hospitals, coordinating cancer treatment across the entire continuum of care.

The determination of where cancer care should be delivered is largely dependent, as described, on the level of specialisation of staff and equipment involved. An example from Italy of where cancer is delivered according to stage is provided in Figure 32.

**Figure 32. Example of diagnostic and therapeutic guidelines**




Different colours signal in which kind of structure each stage of the disease should be treated: green is for basic hospitals, blue is for hospitals with specialists, red is for regional hubs. Source: elaboration from PDTA for colorectal cancer of Emilia Romagna.

In England, the commissioning and organisation of services is centralised. The Department of Health is accountable for cancer services and is ultimately responsible for securing value for money, but commissioning is undertaken by NHS England. Public Health England is accountable for achieving public health outcomes, whilst NHS England is accountable for outcomes achieved by the NHS, including those for cancer services. Other organisations involved in cancer services include clinical reference groups and strategic clinical networks. In primary care, since the year 2004 GPs have worked within a pay-for-performance system where activity is monitored through the Quality and Outcomes Framework (QOF), which is designed to incentivise high-quality care in a number of the most common chronic disease areas. However, it is currently unclear whether the current incentive system has contributed to the poorer cancer outcomes that are observed in England.

The Dutch health care system is based on social health insurance (a Bismarck model). All residents are obliged to enroll in a universal basic health insurance which is provided by competing health insurers. Adults pay a flat rate on top of an income-dependent premium, and a subsidy scheme relieves the financial burden for those with lower incomes. Supplementary health insurance is privately offered on a voluntary basis. Reform in the Netherlands which introduced the uniform health insurance system and intensified managed competition between health insurers was implemented in 2006. Insurers thereby complete on price and quality whilst the government sets rules to ensure that public objectives are met. The ultimate goal is a system that incentivises efficiency whilst ensuring universal access to good-quality care. A central element of the success of such a scheme is not to allow insurers to risk-rate enrollees. To facilitate this, a risk equalisation fund is implemented whereby insurers are compensated for predictable profits (young healthy enrollees) and predictable losses (the elderly and chronically ill). This reduces incentives for risk selection and ensures a level playing field for insurers.

Whilst care is financed through health insurance in the Netherlands, decisions around what type of care is included in the basic package are made at a national level and centrally mandated. The services provided across hospitals are therefore centrally organised. The GP has the role of gatekeeper to the system. Certain treatments can only be provided in a certain number of hospitals that specialise in them. For example, in 2012 the minister for health made the reimbursement of Ipilimumab conditional on the centralisation of melanoma care.

In Sweden, there are six health care regions which are geographically organised: North, Uppsala-Örebro, Stockholm, West, South East and South. The majority of care is delivered at a patient's local hospital, which will have an affiliation to a council (*landsting*). In each health care region there is a regional cancer centre (RCC). The RCCs have an important role in coordinating and developing cancer care, and implementing the Swedish cancer strategy which was established in 2009. This strategy defines ten focus areas, which represent the main areas of focus for RCCs: (1) preventative measures and early cancer detection; (2) cancer tracks (care pathways); (3) psychosocial support, rehabilitation and palliative care, (4) patient perspectives in cancer care; (5) education and competence profiles; (6) knowledge-based health care; (7) clinical cancer research and innovation; (8) management structure; (9) strategic development plan; and (10) level structuring. The national cancer strategy has led to the development of regional cancer strategies and regional cancer plans. RCCs work with county councils and regions in coordinating and implementing these regional plans to work towards more knowledge-based, patient-focused, equal and accessible cancer care (Regionalt Cancercentrum SYD, 2015). There are national clinical guidelines outlining treatment pathways in Sweden, which are written by RCCs (who focus on the process elements such as waiting times and diagnostic procedures) and by the National Board of Health and Welfare.

The organisation of oncology services in France is managed through the National Cancer Institute (Institut national de cancer, or INCa) – a government agency based at the health ministry – which was decreed in the Public Health Act 2004. INCa is a public-interest group which brings together the state, health insurance funds, research organisations, hospital federations and others. It has responsibility for coordinating cancer control activities with the many agencies and stakeholders involved, and reports to the Cancer Plan National Steering Committee. The Cancer Plan in France is a major focus among health care providers and patients. To date, three cancer plans have been implemented: 2003–7, 2009–13 and 2014–19. As well as committing to health care delivery changes and targets, there is also a major focus on research. The ARC Foundation for research on cancer (Foundation ARC pour la recherche sur le cancer) is part of the Cancer Plan. As in other countries, there are also major non-governmental funders of research on cancer, e.g. the League against Cancer (Ligue contre le cancer), which has 213 regional committees (Ligue contre le cancer, 2015).

By way of ensuring excellence in cancer care, France has introduced various measures. Here, we briefly describe three concepts: oncology authorisation, minimum activity thresholds and cancer networks. Since 2009, health care facilities must have specific permission issued by their regional agency of health (Agence régionale de santé, or ARS) to treat patients suffering from cancer. As of 2015, there are 935 health care facilities in France authorised to treat cancer patients (INCa, 2015a). As part of this authorisation process, minimum activity thresholds must be realised, in the form of an annual activity threshold applied to these health care facilities for cancer surgery (30 surgical

interventions per year for some cancers), radiotherapy (600 patients per year) and chemotherapy (80 patients treated per year, of which at least 50 outpatient). These thresholds apply not only to hospitals but also to all public or private health institutions seeking authorisation to offer cancer treatment. These minimum activity levels aim to ensure that all patients have access to high-quality and safe care. In order to support regional activity, France has also implemented "networks" of regional cancer facilities, including networks for rare cancers which each have a "centre of reference" and a national coordinator, as well as "centres of competence". Specific paediatric oncology and onco-geriatric coordination units exist to ensure high quality of care and equal access to those patients.

Coordination in the organisation of cancer services also appears to be a central theme in the Belgian health care system, in which the College of Oncology plays an important role at the national level. Organisation of services was strongly modified in 2003 with the introduction of oncological care programmes and, later in 2008, the National Cancer Plan (SPF, 2015). Care programmes have been implemented since 1999 to offer an organisational framework and implement "clinical trajectories" (clinical guidelines). The oncological care programmes were published in royal decrees in 2002 and 2003 for basic oncology care (which focuses on diagnosis and less complex treatments) and oncology care (offering more advanced diagnostic options and therapeutic possibilities). The royal decrees contain two important requirements of oncological care providers: the implementation of a psychosocial multidisciplinary team and a data manager to maintain data records for submission to the Public Health Institute and the College of Oncology. Further to these oncological care programmes, specialised care programmes are developed for some extremely specialised and/or rare cancers. As in France, to be officially recognised as offering oncological care programmes providers must meet various criteria, including minimum levels of activity. Geographic accessibility criteria are also assessed. As in France, paediatric oncology services are planned through special care programmes to provide support and collaboration for those centres providing services to children; geriatric oncology programmes are (with the support of the Cancer Plan) in a pilot phase. As yet no reference centre for rare cancers has been designated in Belgium.

The "Cancer Centre" in Belgium, an autonomous organisation which sits within the Institute of Public Health, was created in 2008 to monitor, evaluate and develop recommendations for the Cancer Plan (Cancer Plan 2008–10 (Action 32)). This means that all information relevant to the plan is brought together in one place.

In Denmark the diagnostic process for cancer generally starts with the GP. Hospital services are delivered through two different levels. The first is the general-function level, which covers tasks with limited complexity; for these functions, the Danish Health Authority provides advice, but does not decide on the location. The second level is the specialised-function level, which includes highly specialised treatments. Speciality guidelines specify where the treatment should be undertaken, and together all speciality guidelines constitute the "speciality plan". Municipalities are responsible for an interconnected patient pathway, as well as prevention and the promotion of healthy lifestyles. Whilst private hospitals can provide cancer treatments, these are usually funded through the public health care system.

In Italy, each region is responsible for the identification of which activities can be carried out at different hospitals. Given this, it is difficult to paint a national picture. However, in general, each region has a limited number of highly specialised centres where experience

is concentrated – the number of these per region depends on the complexity of treatments involved, the prevalence of the disease, and how difficult it is for patients to be geographically mobile. There is a growing tendency towards this "hub-and-spoke" model. One example is the region of Veneto, which has approximately 5 million inhabitants. "Spoke" hospitals for cancer care are expected to serve areas of around 200,000 inhabitants; there are two "hubs" (Verona and Padua) which act as reference centres for oncologic surgery.

This regional autonomy in Italy extends to disease-specific and therapeutic guidelines, which are issued by most regions. Whilst each region is free to issue its own guidelines, in practice there is overlap. However, some regions are more active than others in developing guidelines.

Summary

The centralisation of specialised cancer services, in order to concentrate expertise and experience and thereby strive for quality and consistency of care, is a theme of many cancer service providers in Europe. Whilst intuitive, the volume–outcome relationship is controversial, as much uncertainty remains about the evidence (Hogan, Kennelly and Winter, 2009). For certain cancer types and procedures, evidence does exist to substantiate the relationship between hospital volume and survival, particularly for surgery in cancers such as pancreatic and oesophageal (Birkmeyer et al., 2007). Studies in most other cancers reveal significant heterogeneity. For example, a systematic review assessing the impact on outcomes of variations in institutional infrastructure and experience for ovarian cancer found that the most important determinant of outcome was the specialisation of the primary treating physician; hospital volume had very little impact on any outcome parameter (du Bois et al., 2009). Conversely, a study which considered mortality of patients undergoing gastrointestinal cancer resections over 20 years in Scotland found that concentration of cancer care had major (positive) effects on health service delivery (Skipworth et al., 2010). Clearly, there are very many factors in the organisation of services which have an impact on patient outcomes. Whilst the evidence base linking outcomes directly with hospital volume appears to be inconclusive, the influence of centralisation will differ across health systems. Centralisation (that is, higher-volume hospitals) could promote increased expertise, which could improve patient outcomes, particularly for rarer cancers (KCE, 2015).

Whilst there is much medical literature researching the improvement in outcomes and quality of care associated with centralising treatments for specific cancer sites, the economic impact of centralisation is less clear. A systematic review of the literature conducted by Ke and colleagues (2012) identified 19 studies investigating the impact of centralisation on economies of scale, cost-effectiveness or overall costs of accessing care for patients and their carers. Most studies found that increasing surgeon volumes were associated with a reduction in costs. For those that considered hospital volumes and costs, six studies reported that mean costs were lower for hospitals with higher surgical volume, with cost differences ranging from 2% to 50%. However, the evidence is inconclusive as three other studies found evidence of higher costs associated with higher volume, and another found no relationship. One cost-effectiveness study found increased costs for centralisation of ovarian cancer treatment, but that the investment was highly cost-effective, at just €3,616 per QALY (Bristow et al., 2007). The review found that centralisation was associated with increased costs for patients and carers (through increased travel costs and time). The systematic review highlights that there appears to be some evidence to suggest that centralisation is cost-effective or leads to cost savings,

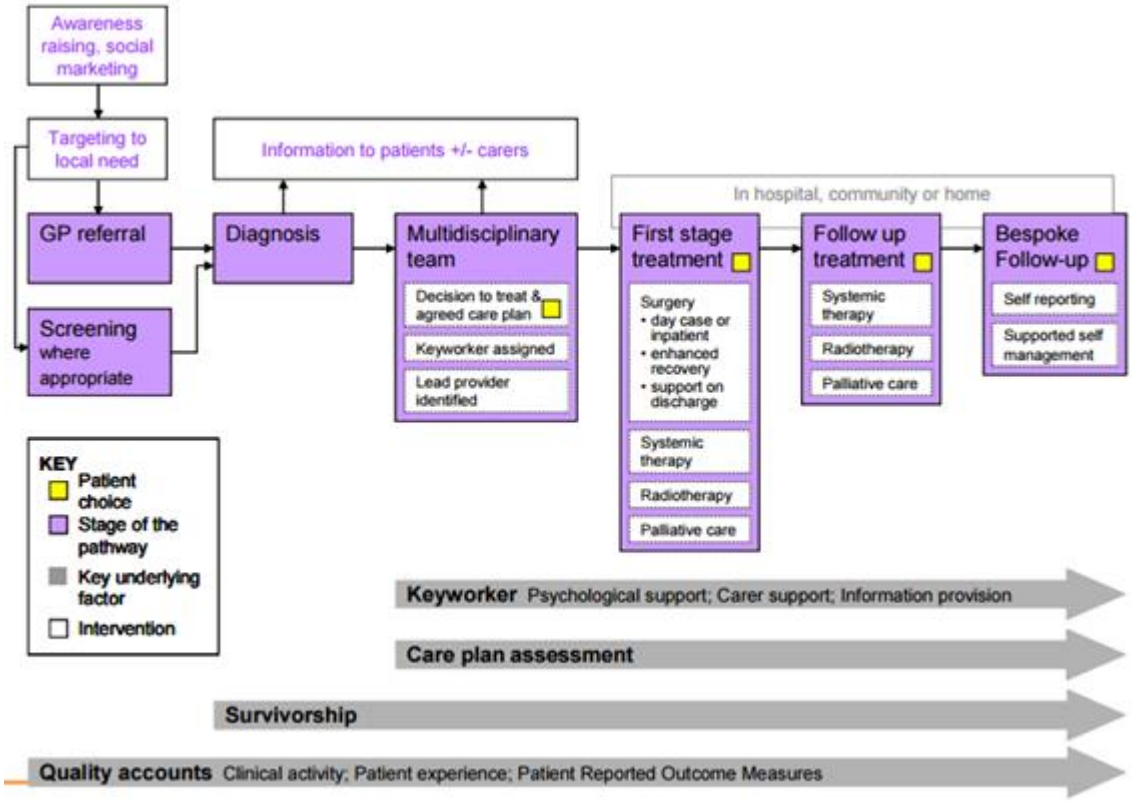
but the evidence is variable and of poor quality. In addition, most studies are from the United States (Ke et al., 2012).

Outside cancer care specifically, there are many aspects of the organisation of care or care delivery and the centralisation or coordination of activities that could generate efficiency savings. An example of this is the information technology (IT) systems utilised to support health care delivery. For example, one trust in the UK's National Health Service implemented an IT system which, previously, was fragmented and replicated across a number of different sites; the IT integration has saved £0.5 million by doing so (Appleby, Galea and Murray, 2014). The benefits of centrally organised systems for the collection of real-world data will be discussed later in this report.

### *Coordination to ensure multidisciplinary patient-centred care*

Whilst the organisation of cancer services is regularly cited to place the patient at the centre, it is rare to observe explicit illustration of how this is the case. For this reason, the aspirational pathway summarised in Figure 33 (in the context of England) could be a useful model to follow. The key point is the need to coordinate the various aspects of care that matter to the patient, using a multidisciplinary approach to clinical care and ensuring follow-up with patients.

**Figure 33. Cancer patient pathway diagram – England**




Source: NHS (2010) A model of care for cancer services: Clinical paper. Commissioning Support for London [Online]. Available at http://www.londonhp.nhs.uk/wp-content/uploads/2011/03/Cancer-model-of-care.pdf, accessed 30 November 2015.

A multidisciplinary approach to diagnosing and managing a patient's treatment is important in order to provide a holistic care plan that meets a patient's needs at the physical, psychological and social levels. This is very important, considering that cancer

patients at various stages of disease may suffer emotional, social and psychological distress as a result of cancer diagnosis and treatment. Psychosocial oncology care can improve quality of life and offset medical costs associated with a patient's care. One study in particular explains how, by taking a whole-person approach to cancer care and addressing the emotional and social aspects of living with cancer, considerable long-term savings could be realised (Carlson and Bultz, 2003). There are a limited number of studies that have measured the resource impact of psychosocial interventions in oncology. However, one prospective randomised study based in Canada measured the quality of life and resource impact of introducing a cognitive-behavioural psychosocial intervention in women with early-stage breast cancer. The authors found after a two-year follow-up that women in the treatment group experienced less depression and better overall quality of life, and cost the health insurance provider 23.5% less, compared with the control group (Simpson, Carlson and Trew, 2001).

A multidisciplinary approach to cancer care is regularly discussed as the objective of cancer care delivery in many of the EU countries studied in this report. For example, in France multidisciplinary meetings (Réunions de concertation pluridisciplinaire, RCPs) involving several doctors of various specialities are involved in treatment decision making, and there is an emphasis on interactions between hospitals and close-to-home caregivers. The treatment pathways for the patient are discussed and agreed at these meetings, and the "announcement" to the patient not only involves a discussion of the diagnosis but also addresses the organisation of a patient's support throughout the care pathway, including potential issues around anxiety, financial problems, etc. Announcement nurses who are specially trained to support patients after diagnosis are central to this process. There is a strong emphasis on personalised care plans, which are centred on the patient. The patient can also have access to other professionals (social workers, psychologists, dieticians, etc.) for support.

Similarly, in Belgium, in order to be recognised as providing oncological care programmes, facilities must deploy a psychosocial multidisciplinary team to support cancer patients. The National Cancer Plan in Belgium fully supports this, and offers financial support to hospitals having a certified oncological care programme by financing extra manpower to support patients with cancer: nurses in oncology (a recognised function since 2009, Cancer Plan Action 14), onco-psychologists, social workers (Cancer Plan Action 10), data managers (Cancer Plan Action 11) and, since January 2011, also dieticians. The funding of this extra manpower is calculated based on the number of multidisciplinary team meetings (MDT) reimbursed in the hospital (KCE, 2015). Additionally, a multidisciplinary oncological care programme (programme de soins oncologiques multidisciplinaires, or PSOM) is implemented in several Belgian hospitals, which coordinates and integrates multiple aspects of care to create a personalised patient pathway; the patient is then supported by an oncological care coordinator nurse (infirmier coordinateur de soins oncologiques, or ICSO), throughout the various stages of treatment.

In Denmark, emphasis on patient access to a multidisciplinary team is made in the "standardised clinical pathways" which cover how examination, diagnosis, treatment and aftercare should be delivered.

Patient-centred care is regularly discussed as an ambition for the care of cancer patients, but establishing parameters to describe this and defining the impact of its implementation is challenging. The use of mobile technology to personalise treatment and organise care around the patient and their life is an ever-expanding part of health

care provision. Sometimes referred to as "mHealth" (mobile health) or "eHealth", improved technology means that patients can now be monitored in their own homes, and empowered to take control of their own care. There are many studies that try to quantify the benefits of mHealth. One report by PwC quantifies the socio-economic impact of mHealth on the EU (note: not cancer-specific) and finds that mHealth could save €99 billion in health care costs across the EU, 23% of which through private savings and 77% through public savings. The majority of these savings (€69 billion) were estimated to be from wellness and prevention, followed by treatment and monitoring (€32 billion) (PwC, 2013).

### 2.3.3. Reducing the cancer burden: prevention and early diagnosis

#### *Cancer prevention*

More than one-third of cancers are preventable (European Commission, 2015). This means that more than one-third of cancers are caused by lifestyle factors that people can change. Prevention strategies therefore provide a major focus for policymakers at both the national and European levels. At the EU level, the European Code against Cancer (presented in an earlier section) provides ways in which to tackle these preventable bases of cancer, to reduce the burden of cancer illness. Smoking, unhealthy diet and physical inactivity are the most heavily emphasised lifestyle factors in relation to cancer. Other factors to reduce risk include drinking less alcohol, being careful with sun exposure, eating less processed and red meat, eating less salt, minimising risk factors at work, minimising certain infections (like HPV and Hepatitis B and C), minimising radiation, minimising time spent on HRT, and breastfeeding if possible. A summary of the methods used to assimilate the evidence to support the recommendations of the European Code against Cancer is provided by Minozzi et al. (2015).

The integration of prevention strategies into health care of public policies is often discussed as one of the key mechanisms in reducing cancer inequalities. Prevention appears to be a strong focus in the Cancer Plans in France and Belgium in particular. In France, core measures to prevent cancer are integrated into the Cancer Plan, and a critical evaluation of how these have been met is undertaken; the assessment report seeks to ensure that lessons are learned and lead to revised efforts to address deficiencies. An evaluation of the Cancer Plan and a review of its successes and failures is similarly integral to Belgium's approach. There, the first Cancer Plan was launched in 2008, and has had five subsequent updates so far (2009, 2010, 2012 and 2014). Some novel measures to prevent cancer in the Belgian Cancer Plan include repayment of consultations for smoking cessation and training for caregivers to assist in the process of giving up, reimbursement of genetic tests, and free preventive health check-ups.

Health inequalities are prevalent in cancer, and in particular deprivation appears to have important implications for cancer incidence. In England, for example, if socio-economically deprived groups had the same incidence rates as the least deprived, there would be 15,300 fewer cancer cases per year (11,700 of which in the lung) and 19,200 fewer cancer deaths per year (9,900 of which in the lung) (Independent Cancer Taskforce, 2015). These represent avoidable cancer deaths due to deprivation.

### *Screening and early diagnosis: key themes*

Population screening programmes represent investments for which the impact extends a long way into the future. The Council of the European Union (2003) recommends three screening tests:

- Pap smear screening for cervical cancer precursors starting not before the age of 20 and not later than the age of 30.
- Mammography screening for breast cancer in women aged 50 to 69 in accordance with European guidelines on quality assurance in mammography.
- Faecal occult blood screening for colorectal cancer in men and women aged 50 to 74.

These recommendations for population-based screening for breast, cervical and colorectal cancers are on the basis of available evidence of effectiveness and are endorsed by the World Health Organisation (WHO).

The question of the impact and cost-effectiveness of population screening programmes is a subject of much debate globally. Whilst the recommendations by the Council of the European Union were made on the basis of a strong body of research, consideration of population screening programmes in local contexts, and over the course of time, means that there is debate about how effective and/or cost-effective the programmes are, in a local context. Whilst it is beyond the scope of this report to conduct a systematic review of the literature in this regard, we highlight some recent perspectives on this.

The debate is particularly rife in the context of population screening for breast cancer. In particular, in some countries where incidence has been decreasing and outcomes of treatment have been improving, the benefits of screening may be reduced, and risk-factor analysis may have an important role to play in the future (Jönsson and Wilking, 2015). One systematic review and meta-analysis demonstrates the extent of over-diagnosis (the detection of cancers that will not cause death or symptoms) of breast cancer from population mammography screening in five countries, finding that one in three was over-diagnosed (Jørgensen and Gøtzsche, 2009). A key factor that makes understanding the impact of mammography screening difficult is to find valid comparator groups. Using historical analysis to observe impact (i.e. before and after the introduction of screening) could be misleading, as it may not take account changes over time, in particular in advancing treatments and breast cancer awareness.

In order to overcome this challenge, a study by Autier and colleagues (2011) examines breast cancer mortality and how this has changed over time in neighbouring European countries (Norther Ireland versus Republic of Ireland, the Netherlands versus Belgium and Flanders, and Sweden versus Norway). Between country comparator pairs, risk factors and treatment availability were similar but implementation of mammography screening was divergent (with a gap of 10 to 15 years); however, reductions in mortality were similar, implying that screening did not have a direct effect on breast cancer mortality reduction (Autier et al., 2011). Another study from Norway found that screening accounted for around a third of total mortality reduction after taking account of temporal trends (Kalager et al., 2010). Thus whilst some studies find no effect, others find some impact, but this may be decreasing over time.

The implementation of cervical cancer screening appears to be less controversial in terms of the positive impact it has on reducing the incidence of cervical cancer. It is regularly cited as having prevented an HPV-driven epidemic of cervical cancer. For

example, a study of 50 years of data from Nordic countries – Denmark, Finland, Norway and Sweden – shows that in the absence of screening, incidence rates would have been between three and five times higher in recent years (Vaccarella et al., 2014). Data from the UK similarly demonstrates the historical rising trend in cervical cancer which was reversed with the introduction of population screening (Peto et al., 2004). The implementation of colorectal cancer screening has been more recent. A Cochrane systematic review of trials covering 320,000 participants concluded that participants allocated to the faecal occult blood test had a 16% relative risk reduction of colorectal cancer mortality (Hewitson et al., 2008).

Despite the issues and debated impact of some population screening programmes, the main body of evidence suggests that there is some positive impact; in the future, more advanced screening tests and risk stratification may improve the acceptability of tests. In addition, it is important to note that the organisation and management of screening programmes, which will differ depending on the cancer, are key. According to the International Agency for Research on Cancer (IARC), the potential benefit of cancer screening can only be achieved if quality processes are implemented at every step in the screening process, including identification and invitation of the target population, the performance of the screening test, diagnostic work-up, treatment, and aftercare (von Karsa et al., 2008). Below, we describe the implementation of screening programmes in the countries evaluated.

With regard the cost impact of screening programmes, it is important to note that spending on early diagnosis through population screening should be regarded as an "investment", the effects of which (in terms of both health gains and health care costs) require a long time frame to be taken into account. This is because the costs of screening are realised immediately, whereas the downstream costs of treatment that would have manifested many years in the future, which are avoided by early detection and intervention, represent long-term savings.

Whilst there is some consensus that well-implemented and appropriately targeted early-detection screening programmes represent a cost-effective use of resources, there is some debate around whether they save costs overall. Whilst cost-saving unclear, it is more helpful in the context of public spending to discuss value; evidence-based cancer screening programmes are thought to be very efficient (Martin-Moreno et al., 2012).

### *Which screening programmes are implemented?*

Of the nine countries studied, seven have put in place national screening programmes for the early detection of cervical, colorectal and breast cancer. France has national programmes of screening for colorectal and breast cancer, but there is no national programme for cervical screening – only experiments which are ongoing (Sicsic and Franc, 2014); a national screening programme for cervical cancer is in the process of being implemented. Sweden has implemented screening programmes for breast and cervical cancer. Until recently, colorectal cancer screening has only been offered opportunistically and through a pilot programme in the Stockholm–Gotland region (since 2008). However, a recommendation for national colorectal cancer screening by the National Board of Health and Welfare has now been made (Socialstyrelsen, 2014). Of note in Belgium is that the strategy for colorectal cancer screening is set up differently across the French, German-speaking and Flemish communities. A screening programme for prostate cancer has been introduced in Germany and partly in the UK, where it is not recommended nationally but it is made available to some men, who can opt for the test

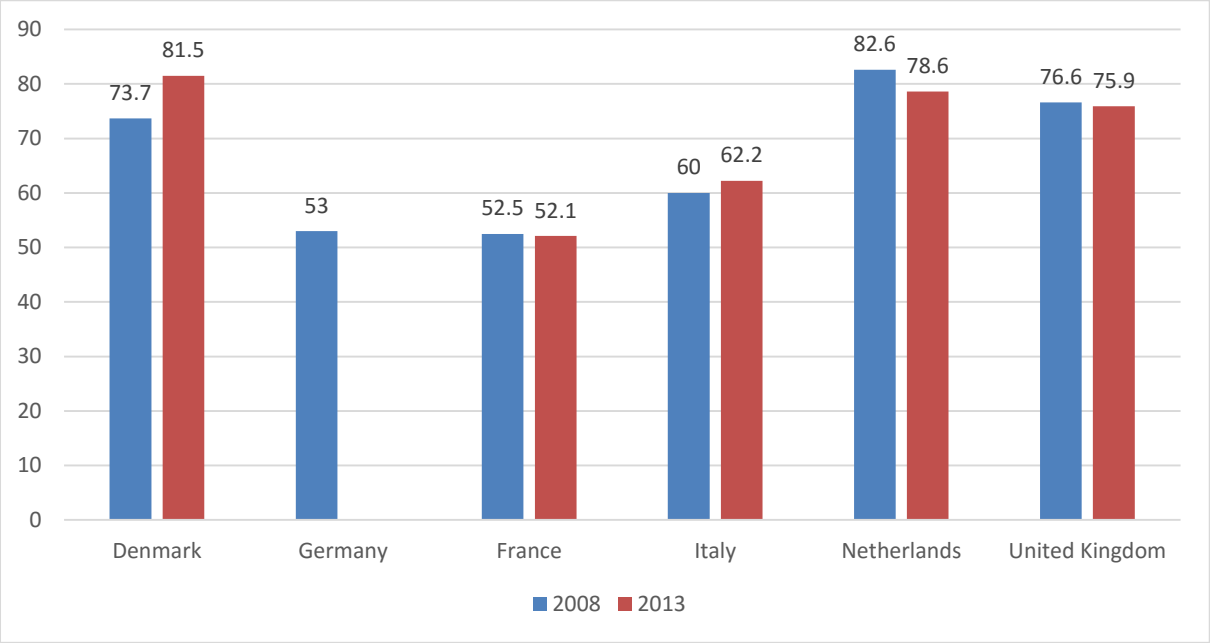
based on evidence about risks and benefits. In addition, Germany provides screening for skin cancer. Colorectal cancer screening in England was one of the first programmes in the world; all men and women aged 60 to 74 are sent a self-testing kit (every two years). It is planned to roll out a test programme introducing a bowel scope (flexible-sigmoidoscopy) as a one-off procedure for men and women aged 55 by 2016; it is estimated that this could save up to 3,000 lives a year (Atkin et al., 2010; Department of Health, 2011; Cancer Research UK, 2016).

The most recent English cancer strategy recommended that the National Screening Committee should examine the evidence for lung and ovarian cancer screening, stating that "PHE [Public Health England] should be ready to pilot lung or ovarian screening within 12 months of a significant positive mortality outcome and cost-effectiveness evidence from studies currently under way, together with a plan for subsequent national roll-out" (Independent Cancer Taskforce, 2015). In France, the most recent Cancer Plan recommends the study of screening programmes for lung cancer, prostate cancer and pancreatic cancer, as well as the benefit of teledermatology for the early detection of skin cancers (INCa, 2015b).

### *What is the uptake?*

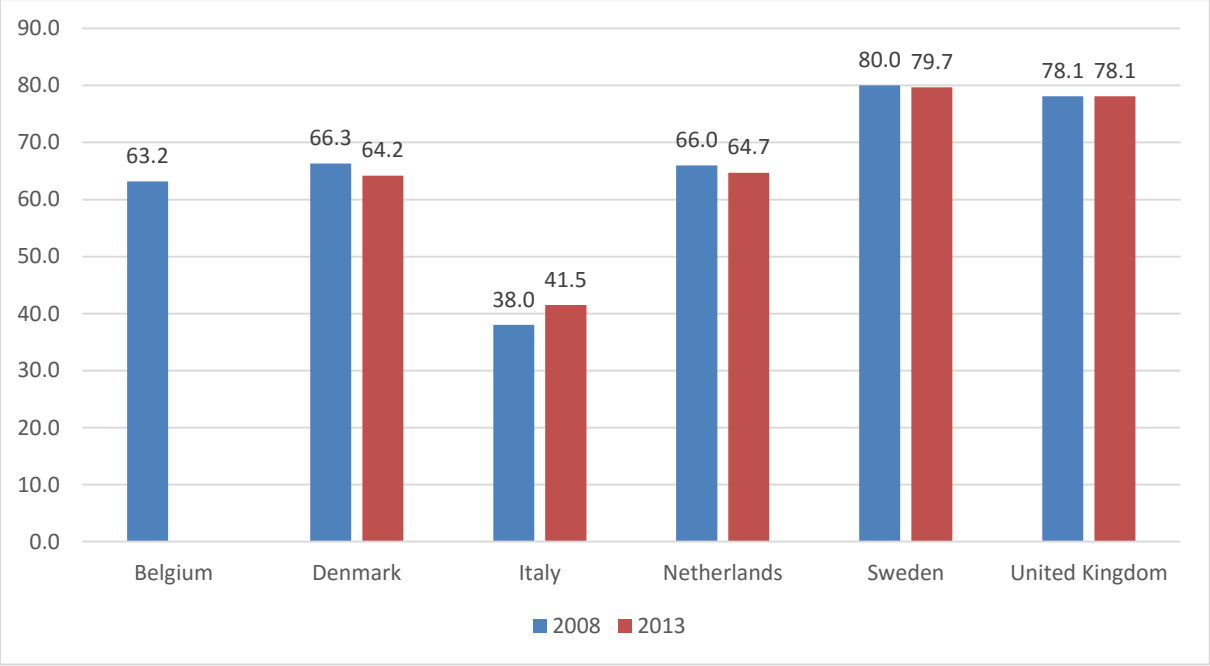
Based on the evidence received from the local experts, coverage of the screening programme in place varies depending on the country and the type of cancer. Screening programmes for breast and cervical cancer have been in place in most countries for many years, with breast cancer screening plans starting in the 1960s, and cervical cancer screening in the 1980s (Eurostat, 2016). Of these two programmes, the lowest proportion of the population covered was reported in Poland for cervical cancer (21% in 2013) and the highest was reported in the Netherlands for breast cancer (80% in 2012) (Ministerstwo Zdrowia, 2015; RIVM, 2015); the Eurostat data presented in Figure 34 shows that in 2013 Denmark had the highest implementation rate for breast cancer screening at 81.5% (although these data cover only five of the nine countries). Figure 35 presents data from Eurostat on the rates of cervical cancer screening in women aged 20–69 years.

**Figure 34. Breast cancer screening (%), women aged 50–69 years**




Data source: Eurostat. Data extracted 13 January 2016
Note: 2012 instead of 2013 for Netherlands and Denmark. The data show the proportion of women aged 50–69 years who had received a mammography within the previous two years (or according to the specific screening frequency recommended in each country) among eligible women for an organised screening programme.
Data unavailable for Belgium, Poland and Sweden.

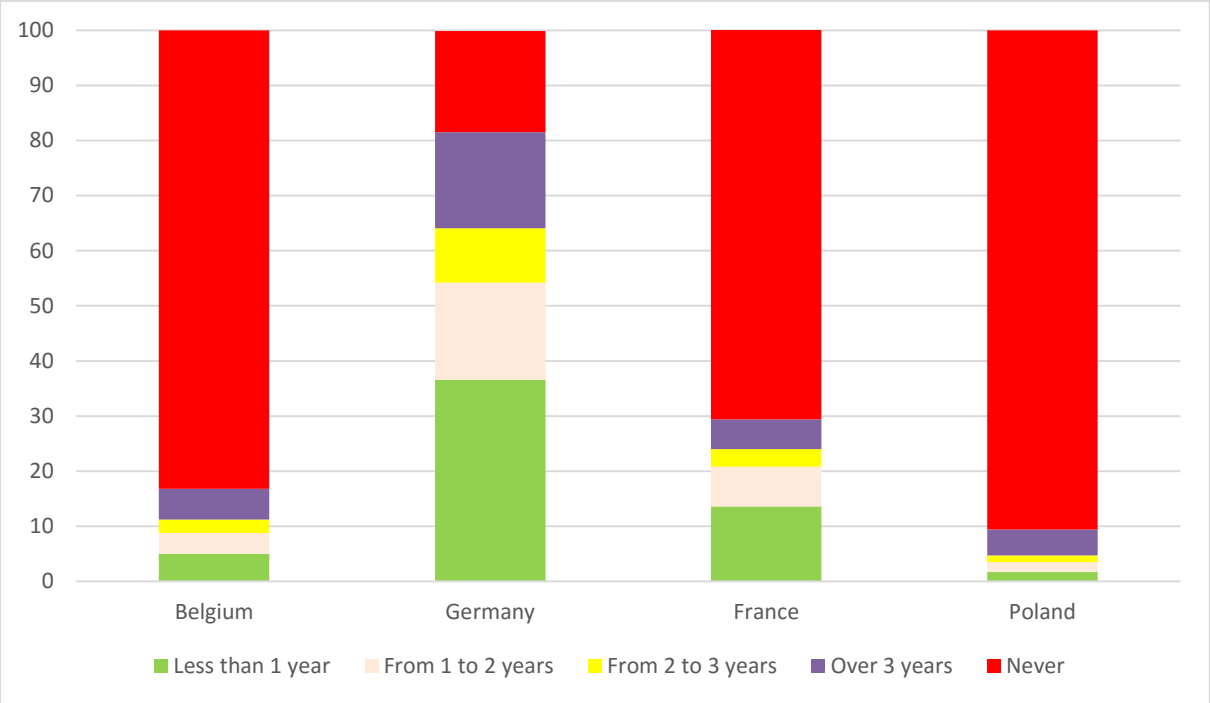
**Figure 35. Cervical cancer screening rate, women aged 20–69 (%)**




Data source: Eurostat. Data extracted 13 January 2016
Note: 2009 instead of 2008 for Denmark; 2012 instead of 2013 for Sweden and Denmark.
The data show the proportion of women aged 20–69 years who had been screened for cervical cancer within the previous three years (or according to the specific screening frequency recommended in each country) among eligible women for an organised screening programme.
Data unavailable for France, Poland and Germany.

Colorectal cancer screening has been introduced much more recently compared with the other two screening programmes, and therefore uptake levels are much lower. The data presented in Figure 36 is from the the European Health Interview Survey (EHIS), for which people were asked to self-report when they had most recently been screened for colorectal cancer.

**Figure 36. Proportion of people aged 50–74 having had a colorectal cancer screening test (self-reported) within the specified time periods, 2008 (%)**




Data source: Eurostat: The European Health Interview Survey (EHIS) (self-reported). Data extracted 13 January 2016.

Uptake of colorectal cancer screening in Poland appears to be particularly low. This could be reflective of the organisation of the Polish screening programme, where referral for colonoscopy has been largely opportunistic. Of the four countries for which there are data available from Eurostat, Germany has had by far the highest uptake rate, with 54.2% of the relevant population indicating that they had undertaken colorectal cancer screening in the last two years. Note – as these figures derive form a self-completed questionnaire, the data may differ to other sources (see the colorectal screening intervention case study elaborated in subsection 3.2).

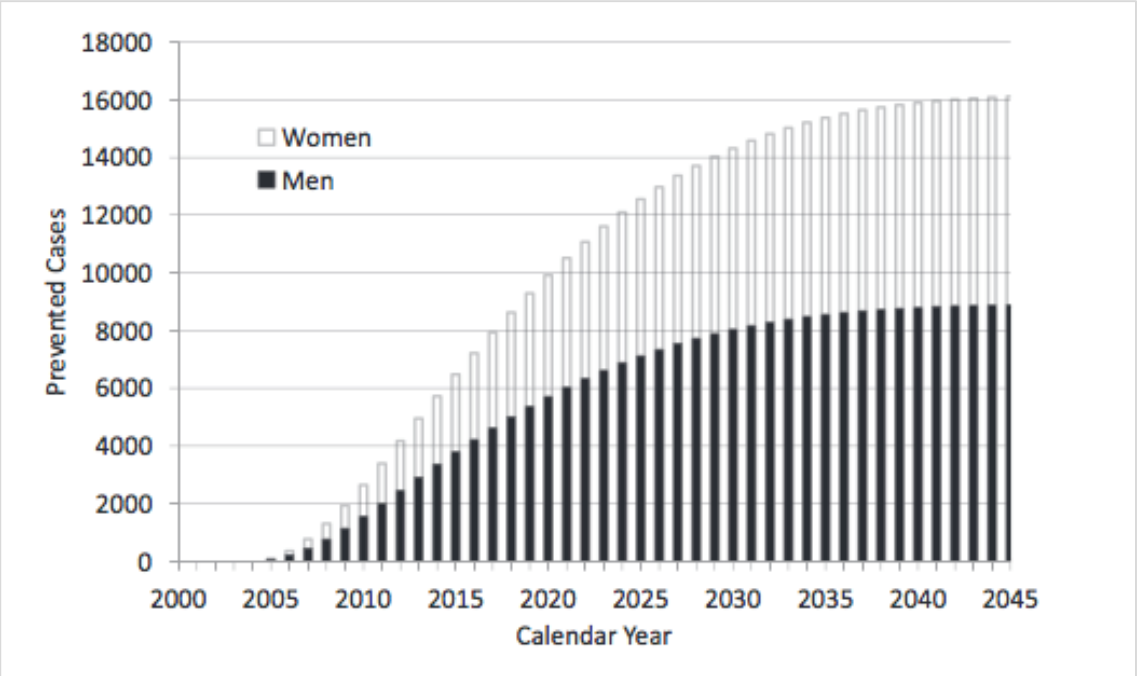
In Italy there is a significant regional variation in participation in the available screening programmes. For example, for national screening programmes for colorectal cancer in place since 2005 it is estimated that the proportion of people invited in the target population was 82%, 59% and 12% in the North, Centre, and South of the country respectively (Zappa et al., 2015).

### *What is the impact?*

There is detailed evidence on the impact of screening programmes on health outcomes in Germany. In particular, for colorectal cancer, a study by Brenner et al. (2015) presented an analysis based on more than 4.4 million colonoscopies in order to estimate the long-term impact of screening. According to the analysis of Brenner et al., the annual number of prevented, clinically manifest colorectal cancers (CRC) is expected to

steadily increase from less than 100 in 2005 to approximately 12,600 in 2025, and then to level off slowly by about 2040 (see Figure 37).

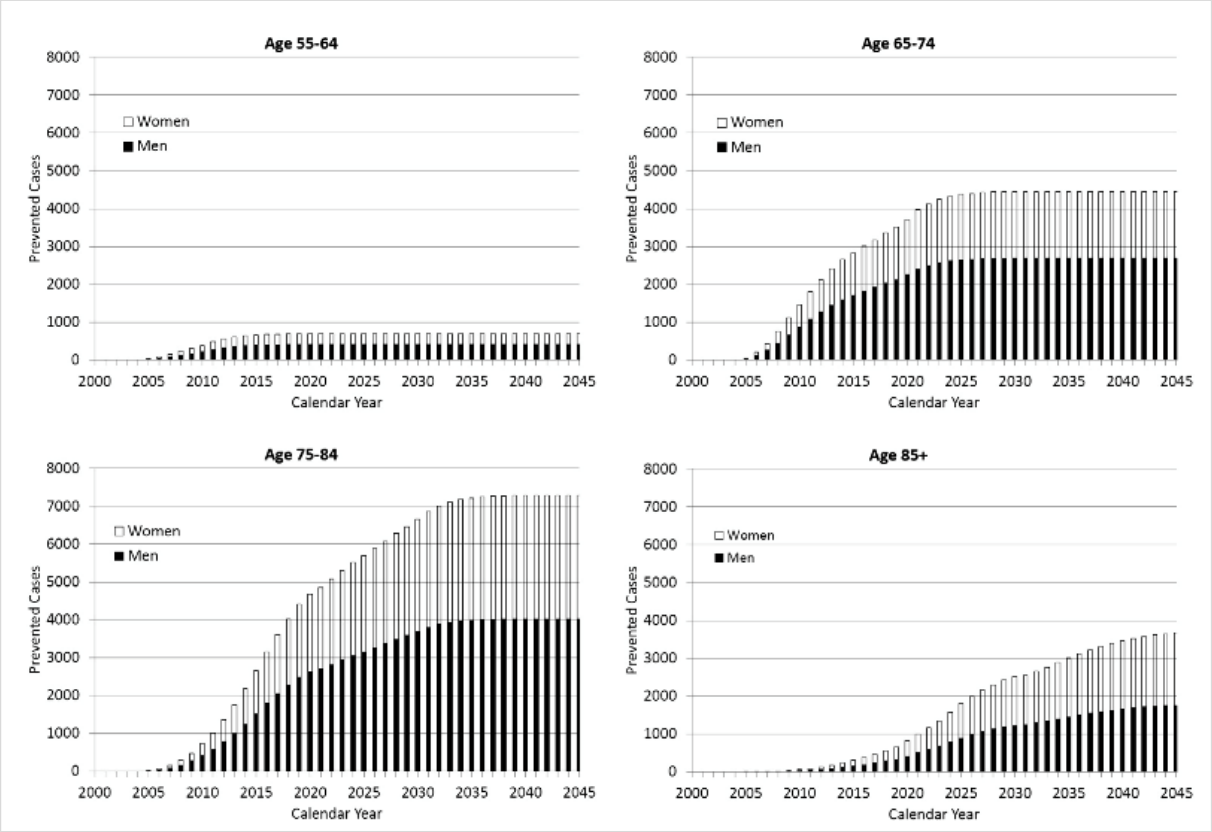
**Figure 37. Expected number of prevented cases of colorectal cancer in Germany, according to year of occurrence**




Source: Brenner et al. (2015).

The authors note that the full impact of screening colonoscopy will be seen with a substantial delay for older age groups. The impact will, however, be much stronger than for younger age groups. The most pronounced effect of decreasing mortality will be on the numbers of prevented cases in the older age groups. This would be expected to increase over time to levels approximately twice as high compared with those projected in the base case scenario with constant mortality rates (Brenner et al., 2015).

**Figure 38. Expected number of prevented cases of colorectal cancer in Germany, according to year of occurrence in different age groups**



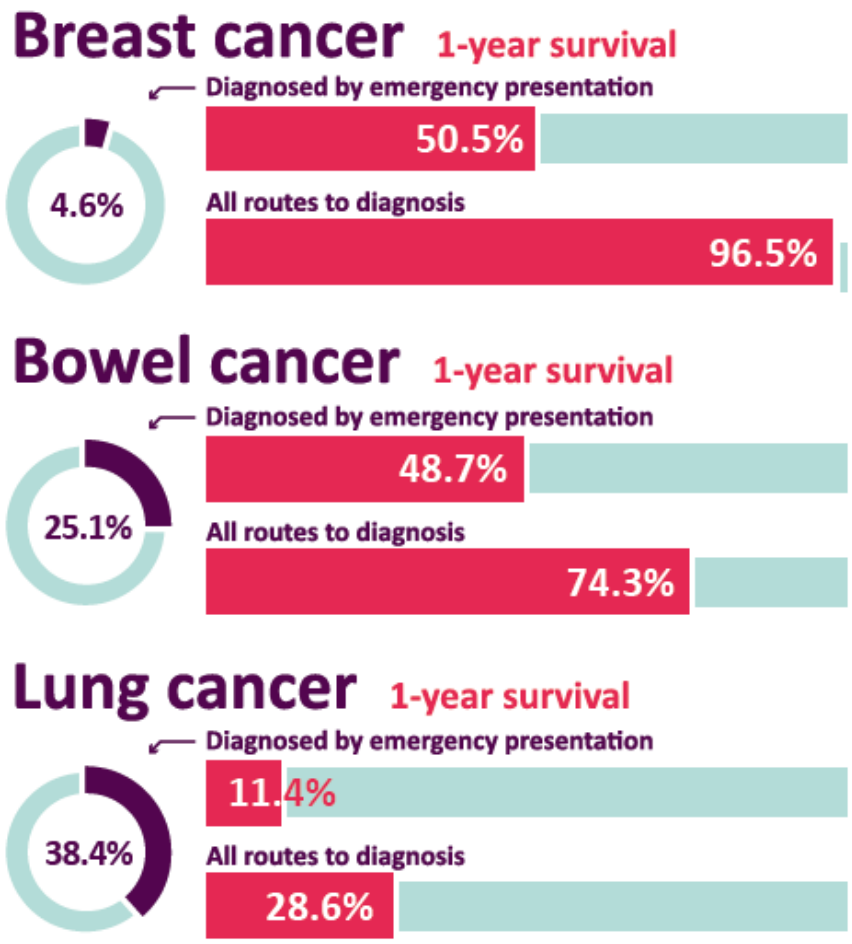

Source: Brenner et al. (2015).

### *Earlier diagnosis of cancer*

The primary aim of screening programmes is to catch cancer earlier, at a stage when it is more treatable. This has a very important impact on outcomes, as well as on health care costs. For example, in England it is estimated that significant savings could be realised if all clinical commissioning groups (CCGs) were able to achieve the levels of early diagnosis of the best CCGs; these savings could reach £24 million for colon cancer (Incisive Health, 2014).

There is particular concern in England that cancer survival is lower than that of other European countries. It is estimated that – if survival in England were comparable to the European average – then 5,000 or more deaths within five years of diagnosis could be avoided. The lower survival rate in the first year after cancer diagnosis in England can be interpreted as evidence of later diagnosis compared with Europe (Elliss-Brookes et al., 2012). Figure 39 demonstrates the difference in one-year survival for breast, bowel (colorectal) and lung cancer patients between those diagnosed through an emergency presentation (i.e. late diagnosis) and those diagnosed through all other routes. It also shows the proportion that are currently diagnosed through emergency presentation.

**Figure 39. Proportion of diagnoses and impact on one-year survival by emergency presentation in England**




Source: Elliss-Brookes et al. (2012); (Independent Cancer Taskforce, 2015).

Later diagnosis has an important impact on survival. The authors of the study break down the category of "all routes". For those patients detected through screening for breast and colorectal cancer (there is currently no screening programme for lung cancer), one-year survival is 100% and 98% respectively.

In order to promote more streamlined diagnosis of cancer in primary care, the National Institute of Health and Care Excellence (NICE) has issued a guideline on "Suspected Cancer: Recognition and Referral", which offers evidence-based advice on the recognition of and referral for suspected cancer cases. Efforts to disseminate these recommendations have included the development of infographics for use by GPs, which have been published in the *British Medical Journal* (Stahl-Timmins, 2015).

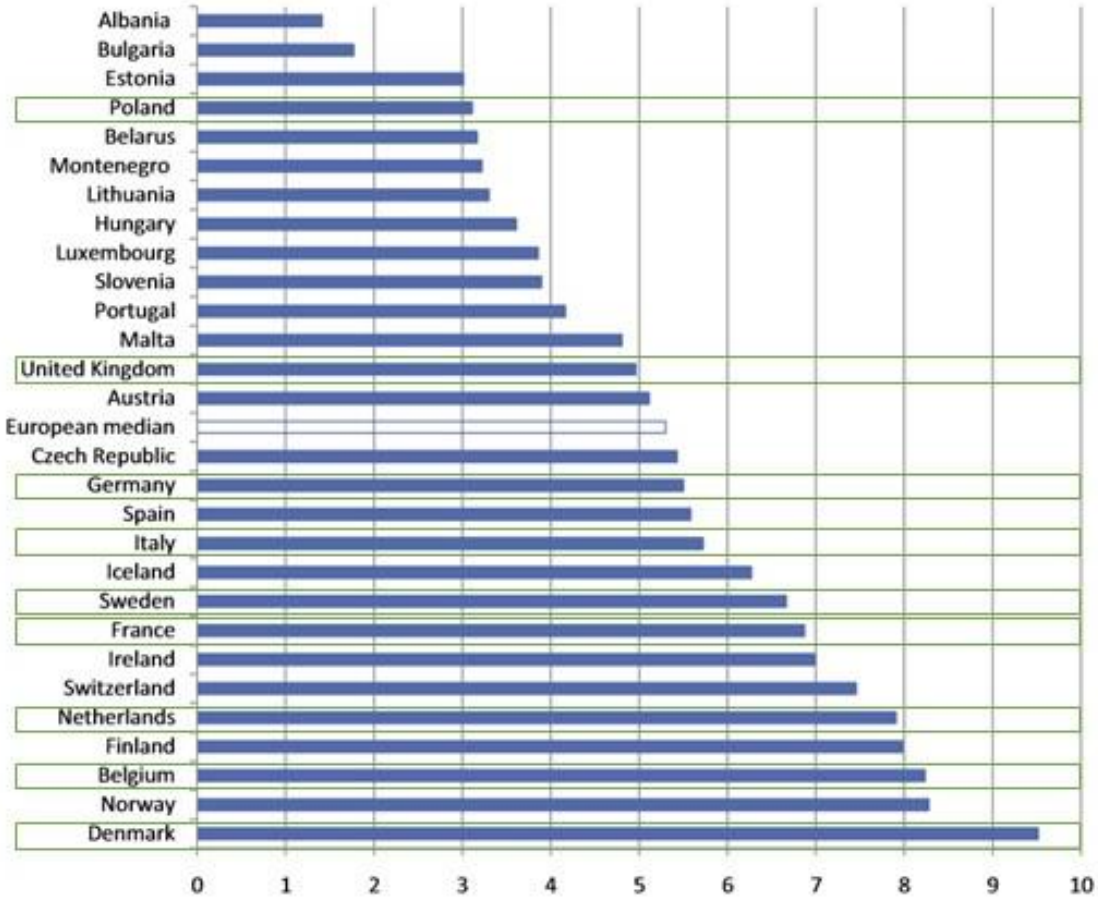
A good-quality diagnostic testing infrastructure is critical to the accurate and efficient diagnosis of cancer. This is not always in place. According to a Belgian study, a significant barrier to achieving this in Belgium is the fragmentation in the Belgian laboratories sector, with a need for greater standardisation (Van Dyck and Geldof, 2015).

### 2.3.4. Treatment pathways

In the EU, the most common cancers are colorectal, breast, prostate and lung (European Commission, 2015). It is for this reason that these four cancers were selected in asking our country experts, via the pro-forma, to describe the clinical pathway of a patient. These can be viewed in the annex of country pro-formas (available from the authors), and will not be summarised in detail here.

By investigating the care pathways for cancer, we aimed to identify areas of efficiency or inefficiency in the provision of care outside the provision of medicines. One area of under-provision appears to be radiotherapy, which has an increasingly important role to play in the treatment of many cancers; 50% of all cancer patients would benefit from radiotherapy (Grau et al., 2014). In reaction to a perceived under-recognition of and underinvestment in radiotherapy, the European Society for Radiotherapy and Oncology (ESTRO) set up the Health Economics in Radiation Oncology (HERO) initiative, to develop a knowledge base for health economic evaluation of radiation treatments in Europe (ESTRO, 2012). Grau et al. (2014) provide a comparative assessment of access to radiotherapy treatment machines, as demonstrated in Figure 40.

**Figure 40. Availability of radiotherapy treatment machines per million inhabitants in the EU, 2014.**

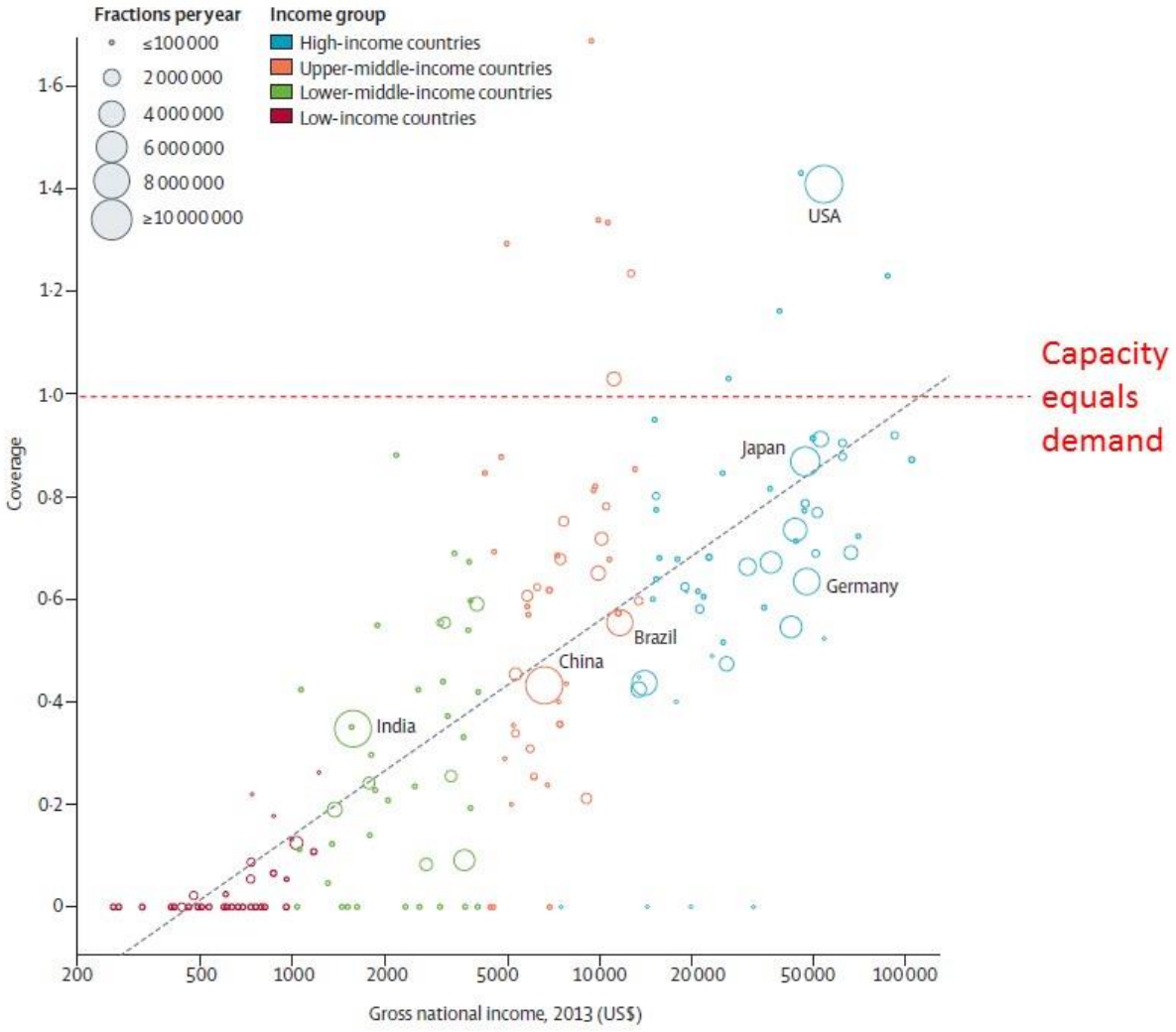



Source: (Grau et al., 2014).

Over our nine countries, two have low availability of radiotherapy machines compared with the European average: Poland and the UK. Borras et al. (Borras et al., 2015) assessed optimum utilisation of radiotherapy across Europe, finding that actual use was

significantly lower than the optimal use predicted by evidence-based estimates in the literature (the European median utilisation is only 70%). According to Atun et al. (2015) there is a major under-provision of radiotherapy services in most countries (including high-income countries). This is summarised in Figure 41, which demonstrates radiotherapy coverage as a function of national income.

**Figure 41. Radiotherapy coverage as a function of gross national income. The Lancet Oncology Commission**




Source: Atun et al. (2015)

As demonstrated in Figure 41, in very few countries does radiotherapy capacity meet demand. Predictably, the authors find over-provision in the USA. By conducting an analysis of net monetary benefit (they also demonstrated return on investment), the authors calculate the costs and benefits of scaling up radiotherapy capacity from 2015 to 2035 in low- and middle-income countries, finding that 6.3 million life years (low-income countries), 9.9 million life years (lower-middle-income countries) and 10.7 million life years (upper-middle-income countries) could be saved over the 20 years. The net

monetary benefit[13] of such an investment was calculated to be $265.2 million in low-income countries, $38.5 billion in lower-middle-income countries and $239.3 billion in upper-middle-income countries, using the "value-of-life-years" approach.

It should be noted that it is not only the number of treatment machines that is of importance, but also how radiation units are organised. Small units with one or two machines are probably less cost-effective that units with three or more machines, as dose planning and many other activities around radiation therapy can potentially be performed more effectively, both from a cost perspective and from a quality point of view.

In France, access to quality imaging is unequal, with insufficient numbers and distribution of MRI machines. A study conducted by Pourcel et al. (2013) measured waiting times in breast, lung, colon and prostate cancer care in several regions of France. Results showed important variability between regions, cancer types and patients' characteristics. Age, circumstance of diagnosis, tumour stage and category of care centre all had an influence. Waiting-time differences between regions remained two- to fourfold, even after controlling for these factors. The authors thought that the regional differences might be explained by health system organisational factors, although these were not explored in detail.

### *Supportive and palliative care*

Much of the discussion around caring for patients who live with and beyond cancer is in recognition that – as treatments advance and supportive services improve – cancer is being considered a "chronic disease". Indeed, in France cancer is considered a long-standing disease (affection longue durée, or ALD), with the implication that treatment is covered 100% by health insurance (patients have co-payment-exempt status). In addition, at the end of cancer treatment in France patients can be offered an after-cancer personalised programme (programme personnalisé après cancer, or PPAC), where personalised support is offered to help the patient resume their social and professional life.

An initiative of the European Society for Medical Oncology (ESMO), which was designed to improve delivery of supportive and palliative care by oncologists and oncology departments, is described by Cherny and colleagues (2010). ESMO designed an incentive programme through the establishment of "designated centres", for programmes that met predetermined targets of service development and delivery of high-level supportive and palliative care. Perceived benefits of this accreditation status included improved status and positive impact on daily work, business activity and funding for projects (Cherny et al., 2010).

The multidisciplinary approach to cancer services that is increasingly integrated into service planning was described in an earlier section. This approach can provide for holistic support of cancer patients during and after treatment, by providing lifestyle advice to promote health and/or support a patient recovering from cancer in society. The

[13] Net monetary benefit = [cost of investment – economic return]. The economic return was calculated in two ways: (1) Using the 'human-capital approach' which considers the economic contribution of individuals through participation in the workforce, and (2) the 'value-of-life years' approach, which captures human welfare and societal impact beyond working alone, and is calculated as 2.3 times GDP per person (Atun et al., 2015).

Belgian Cancer Plan, for example, provides for professionals such as dieticians, social workers and psychologists as part of a patient's care-and-recovery plan.

The cancer charity Macmillan published a report in 2015 called "Cancer cash crisis: counting the cost of care beyond treatment" (Macmillan Cancer Support, 2015). The report focuses on care post-treatment, and mitigating costs by giving equal priority to people living with and beyond cancer, recognising that costs stretch well beyond treatment alone. It finds that supporting people with cancer beyond their initial treatment costs the NHS at least £1.4 billion every year. This reflects the costs of monitoring, follow-up and the consequences of treatment, excluding care at the end of life. It is extremely important to be cognisant that, for patients living beyond cancer, poor quality of life from long-term health issues can inhibit their activities and drive up the cost of care. Two in three people with cancer are also living with one or more other serious long-term health conditions (Macmillan Cancer Support, 2015). For patients who have survived prostate cancer, for example, the cost of inpatient care for the six months post diagnosis was 10 times higher for those patients who also had another serious condition.

In the report the NHS is described as using a "one-size-fits-all" approach which leads to unneccesary appointments, and fails to meet people's needs. The authors estimate that £500 million a year is spent by the NHS on emergency inpatient care, just for people diagnosed with one of the top four cancers. Of this, approximately £130 million (one-quarter) is spent on emergency inpatient care for people who have finished their initial treatment, but are not in their last year of life. These are patients who should be receiving long-term support and management, which will help prevent the need for emergency care. The authors contend that the resources dedicated to long-term care are insufficient, and that these figures demonstrate the cost-saving opportunities from improving long-term care. By taking into consideration, the Macmillan report estimates that investing in the cancer strategy could deliver offsetting savings of £420 million, compared with failing to fund it at all.

To support patients who are at the end of life, palliative care is an established part of cancer care plans, and in many countries activities to optimise and improve palliative care appear to be well defined. In Belgium, for example, the Federal Committee of Palliative Care Assessment (Cellule fédérale d'évaluation des soins palliatifs) was created in execution of the law on palliative care (2002), and includes three Belgian federations of palliative care, insurers, the Federal Commission of Euthanasia Control and Appraisal, the Bioethics Advisory Committee, the National Council of Hospital Facilities and patient associations. This committee regularly evaluates palliative-care needs and quality. In France, there are significant inequalities in access to palliative care.

### 2.3.5. Additional examples of efficient and inefficient clinical policies and practices

In addition to the information set out above, our country experts were asked to identify further examples of good or bad practice in the delivery of cancer care.

#### *Particularly inefficient practices in the provision of cancer care*

**Waiting times and referral practices**

- Poland is among the countries with the highest waiting times in Europe (OECD, 2013a). Tackling long waiting times is essential in improving the rate of early diagnosis of cancer.

- The role of GPs in acting as "gate-keepers" in England, whilst containing costs, could result in GPs not referring patients in the early stage of disease when symptoms are less obvious.
- In Denmark, there is regional inequality in waiting times. There have been various consolidated efforts to address long waiting times in recent years, including a political move to label cancer an "acute" disease that must be treated straight away, and the creation of clinical pathways to set maximum waiting times.

We set out below the improvements being proposed to tackle these problems.

**Poor data availability and/or transparency of clinical practice evidence**

- In the Netherlands, it appears that many performance indicators of quality of care are not transparent to the general public.
- Similarly, in Italy a substantial source of inefficiency was noted to be the unrealised potential of data that are collected alongside routine clinical practice.
- In Germany, the fragmentation of cancer registries is noted to be an important problem.
- In England, information sharing by the Health and Social Care Information Centre (HSCIC) has become more problematic following patient-confidentiality concerns.
- There is a need to collect better evidence on outcomes. An excessive focus on activity-based rather than health outcomes (e.g. things that are easy to measure) may lead to inefficient allocation of resources within cancer care. This was noted to be an issue in England.

**Fragmentation concerns**

- In Italy, the implications of fragmentation or decentralisation, which characterises the Italian NHS, could be numerous. A benefit of organisation by region is that care plans are tailored to the local community; some regions are typically leaders in organisational innovation and are often followed by other regions in the adoption of best practice. However, efficiency can be hindered by duplication of effort for some activities. An example is that for several drugs, there is an assessment at regional as well as national level. The high variation between regions also clearly raises equity concerns.
- In England, fragmentation in the delivery of services since the abolition of cancer networks and primary care trusts (PCTs) is a concern, with lack of clarity around who is responsible for delivering cancer services (Cancer Research UK, 2014).
- Low volumes of procedures and variability of care were noted to be a problem in Belgium, particularly for highly complex interventions in rare cancers.

**Dichotomisation between cancer care providers**

- In Germany, dichotomisation between ambulatory (outpatient) and hospital care is regularly cited to be an important source of inefficiency.
- In England, a key theme of NHS England's Five Year Forward View for the NHS as a whole was to tackle barriers that are present between primary and secondary care. Primary care must be seen as integral to the delivery of cancer services through an integrated pathway.

**Perverse physician incentives**

- In Germany, physician payment incentives may perversely affect appropriate treatment decisions. This comes about because of the way doctors are paid using the

catalogue of medical services and associated scores (EBM) which have sections for sub-disciplines. If not drawn up appropriately, these may disincentivise specialists from prescribing the most appropriate treatments.

- According to Medeiros and Schwierz (2015), the EuroDRG project explored inefficiencies in payment systems based on diagnosis-related subgroups, and found that intentional up-coding and overtreatment are substantial problems in France and Germany.

### *Practices that have improved the efficient delivery of cancer care*

**Streamlining and speeding up access to treatment**

- The Polish government has introduced an "oncology treatment package" aimed at shortening waiting times, by
  - strengthening primary care in early diagnosis by improved training and extending diagnostic procedures
  - introducing a waiting-time limit of nine weeks from diagnosis to treatment
  - abolishing health insurance quotas for cancer treatment in secondary (specialist) and tertiary (hospital) care.
- In England, national cancer waiting-time standards have been introduced which have provided rigorous monitoring of a number of key targets, and incentives for improvement (e.g. the urgent two-week referral pathways – 93% of urgent referral patients should be seen by a specialist within 14 days of a referral from a GP).

**Coordination of cancer services through collaborative working and clinical guidelines**

- The cancer plans implemented in all of the countries studied work towards this aim.
- In order to improve coordination and exchange of information between providers – noted to be a problem in France – the 2014–19 Cancer Plan will establish a cancer communication file, and will formalise the handover between the hospital and primary-care teams.
- In the Netherlands, the Dutch association for medical oncology was established in 1997. One of their committees – BOM – evaluated clinical value and aims to improve national collaboration and coordination in oncology practice. The national oncology foundation (SONCOS) defines and monitors national quality of cancer care standards in collaboration with the surgical and radiotherapy associations.
- In Italy, there are several initiatives in different regions to develop clinical pathways to guide the course of cancer treatments, though coverage is still limited both across disease and geographically. Several groups are currently working on developing clinical pathways, but the Emilia Romagna Region can be considered a leader. To the extent that this practice will also reach regions where the quality of care is usually lower (mainly in the South) it could contribute to reduce inter-regional inequality.
- The establishment of "oncologic networks" in Italy is expected to include as outcomes a better integration of primary care in the overall process, earlier diagnosis, greater appropriateness of treatment, and reduced geographic inequality even within regions.
- In Germany, the implementation of comprehensive cancer centres (CCC) in 2004 has created the space for innovation in cancer care, where the focus is on the more institutionalised cooperation of medical disciplines. CCCs work within a network to develop synergies and coordinate standards. Oncological psychology, survivorship

care and lifestyle modification are also components of these programmes. By working towards the better integration of ambulatory (outpatient) care offered by resident doctors and inpatient care, the introduction of CCCs addresses one of the weaknesses of the German system.

- In France, the implementation of cancer coordination centres (3Cs) aim to ensure a collaborative, multidisciplinary approach to a patient's care; to ensure quality standards, to ensure effective delivery of the personalised care programme, and to improve data collection.
- In Belgium the development by the College of Oncology of "clinical trajectories" (or clinical guidelines) ensures coherence between the various stages of the care process for any given cancer, across all the relevant medical disciplines in the patient's care. Similarly, clinical guidelines are available in France and Sweden.
- In Denmark standardised clinical pathways – *pakkeforløb* – were implemented to reduce waiting times and to avoid regional differences in care. These pathways cover examination, diagnosis, treatment and aftercare. These guidelines also place emphasis on access to a multidisciplinary team, on communication and the involvement of patients and relatives, and on supporting rehabilitation. The Danish regions are responsible for implementing the pathways. In addition, the establishment of the Danish multidisciplinary cancer groups (DMCGs) promotes research coordination and collaboration, monitoring cancer care, disseminating knowledge, and creating clinical guidelines for diagnosis and treatment.

**Centralisation/integration of cancer services**

- A viable model for the provision of cancer care is to coordinate at a national level cancer service decisions, with networks to support regional provision of cancer care.
- In the Netherlands, the minister made reimbursement of the first novel drug (ipilimumab) for melanoma cancer conditional on the setting up of a patient registry and the centralisation of melanoma care. Centralisation of care in designated hospitals appears to increase the quality and efficiency of care.
- Measures to ensure excellence of service provision in France include the need for "authorisation" to provide cancer services, which, among other things, is based on minimum activity thresholds. These minimum activity levels aim to ensure that all patients have access to high-quality and safe care. These are similarly implemented in Belgium.
- In Germany, with effect from January 2012, a change in legislation opened new opportunities for the integration of outpatient speciality medical treatment, the idea being to address the barriers between hospital and ambulatory care. The legislation (§116b of the Social Code Book 5 (SGB V)) tackles the fact that rare diseases and disease states with relatively small numbers of cases, or severe progressive forms of diseases with specific disease processes, as well as highly specialised services, are particularly demanding when it comes to diagnosis and treatment. The change facilitates access to interdisciplinary care and treatment for cancer patients. The Joint Federal Committee (Gemeinsamer Bundesausschuss, G-BA) is currently involved in developing new guidelines on the basis of this norm. These will cover new forms of contracting with resident specialists and innovative service complexes. However, there has been little evidence of impact and oncologists have complained that the regulation has supported the creation of silos of single sub-disciplines within oncology

and has delayed the development of a broader interdisciplinary approach to cancer care in Germany.

### *Efficiency savings to be found outside of cancer care*

Whilst not a focus of this report, there are many examples of savings that could be made outside of cancer care in the health system more generally. Examples include:

**Unnecessary treatment and non-adherence**

- The provision of unnecessary treatments is an issue that is very difficult to quantify at a system-level, but which is likely to have important implications for the wasteful use of resources in health care.
- Another potential source of inefficiency and waste is the non-adherence to treatment guidelines and protocols, both at the patient and prescriber level.
- The European Federation of Pharmaceutical Industries and Associations (EFPIA) estimate that 50% of patients do not take their medicines properly, and that non-adherence costs governments around €125 billion and leads to nearly 200,000 premature deaths per year in Europe (EFPIA, 2012) (note: this is not for cancer specifically).
- Some estimates exist around specific measures that could reduce spending by eliminating unnecessary treatment or reducing non-adherence or reducing wasteful spending on treatments. For example, at a UK health system level (i.e. not within cancer specifically), the Academy of Medical Royal Colleges have signalled various measures to reduce waste in health care spending (Academy of Medical Royal Colleges, 2014):
    - It is estimated that adverse drug reactions account for 6% of all hospital admissions. Eliminating adverse drug reactions, for example by introducing medication review tools, could save up to £466 million a year through reduction in bed days.
    - £85 million in the UK could be saved by prescribing lower-cost statins.

**Reducing waste and improving efficiency in the provision of health care**

- Further examples of reducing waste in the provision of health care (broadly, rather than within cancer specifically) exist. For example in the UK:
    - Maximising operating theatre capacity could save around £2 million for a given hospital trust (Academy of Medical Royal Colleges, 2014).
    - Enhancing community-based treatments (replacing admissions to hospital) saved one trust £1.5 million over two years (Academy of Medical Royal Colleges, 2014).
    - Improving psychiatric liaison services in general hospitals has saved £3.55 million in one hospital.
    - Reducing radiology referrals through educational reminders alone could achieve savings of £221 million in reduced x-rays per year (Academy of Medical Royal Colleges, 2014).
- Fraud and corruption is another source of waste across the EU (Medeiros and Schwierz, 2015).
- A study by Medeiros and Schwierz (2015) utilised data envelopment analysis (DEA) to examine the efficiency of health care delivery across European countries. It found that large efficiency gains could be made, on average

increasing life expectancy by 1.8 years in the EU, by all countries performing on the "efficiency frontier".

**Unwarranted variation in the provision of care**

- A European project investigating variations in care for specific conditions identified via follow-up that health care systems performed very differently, and that in all countries there were regional- and hospital-level differences (EuroHOPE, 2014).
- Across non-specialist acute hospitals in England (not for cancer care specifically), the Carter report (Carter, 2016) estimated that unwarranted variations between hospitals is worth around £5bn in potential efficiency savings (i.e. if all trusts improve performance to match the most efficient hospitals). This variation extended across resource areas including clinical staff, medicines and pharmacy, diagnostics and imaging, procurement, administrative functions and facilities.

## 2.4. *Reimbursement and regulation mechanisms*

In this subsection we consider the efficiency of reimbursement and regulatory mechanisms for cancer drugs.

Various measures have been taken to facilitate access to cancer drugs. In a review of studies in eight countries,[14] Pauwels and colleagues note that several different measures have been taken, including adjusting cost-effectiveness thresholds used by HTA agencies, regulation of off-label use, and market-access agreements. There are also examples of innovative cancer drugs being excluded from explicit cost-control measures such as payback of budget excess by pharmaceutical companies and lump-sum payments for diagnostic-related groups (DRG) in hospitals (Pauwels et al., 2014). Neumann and colleagues come to similar conclusions in a study on HTA practices in a partially overlapping set of countries.[15] They note that the HTA agencies often struggle when it comes to cancer, and apply special considerations in these cases (Neumann, Bliss and Chambers, 2012).

There are large variations in the use of new therapies. Among other things, this is affected by the process by which products are approved. Table 7 shows data collected by EFPIA on the time from approval by the EMA to the time when products can be accessed by patients. These figures cover all drugs and do not discriminate between cancer and other drugs. Note that these figures may have changed or may change in the future with the introduction of new policies. For example, the time between approval and access in Denmark is likely to increase significantly in the coming year, due to the introduction of a new Medicines Council that will consider benefit in relation to price and negotiate discounts.

**Table 7. Time to access from marketing approval for all drugs launched 2008–10**

| Country | Days from EMA approval to access |
|---|---|
| Belgium | 371 |

[14] France, Germany, Italy, Belgium, the Netherlands, the UK, Sweden and Poland.
[15] Australia, Canada, Denmark, France, the Netherlands, Sweden, the UK and the USA.

| | |
|---|---|
| Denmark | 116 |
| France | 316 |
| Netherlands | 209 |
| Sweden | 272 |
| UK | 118 |

Source: Patients W.A.I.T: indicator. EFPIA. (European Federation of Pharmaceutical Industries and Associations, 2011) Data on Germany, Italy and Poland not available.

In a recent report looking more specifically at drugs in lung cancer, multiple myeloma and malignant melanoma, Jönsson and Wilking concluded that there are large variations in uptake of new drugs, with a faster uptake in western Europe compared with eastern Europe (Jönsson and Wilking, 2016). Table 8 summarises how the countries included in this report (for which data are available) perform.

**Table 8. Ranking of uptake (2013) out of a total of 12 studied countries**

| Country | Lung cancer | Multiple myeloma | Malignant melanoma |
|---|---|---|---|
| Belgium | 5 | 2 | 2 |
| Denmark | 7 | 8 | 3 |
| Germany | 4 | 5 | 1 |
| Netherlands | 8 | 3 | 6 |
| Poland | 12 | 11 | 12 |
| Sweden | 6 | 7 | 8 |
| UK | 10 | 6 | 5 |

Source: (Jonsson, Persson and Wilking, 2016) Data on France and Italy not available.

It can be noted that the countries rank differently in the different diagnoses, which implies that there are more factors than national policy at play. This is echoed by a study on colorectal cancer by Kanavos and Schurer, which, based on somewhat older data (2007), concludes that there are large variations in both practice and access to pharmaceutical treatments between and within countries (Kanavos and Schurer, 2010). There are fundamental differences in practice, where the absence, or the long time between updates, of local treatment guidelines are identified as one factor, with reimbursement decisions causing further differences. In less wealthy countries, out-of-pocket payments tend to be higher, which can provide an additional barrier.

The European Federation of Pharmaceutical Industries and Associations (EFPIA) provides, through the patient WAIT indicator, the rate of availability of new medicines with first marketing authorisation in the period 2008–10, and the average time between marketing authorisation and patient access (measured by number of days elapsed from EU marketing authorisation and day of completion of post-marketing authorisation administrative processes) (EFPIA, 2011). Note that this is not specific to cancer medicines.

**Table 9. EFPIA, Patients WAIT Indicator, 2011.**

| Country | Number of medicines included<br>% rates of total number within scope<br>*100% = 66 new medicines* | | Average time elapsed between date of EU MA and "accessibility" date<br>*In number of days* |
|---|---|---|---|
| Belgium | 31 | 43% | 371 |
| Italy | 33 | 50% | 347 |
| France | 23 | 35% | 316 |
| Sweden | 47 | 71% | 272<br>Average for 29 |
| Netherlands | 40 | 61% | 209 |
| UK | 51 | 77% | 118<br>"available" |
| Denmark | 51 | 77% | 116 |

Source: EFPIA's Patients WAIT Indicator (EFPIA, 2011). Data not available for Poland or Germany.

In summary, there is evidence that access to cancer medicines varies among European countries. One of the possible drivers of this variation is the reimbursement system in place which in some cases is driven by formal health technology assessment (HTA) approaches. We analyse specific national reimbursement systems and highlight inefficient and efficient practices in the following section. In subsection 2.4 we discuss the approach taken by HTA-based systems to assess cancer medicines and to what extent they are able to capture all the elements that are relevant to patients and society. This is followed in subsection 2.5 by an assessment of how the market for generics performs across Europe. We then discuss ways in which regulation and reimbursement policy could address the issues identified.

### 2.4.1. Reimbursement of cancer drugs: the status quo and issues in Europe

Below, we summarise the broad process of reimbursement for each of our nine countries. After summarising the systems in the nine countries, we describe specific features that they have in common, before outlining specific aspects of these reimbursement systems which act as a barrier to the uptake of innovative medicines.

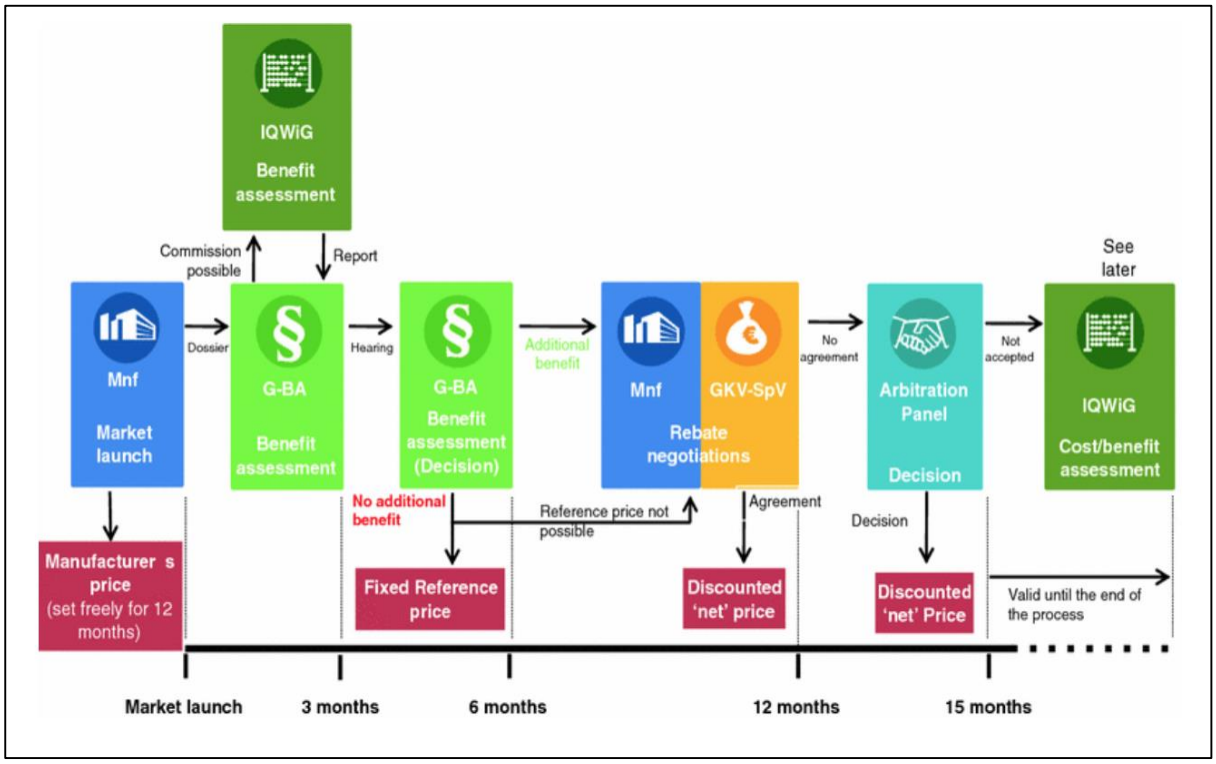
**Germany**

The reimbursement process differs according to whether drugs are dispensed in an inpatient or an outpatient setting. In the outpatient setting (ambulatory care), drugs are automatically reimbursed upon marketing authorisation, unless they have been proactively disapproved by the G-BA. For the inpatient sector, payment is included in the relevant diagnosis-related group (DRG). Where medicine costs are high, the hospital may apply to the Institute for Hospital Reimbursement (Institut für das Entgeltsystem im Krankenhaus, InEK) for additional funding via the New Examination and Treatment Methods process (Neue Untersuchungs- und Behandlungsmethoden, NUB) or the DRG supplement list (Zusatzentgelte).

The assessment of new drugs changed with the introduction of the Pharmaceutical Market Restructuring Act (AMNOG) in 2011. Immediate access is still guaranteed, but free pricing of non-reference-priced pharmaceuticals is now limited to 12 months. A rapid benefit assessment is conducted and an assessment by the Institute for Quality

and Efficiency in Health Care (IQWiG) might be undertaken. The process is summarised in Figure 42.

**Figure 42. Benefit assessment and price setting for new drugs**




Source: Runge (2012) Separating the wheat from the chaff. The European Journal of Health Economics, 13, 121-126.

There are four alternative outcomes of this benefit assessment:

1. The drug offers additional benefit to existing drugs. The reimbursement price is negotiated: priced above the standard of care if benefit is significant.
2. The drug offers additional benefit and is comparable to an existing drug: price set such that annual cost does not exceed that of cost of alternative therapy.
3. The drug offers no additional benefit and is comparable to existing products: included in reference pricing system.
4. The drug is inferior to alternative therapy: excluded from reimbursement.

The G-BA and IQWiG assessments are focused on health benefits based on clinical evidence meeting specific standards (e.g. surrogate outcomes are generally not accepted). IQWiG focuses on randomised controlled trials (RCTs) in its general methods because of their internal validity and hence ability to demonstrate causal relationships (Fricke and Dauben, 2009). Three characteristics are important: the number of studies, the certainty of the results and the consistency of the direction of the effect between the studies. Based on these three criteria, the evidence presented for each new drug is classified into three categories: (1) proof, (2) indication and (3) hint (Ruof et al., 2014).

There are some complaints about the methodological approach, particularly for cancer drugs, given the difficulties in demonstrating longer-term benefits. In May 2015 the president of the Medicines Commission of the German Medical Profession suggested that, to address flaws in clinical studies and to understand impact in real-life applications, there should be a "late benefit assessment" two to three years after market entry. This

has been introduced in other countries through Coverage with Evidence Development. However, this has not been taken up in further policy discussions.

Orphan drugs are treated as an exception. In this case, market authorisation is considered proof of additional benefit. Therefore orphan drugs are excluded from the obligation to have a benefit assessment providing they have revenues that do not exceed €50 million per annum. The IQWiG only assesses the target population size and drug budget impact. The G-BA alone will decide on the extent of the additional benefit for pricing purposes (Ognyanova, Zentner and Busse, 2011; Rémuzat et al., 2014).

In summary, IQWiG, is a very special case in Europe, essentially ignoring standard HTA processes. Indeed, they very much like to be the exception to the rule; their methods guidelines note that while "a decision based on a threshold per QALY gained is often presented as the international standard in health economics", this "should be seen critically". They emphasise that opting for cost per QALY is not a real "methodological standard" as it rests on value judgements, noting that the measure of overall benefit arises "not only as a methodological question", but essentially also as a value judgement, and that the question whether QALYs should be used involves ethical, legal and cultural considerations. From an industry perspective, such an outlier does not aid efficiency in the market-access model.

**England**

The principal means of assessing drugs in England is through the technology appraisal (TA) programme of NICE. It assesses the clinical and cost-effectiveness of medicines, and makes recommendations about their uptake in the NHS. Formal referral of a drug to the TA programme is by the Secretary of State for Health, and topics are selected based on the whether the drug could have a significant impact on patient care and/or the NHS. Whilst not all new drugs are assessed, the Cancer Reform Strategy in 2007 stated that all new cancer drugs and significant new licensed indications would be referred to NICE (providing there is sufficient patient population and evidence base) (Department of Health, 2007); this has been reaffirmed in the recent discussions around the cancer drugs fund (NHS England and NICE, 2015).

In deciding whether to recommend a drug, NICE apply an incremental cost-effectiveness ratio (ICER) threshold range of £20,000–£30,000 per QALY. In theory, this is to ensure that the product adds enough value to justify its cost, and that it will not displace other NHS spending that is more cost-effective (i.e. could achieve more health for the same money). For drugs meeting the end-of-life (EoL) criteria a threshold multiplier of up to 1.6 can be applied, increasing the upper bound of the threshold range to £50,000 per QALY. Once NICE recommends a product, NHS commissioners of health services are legally obliged to make funding available for clinicians to prescribe the drug. Between 2007 and 2014, NICE appraised 102 cancer drugs and recommended or partially recommended 47 of them (National Audit Office, 2015b). Other decision outcomes are: "optimised" (recommended only for a subgroup of patients), "only in research", or "not recommended". Prices for drugs are not negotiated (there is freedom of pricing at launch), but under the current 2014–18 Pharmaceutical Price Regulation Scheme (PPRS) the rate of growth of total expenditure on drugs is capped; if spending on drugs by the NHS exceeds this amount, then the pharmaceutical industry refunds the excess expenditure.

NICE is also often seen as an outlier, but at the other end of the HTA distribution. There is considerable rigidity in its approach. NICE would argue what they provide is clarity and

explicit decision making; however, there have been delays in accessing innovative treatments, and the establishment of the CDF reflects a response to this rigidity.

**Italy**

In Italy, prices for pharmaceuticals reimbursed by the Italian NHS are set through a negotiation between the Italian Medicines Agency (AIFA) and pharmaceutical companies. Criteria include cost-effectiveness (there is no explicit "threshold" applied), benefit–risk ratio, economic impact, potential market share, and a comparison with prices and consumption in other European countries (though no formal external reference pricing is applied). In contrast to many other countries (England, for example), budget impact is taken explicitly into account in the assessment for reimbursement. Managed-entry agreements are routinely negotiated for new oncology drugs.

A concept that is crucial to the AIFA approach to assessment and reimbursement decisions is "therapeutic innovation". The idea is that products that achieve a major improvement of patient outcomes and target a severe disease with no or limited therapeutic alternatives in comparison with existing technologies can be classified as "innovative". The acknowledgement of this status may have mainly three implications: a more favourable negotiation in terms of adoption and price, a special regime of "conditional reimbursement", and access to additional budget.

**The Netherlands**

In the Netherlands drugs are assessed for reimbursement by the National Health Care Institute (Zorginstituut Nederland, ZIN). Since 2012, the minister has had the option to negotiate with the manufacturer on the price (with a confidential discount), or implement an outcomes-based agreement. There are two pathways for drug assessment. The first is for outpatient drugs, where ZIN must assess the drug before its being put on the positive list for reimbursement. The reimbursement of therapeutically interchangeable drugs is limited to a historically determined average product price. Those with added therapeutic value must submit pharmaco-economic evidence and are fully reimbursed. The other assessment pathway is for medical specialist drugs, where pharmaco-economic evidence must be submitted and a cost prognosis provided: all cancer drugs fall under the pathways for medical specialist drugs. Where specialist drugs have a budget impact of under €2.5 million, they are funded within the diagnostic related cost group; where they exceed this budget impact, they are funded separately as "add-ons" and are evaluated by ZIN. This means that in normal circumstances hospitals can utilise new drugs without delay. However, in July 2015 the minister introduced a new policy tool to accompany the introduction of nivolumab for non-small-cell lung cancer. The policy is called "lock" (*sluis*). Because of the high uncertainty regarding budget impact (unknown number of eligible patients), the minister decided that nivolumab could not automatically be added to the basic benefit package for non-small-cell lung cancer. Currently, the drug is funded through a compassionate-use programme whilst ZIN is evaluating.

A coverage-with-evidence-development (CED) scheme was introduced in 2006 to facilitate earlier access and to collect outcomes data for specialist drugs prescribed in hospitals. This period of data collection was set at four years, during which 80% of the drug expenditure of included products was covered by an earmarked budget and the remaining 20% by the hospital. This changed in 2012 along with the wider changes described above, whereby drugs in the CED scheme are fully covered via an "add-on". However, this scheme has not been successful in collecting data which adequately

addresses the uncertainty, even after extensions of the data collection period to seven years. In addition, it is politically challenging to delist drugs once they have already been made available to patients; in cases where re-assessments have found the drug not to be cost-effective, public pressure has avoided their delisting. It is expected that there will be a change in the approach in the near future. In particular, the reassessments after four years of data collection will no longer be standard for oncology drugs. A reassessment may in the future only be conducted in case of "high"-impact drugs (i.e. mainly with an expected high budget impact) (personal communication with local expert).

There is no formal cost-effectiveness threshold in the Netherlands (no threshold has been endorsed by the minister). However, ZIN describes a step-wise approach varying between €20,000 per QALY for diseases with low severity to €80,000 per QALY for diseases with high severity, although they are careful to state that cost-effectiveness is only one criterion (Zwaap et al., 2015). Higher costs per QALY have been known to be approved and may lead to price negotiations. A societal perspective is used in economic evaluation, which accounts for all direct and indirect medical and non-medical costs, including productivity costs (using the friction-cost method), patient costs (e.g. travelling expenses) and informal care giving. However, in practice, economic evaluations are often not conducted (are exempted) or often do not use a societal perspective. Exemptions include drugs with orphan status, drugs with an estimated budgetary impact of below €500,000 per year, and HIV drugs (Franken, Koopmanschap and Steenhoek, 2014). From July 2016 indirect medical costs (downstream medical costs) will also need to be included, and value-of-information analyses will also be required in applications.

**Poland**

In Poland, requests for reimbursement are made by the marketing authorisation holder to the Ministry of Health. The submitted HTA report is reviewed by AOTMiT (the Agency for Health Technology Assessment and Tariff System); AOTMiT's reccomendations then play an important role in price negotiations between the pharmaceutical companies and the Economic Council. Following the negotiations, a positive reimbursement decision (made by the Ministry of Health) is valid for two years, and can be prolonged by three or five years (but not beyond patent expiry). The cost-effectiveness threshold is set as three times GDP per capita per QALY. However, transparency in decision-making is low. Innovative drugs are usually made available under a "drug programme" (of which there are 72). Oncology programmes represent 32% of all drug programmes funded through the public payer (NHF) (MZ, 2015). Access to drugs in Poland is very poor and uptake is slow. In a report by EY, sales in Poland were the slowest among countries studied after Romania, taking over three years to achieve "significant utilisation" (EY, 2015). In assessing access to 30 innovative cancer drugs across 13 European countries, they found that Poland had the lowest uptake: just two available and a further 16 with restrictions. According to an analysis by Niewada et al. (2013), there is no clear relation between cost-effectiveness, budget impact and the nature of final reimbursement decisions (Niewada et al., 2013). A significant barrier to access which has been introduced since 2012 with a new legislative Act is that reimbursement can no longer be provided on an individual case-by-case basis (compassionate use).

**France**

In France, pricing and reimbursement decisions are taken at a national level, based on the opinion of the French National Authority for Health (Haute autorité de santé, HAS)

through two of its committees: the Transparency Committee (Commission de la transparence, CT) providing clinical assessment, determining the improvement of the medical benefit (amélioration du service médical rendu, ASMR) rating, and the Economic and Public Health Assessment Committee (Commission évaluation economique et de santé publique, CEESP), providing health economic assessment for innovative products. The CT reviews all new medicines; CEESP provides a health economic assessment only in cases where two criteria are met: (1) the ASMR claimed by the company is major, important, or moderate (ASMR I, II, or III), and (2) the product may have a significant impact on costs or the organisation of services (Rémuzat, Toumi and Falissard, 2013). The manufacturer submits a dossier at the beginning of this process.

The process for pricing differs depending on whether it is an outpatient drug (price set through negotiation between the Economic Committee on Health Care Products (Comité économique des produits de santé, CEPS) and the drug company) or a hospital drug. Hospital medicines are included either in the drug formulary DRG system (in which case prices are set freely), or in a supplementary list for costly medicines, for which CEPS sets the reimbursement level. In addition, there is a list for hospital drugs dispensed to outpatients, Médicaments de rétrocession. The reimbursement rate is fixed by the National Health Care Insurances (Union nationale des caisses d'assurance maladie, UNCAM). The Health Ministry makes the final decision to include the drug on the list of reimbursed medicines or in the hospital list of medicines.

**Sweden**

The Medicinal Products Act (SFS 1992:859 latest update 2013) governs control and oversight of medicinal products in Sweden. The Board of Pharmaceutical Benefits (TLV) is an autonomous national authority which evaluates drugs for reimbursement and inclusion in the Pharmacy Benefit Scheme. The assessment of drugs is initiated by the manufacturer, who provides a submission to the TLV. Drugs are assessed based on their cost-effectiveness, using a cost-per-QALY threshold of approximately between SEK 700,000 and SEK 1 million. Unlike most other countries, a societal perspective is taken which takes into account productivity costs. Whilst this is the base case for TLV assessment, in practice different perspectives might be adopted and there is some ambiguity in this regard for the pharmaceutical industry. The principle of solidarity and equity is also incorporated into value assessments, and the threshold varies with, for example, disease severity. Since 2009, the New Treatment Council (NT Council), a working group within the Swedish Association of Local Authorities (SKL), was introduced to make access to drugs across the country more equal. Using a societal perspective, in theory, means that Sweden may value certain health care interventions more highly than other countries, if, for example, they lead to productivity gains.

There have been some calls in Sweden for the introduction and monitoring of new cancer drugs to be conducted at the regional level, by county councils, who are best placed to evaluate the benefits to patients locally and to take into consideration the relevant opportunity costs (Jönsson and Wilking, 2014).

**Belgium**

For the reimbursement of drugs in Belgium, maximum prices for reimbursement are set by the Minister of Economic Affairs, based on recommendations by the Medicines Pricing Commission (Commission des prix des spécialités pharmaceutiques, CPSP). Manufacturers are required to submit a pricing application to the Price Department (Service des prix) of the Federal Public Service for Economic Affairs (Service public fédéral économie). A

reimbursement dossier must be submitted simultaneously to the National Institute for Health and Disability Insurance (Institut national d'assurance maladie-invalidité, INAMI). Once established, the minister's maximum-price decision is forwarded to the Medicines Reimbursement Commission (Commission de remboursement de médicaments, CRM) for reimbursement purposes. Based on the advice of the CRM, reimbursement decisions are made by the minister for social affairs and public health – part of the INAMI.

A drug's therapeutic value determines its reimbursement price and conditions. Most cancer drugs come under reimbursement Chapter IV, indicating pre-prescription control. For drugs reimbursed under this chapter, a priori conditions for reimbursement are formulated (e.g. specified indications, dosages, patient groups, etc.). Pharmaco-economic data are required form Class 1 products, which refer to interventions with a proven therapeutic benefit compared with existing treatments, as a means to justify their higher price.

**Denmark**

In Denmark, there are five regional authorities which provide funds for the reimbursement of pharmaceuticals. Assessment differs according to whether they are prescribed in the setting of primary care or the hospital. For primary-care drugs (and any drug that is available on prescription) the Danish Medicines Agency (DMA) decides on the reimbursement status. For drugs in the hospital setting, assessment is undertaken by the Coordination Council for Placing in Service Hospital Medicines (KRIS), which assesses benefits and risks (but not financial consequences), and by the Danish Council for Use of Expensive Hospital Medicines (RADS) when there is expected to be a high cost impact. Whilst RADS looks at price, cost-effectiveness assessments are not undertaken. However, this is likely to change in 2017 when KRIS and RADS will be replaced by a Medicine Council. Whilst the details remain unclear, the Medicine Council is likely to have a role in negotiating discounts on hospital drugs based on an assessment of drug benefit in relation to price. This may impose a barrier to the uptake of new cancer medicines.

### *Drug expenditure capping*

Whilst in Germany there is no explicit cap on drug expenditure, Sickness Funds in Germany hold the prescribing doctors accountable and, regionally, agreements and prescription limits are made. In practice, however, penalties for overprescribing do not apply in cancer care, as long as doctors are able to justify the treatment decision.

In the UK, whilst the PPRS arrangements place a cap on drug expenditure, this acts as a guarantee for the NHS rather than a restriction on spending, as the industry must pay back the amount by which spending exceeded the target annual drug bill growth. In 2014 this was predicted to be worth 3.7% of estimated total expenditure (Department of Health and ABPI, 2014).

In Denmark, on 1 April 2016 a new agreement between the Ministry of Health, the Danish Regions and the Danish Association of the Pharmaceutical Industry (LIF) was implemented to ensure that costs of all hospital medicines will decrease by 10% over a three-year period.

In Italy there is an explicit cap on pharmaceutical expenditure. For pharmaceuticals related to hospital care, spending cannot exceed 3.5% of the total National Healthcare Fund; for community expenditure, the cap is 11.35% of the budget. As in the UK, excess expenditure must be paid back. However, in Italy, 50% of the excess must be paid back by companies, and the remaining 50% by the regions that exceed the cap (unless they comply with the budget constraint on overall health care expenditure). In the Italian pro-

forma, tables are provided documenting the level of over- or underspend across all Italian regions, for both territorial and hospital pharmaceutical expenditure. These demonstrate that overspend is an issue for medicines of both types, but particularly for hospital pharmaceuticals, where only one region did not have excessive expenditure in the last two years.

In Poland, drugs expenditure cannot exceed 16% of the total health budget in 2016. However, this expenditure cap has never yet been reached.

Whilst there is no explicit drug expenditure cap in France, each year there is social-security funding law to control the social and health budget. It determines budget objectives based on a forecast of revenues. Prices are reviewed on a regular basis and price cuts can be applied.

### *Are cancer drugs assessed according to different criteria compared with treatments for other diseases?*

There are no particular differences in the HTA process or criteria for cancer drugs compared with treatments for other diseases in Germany, the Netherlands, Poland, Denmark, Sweden or France.

In England, cancer drugs that are approved by NICE are funded in the same way as drugs for other diseases. However, the Cancer Drugs Fund (CDF) was established in 2011 as a ring-fenced budget to provide access to cancer drugs that were not available on the NHS, often because they were not recommended by NICE on grounds of cost-effectiveness. This means that, in practice, for those cancer drugs reimbursed through the CDF, the notional cost-effectiveness threshold for drugs approved for reimbursement was higher than for other drugs. The scheme, initially to be in place until 2014, was extended to March 2016. It had a total lifetime budget of £1.27 billion (National Audit Office, 2015b) and provided access to cancer medicines to more than 74,000 patients.

Following a consultation that started in late 2015, the CDF, as of April 2016, has become a "managed-access" fund. This means that the fund temporarily pays for new drugs which are potentially cost-effective in order to collect additional evidence to inform NICE's subsequent appraisal (NHS England and NICE, 2015). Within this scheme it has been suggested that data collection should last no longer than two years and be funded by the company. The consultation proposal also entailed capping the drug cost paid by the NHS to the patients required to generate evidence in England. Any additional patients could access the drug at the expense of the company. However, the patient capping does not appear in the approved CDF and more details on how it will be implemented remain to be seen. This will be discussed further in subsection 3.4.

Another departure in England from the normal cost-effectiveness criteria applied to most drugs is NICE's "end-of-life criteria", noted above. This is particularly relevant for the benefits associated with cancer drugs and means that the committee can approve medicines that are associated with a higher cost per QALY gained. This is discussed further in subsection 2.4.1.

With the approval of the new CDF, the end-of-life criteria have been reduced to two issues: patients' short life expectancy and a minimum increase in patients' survival. The criterion of a small population, whereby only treatments with a total population of less than 7,000 patients were eligible, has been removed.

In Belgium, whilst oncology products do not have a special reimbursement status per se, oncology drugs (along with orphan drugs, immunoglobulin, albumin, antiretrovirals and

radioisotopes) are excluded from the All Patient Refined Diagnosis Related Groups (APR-DRGs), and are fully reimbursed at their official reimbursement price (rather than the 75% rate for most other inpatient hospital drugs).

In Italy, whilst cancer treatments do not per se have different reimbursement or funding criteria, if a drug can be classed as a "therapeutic innovation" or a "potential therapeutic innovation" then it could have more favourable negotiations for adoption or price, or for the latter could be considered for a special regime of conditional reimbursement (reimbursement that is conditional upon the collection and presentation of further evidence). The assignment of this "innovation" label is based on a number of criteria, including severity; cancer is offered as an example. Most cancer drugs in Italy are subject to conditional reimbursement. Early access is combined with a requirement for studies to be carried out in a time frame of two to three years. Some of the "additional funding" available for therapeutic innovations is collected from savings from expiring patents.

Whilst in other countries studied the criteria for assessment of cancer drugs is not distinct, the funding mechanism might be. For example, in France cancer drugs are reimbursed 100%, whereas drugs for other diseases are not.

### *Reimbursement of orphan drugs*

Orphan drugs, for many reasons, pose a challenge to payers. Most notably, these challenges include the vulnerability of very small patient groups with limited treatment options, the nature and extent of the evidence, and the challenge for manufacturers in making a reasonable return on their research and development investment because of the very small populations treated. Therefore many countries have employed alternative assessment or funding procedures for orphan drugs:

- In Germany, orphan drugs do not undergo the same reimbursement assessment procedures as long as they do not reach a significant amount of sales (€50 million per annum). An assessment of the extent of additional benefit is undertaken and price negotiations take place. However, they are guaranteed at least minor additional benefit; after the €50 million threshold is reached, a new dossier must be resubmitted.
- In England, there is a separate programme of evaluation by NICE which assesses "highly specialised technologies". This includes the small number of "ultra-orphan" drugs. The methods used are distinct from the technology appraisal programme for other drugs, and the conventional cost-effectiveness threshold is not applied.
- In Italy, the only characteristic of the disease that is explicitly mentioned as potentially affecting negotiation is whether it is an orphan drug. Orphan drugs are allowed a premium price.
- In the Netherlands, drugs are exempted from submitting economic evidence if they are orphan drugs or have a budgetary impact of below €500,000 per year.
- In Belgium there exists a Special Solidarity Fund (Fond spécial de solidarité, or FSS), which is a special fund to reimburse medicines for rare conditions which otherwise would not be reimbursed. There is also a Fund for Rare Diseases and Orphan Medicines, which brings together the relevant parties in Belgium to promote a coherent policy to enhance quality of life for people affected by rare disease. This initiative was inspired by the French temporary authorisation model, and provides temporary access to drugs outside their authorised indication.

### *Tackling off-label use*

In France, there are special procedures for granting access to medications that already have a marketing authorisation but for a different indication, through the "temporary recommendation for use" (RTU) (ANSM, 2016). Over the period of the RTU, the pharmaceutical company must monitor patients taking their medicine. The aim of this programme is to make off-label use safer by collecting information on therapeutic benefit and risks. Belgium has a local "medical need programme" which similarly permits access to drugs licensed for different indications, where patients have severe unmet need, and where either authorisation application is under way, or clinical trials in that indication are ongoing.

### *Developing and securing access to personalised medicines*

Personalised medicine is a rapidly growing, science-driven area with huge potential to benefit patients, clinicians and health care systems (European Commission, 2013). Whilst the definition is not fixed, personalised medicine generally involves molecular profiling to tailor the right therapeutic intervention to the right person. Various initiatives exist across Europe to investigate and secure access to personalised medicines; since 2007, over €1 billion has been spent at the European level on the development of personalised medicines (European Commission, 2016).

In France, the Institut national du cancer (INCa) is supporting the development of personalised medicines, which was an important focus of the 2009–13 Cancer Plan, through the AcSé programme. This programme supports patients with advanced refractory cancers that have no therapeutic alternatives, by allowing access to targeted therapies based on the molecular profile of their tumour. Through clinical trials, the programme helps to explore further potential indications of molecules. The drugs are provided free of charge by the company.

A significant study from Belgium by the Vlerick Healthcare Management Centre examines Belgium's preparedness to provide access to innovative, personalised treatments and cancer medications in the pipeline (Van Dyck and Geldof, 2015). The authors highlight in particular the current disparity in the authorisation and reimbursement processes for specialised medicines and their companion diagnostics, which are evaluated by completely separate committees. This is causing market access delay for these innovative personalised medicines. In France, HAS is trying to address this, for example through their 2014 publication of guidance entitled "Companion diagnostic test associated with a targeted therapy: definitions and assessment method".

We summarise the barriers we have discussed in Table 10.

**Table 10. Barriers to the uptake of innovative cancer treatments**

| Barrier | Country evidence |
|---|---|
| Time taken to gain marketing authorisation and subsequent uptake | This is an issue in all countries, and is the reason for the various emergent schemes for early-access or adaptive-pathway programmes (see subsection 2.4.3).<br><br>In Italy, it has been shown that regions impose significant delays in access, and this varies across the country. (The existence of risk-sharing agreements has been shown to potentially lead to earlier access – this will be addressed in subsection 2.4.4). |

| | |
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| | In Germany, the process for the inclusion of treatments into a reimbursed list provides for case-related negotiations between contract partners (hospitals and sickness funds). This can introduce substantial delays. Whilst this does not present a delay for patients, it can be a problem for hospitals, who for a period of time cannot cover the price of the innovative therapy in the interim DRG.<br><br>In Poland there are huge delays in the uptake of medicines; timelines have been shown to be among the slowest in Europe. |
| Regional inequality of access | In Germany and Poland, barriers to uptake are discussed in relation to social inequalities. However, there is no evidence of social differences in treatment access across Germany (Geyer, 2012) and regional differences appear to be explained by demand-side factors (SV-Gesundheit, 2014). In the Netherlands, the coverage with evidence development scheme was designed to address these concerns, but accessibility issues remain (Blommestein et al., 2014).<br><br>In Italy, delay in access to drugs was noted to differ across regions.<br><br>For Sweden, whilst reimbursement recommendations by the TLV are national, funding is on a local basis, and therefore access to drugs does vary between regions due different interpretation of the recommendations and/or different budget planning mechanisms.<br><br>In England, although all positive NICE drug recommendations must be funded in three months, in practice regional differences in access to NICE-approved drugs remain. |
| Price negotiations delay access to patients | Reimbursement is not delayed by pricing negotiations in Germany, England and the Netherlands. In those countries where pricing is negotiated (Italy and Poland) timelines are often longer.<br><br>In Belgium, the sequencing of the pricing and reimbursement decisions was a problem, as the maximum price (determined by the Ministry of Economic Affairs) is determined before the reimbursement discussions, where the therapeutic added value of the drug compared with the alternatives is investigated.<br><br>In Denmark there are currently no price negotiations and access to medicines is very quick. This may change in the near future as cost-effectiveness analyses are likely to be incorporated into decisions and price negotiations introduced. |
| Expenditure caps for drugs and "silo budgets" | This was noted to be a barrier to uptake in Italy and Poland (though in Poland the cap has never been reached).<br><br>In the UK, there is an expenditure cap but this acts as a guarantee that NHS spending won't exceed a certain amount, and is governed through the PPRS (with industry agreeing to |

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| | pay back any increase in annual budget beyond that). The guarantee could speed up rather than delay uptake.<br><br>In Italy in particular, the huge pressure on Italian public finance through the recent financial crisis has been noted; since pharmaceutical expenditure for oncology drugs has increased more than for other classes in recent years, the pressure is even greater in this area. Silo budgets incentivise a narrow perspective on the assessment of the financial implications of adoption, and only very rarely are implications in terms of overall health care expenditure taken into account (e.g. hospital admissions etc.), let alone socio-economic implications (e.g. productivity losses). Whilst is it written into law in Italy that a pharmaceutical deficit has no implications if the overall budget is balanced, in practice different offices are responsible for the two budgets. These issues have negative implications for allocative efficiency.<br><br>In Sweden, it was noted that an important reason for inequality of access to treatments across Sweden was that the decision makers for treatment recommendations were not the budget holders, and therefore recommendations are adopted inconsistently.<br><br>In Denmark, a recent agreement between various organisations means that the cost of all medicines must decrease by 10% over the next three years. |
| Cost-effectiveness thresholds and international reference pricing (IRP) | The purpose of a cost-effectiveness threshold is to ensure that treatments represent value for money; this will inevitably lead to access issues for drugs that offer less value in relation to their cost. However, this is noted to be a particular problem in Poland, where the threshold is anchored on GDP. As Poland has a relatively low GDP per capita, the cost-effectiveness threshold applied is consequently low (e.g. in Poland the cost-effectiveness threshold is currently equal to 125,955 PLN, while in Sweden, for example, the cost-effectiveness threshold is around 308,060 PLN (applying the November 2015 exchange rate)). As drug prices are similar in Poland to other countries, this poses an important barrier for many oncology drugs which struggle to meet these criteria. This difficulty arises because of limitations in pricing discrimination due to international reference pricing (IRP) and parallel trade in Europe. Payers and HTA organisations are learning how to handle this through the use of confidential discounts. |
| Disconnect in the approval processes of targeted treatments and their companion diagnostics | The need for synchronisation in the market authorisation and reimbursement processes for personalised medicines and their companion diagnostics is clear. This was noted in particular as an issue for Belgium. The present disconnect is seen as the predominant reason for market access delays, which need to |

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|---|---|
| | be overcome to ensure that delay in medicine access is avoided. |
| Budgetary constraints in health care | Health care budget constraints will always act as a hurdle to funding for innovative therapies. This is inevitable, and as one objective in this project we aim to identify ways in which other parts of the health care system can be made more efficient. One important area of inefficiency is likely to be the continued funding of treatments and practices that are not (cost-)effective. In order to identify such practices, the remit of HTA bodies must extend beyond reviewing new therapies and to therapies or practices that might warrant disinvestment. Whilst many HTA bodies state that disinvestment is within remit, few actually pursue such opportunities actively.<br><br>In Poland, budgetary constraints represent a major barrier to medicine uptake, which is very low. That said, transparency of decision-making is also very low and one study found that reimbursement outcome was not correlated with cost-effectiveness or budget impact (Niewada et al., 2013). |
| Inflexibilities in multi-indication pricing | In most countries, setting different prices for different indications of a drug is not possible. This means that when a drug could have clinical benefit in more than one group of patients, the manufacturer may be disincentivised to investigate those indications where the clinical value is lower, as this may have a negative impact on the price they can charge. |

### *Further efficient and inefficient policies in the reimbursement of cancer drugs*

**Inefficient practice**

**Lack of exploitation of real-world evidence in clinical practice**

- In Italy, in order to be able to prescribe a "high-cost drug" the clinician must necessarily complete an online register entry, set up and managed by AIFA. This database therefore contains extremely useful information on prescription behaviour and real-life patient outcomes. However, the potential utility of this data is currently unexploited, as no data are released by AIFA.
- In England, a shortage of data for evaluating the Cancer Drugs Fund is of concern, as well as insufficient analytical capacity to exploit cancer data which are currently being collected including the Systemic Anti-cancer Therapy (SACT) Dataset (National Audit Office, 2015a).

**Inefficient control of off-label drug use**

- This can represent a safety issue for cancer patients. This was considered to be a problem in France by our expert, though the introduction of the ASCé programme to secure off-label access to targeted therapies has addressed this somewhat, as well as the "temporary recommendation for use" (RTU) framework for medicines that have a

marketing authorisation in France but for a different indications. This has improved data collection and monitoring.

**System incentives**

- In Germany, it was noted that physicians are influenced by the way their payments are determined, which uses a catalogue of medical services and associated scores (EBM) which have sections for sub-disciplines. If not drawn up appropriately, these may disincentivise specialists from prescribing the most appropriate treatments.
- In addition in Germany, there is some concern around the distributive effects of the social health insurance risk equalisation mechanism, which may disadvantage expensive forms of treatment (such as cancer treatments) and favour the most common diseases with comparatively low treatment costs.

**Efficient practice**

**Evidence-based recommendations**

- In Italy, since 2009 in Emilia Romagna, a multidisciplinary group (GREFO) has provided evidence-based recommendations on the adoption of new oncology drugs using the GRADE methodology (Agenzia sanitaria e sociale regionale, 2015). The group includes oncologists, other physicians involved in the delivery of cancer care at different stages, pharmacists, and managers of local health authorities. For each new drug approved by AIFA, the level of recommendation is then associated with an expected percentage of adoption in the population with certain characteristics. This is perceived by oncologists as a useful tool as compared with general recommendations provided by national and international scientific associations. More recently, a similar group has been established in Veneto region.

**Collaborations**

- In France, INCa is supporting research into targeted therapies by developing a collaborative programme with partners in the pharmaceutical industry and academia. By financially supporting a network of 16 early-phase clinical centres, clinicians are able to access molecular targeted agents for early-phase clinical trials. This generates evidence as to the benefits of personalised or targeted therapy.

### 2.4.2. The role of HTA for cancer drugs: methodological considerations

In countries such as the Netherlands, Poland, Sweden and the UK, decisions about the reimbursement of health technologies are informed by cost-effectiveness analysis, in which costs are measured using monetary units and effects are measured in terms of a single health-related measure. To aid decision making at a technically efficient level, many HTA agencies use the quality-adjusted life year (QALY) to measure health. The QALY is a single, generic measure of health that combines length of life with health-related quality of life. This is not dissimilar to DALYs, although DALYs measure health loss and QALYs health gain. The disability weights in a DALY are also derived differently, using a person-trade-off technique, while QALY quality-of-life/utility weights are preference-based such that they are elicited in scenarios that involve choosing between health states for one's own risk or one's own trade-off. QALY weights are mostly valued using multi-attribute utility instruments. Instruments like the EQ-5D or the SF-6D use societal preferences to value health states.

In order to ensure consistency across evaluations, NICE's guidelines (NICE, 2013) prescribe a set of methods for estimating QALY gains (a similar framework is applied in many other jurisdictions). First, patients' health must be described. NICE's preferred measure is the EQ-5D, which includes five aspects of health: mobility, self-care, usual activities, pain/discomfort and anxiety/depression. The EQ-5D is an example of a generic measure, but condition-specific measures (including those designed specifically for cancer) can also be used.

Second, each "health state" described by the chosen measure must be assigned a numeric value. This is done using stated-preference techniques such as the time trade-off, an exercise that is administered in surveys of members of the general population. The values generated must lie on a scale anchored at 1 (representing "full health") and 0 (representing "dead"), with values of less than 0 assigned to health states considered by the survey respondents to be "worse than dead".

Finally, the QALY gain associated with the technology of interest must be calculated. This is done by multiplying the duration of each health state experienced by patients by the corresponding value for that health state (as generated in the previous step). For example, if on average the technology extends patients' lives by one year and that year is lived in a health state with a value of 0.5, then the gain would be $1 \times 0.5 = 0.5$ QALYs.

**The QALY framework for assessing cancer treatments: potential limitations**

*A blunt tool?*

The QALY framework described above may not work well for assessing treatments for cancer. See Garau et al. (2011) for a detailed review. Measures such as the EQ-5D are designed to be simple and versatile, and are therefore intentionally brief. As a result, they may not be comprehensive or sensitive enough to capture in their entirety the improvements in health brought about by cancer treatments. For example, there is evidence that "vitality" is an important aspect of health for cancer patients, yet the EQ-5D does not explicitly cover vitality, fatigue or energy.

Cancer-specific measures – such as the EORTC QLQ-C30 or the FACT-G – are argued to be more sensitive to the clinical impact of new anti-cancer drugs. However, as these are non-preference-based, they do not aid allocation decisions that are required across diseases. Recently two new condition-specific instruments have been developed, EORTC-8D (Rowen et al., 2011) and the QLU-C10D (King et al., 2016), which allow for estimation of cancer-specific QALYs; however, more research is required to understand how these differ from so-called generic QALYs.

*Whose values?*

The use of health state values obtained from samples of the general population (rather than from patients) is based on the argument that the aim of HTA in publicly funded health care systems is to guide policies that fulfil the interests of society as a whole, rather than to make decisions at the individual patient level (Gold et al., 1996). However, patients tend to value a given health state more highly than do non-patients (De Wit, Busschbach and De Charro, 2000). The use of general-population values will therefore tend to give a lower QALY value to life-extending interventions than if patient values had been used. In the context of cancer, the discrepancy may be due to survey respondents failing to understand what it is really like to live with cancer. It has been

argued that only patients themselves can properly evaluate preferences relating to life and death (Slevin et al., 1990).

*Do end-of-life treatments warrant special consideration?*

The limitations described above mean that the standard approaches for assessing health technologies may underestimate the benefits brought about by cancer treatments, which reduces the likelihood of those treatments meeting the criteria required for reimbursement. Further, it has been recognised that society may place special value on treatments that extend the life of patients with terminal illness, including some types of cancer (Rawlins, Barnett and Stevens, 2010; Department of Health, 2010). For these reasons, NICE has introduced a policy which indicates that if certain criteria are met, it may be appropriate to recommend the use of "life-extending, end-of-life" treatments even if their cost-effectiveness estimates exceed the range normally considered acceptable (NICE, 2009). Although the policy is not specific to cancer, in practice only cancer drugs have met the criteria for special consideration (Trowman et al., 2011; Collins and Latimer, 2013). Of the 39 cancer drug indications recommended by NICE between 2009 and 2014, 14 (38%) were recommended using the end-of-life criteria (National Audit Office, 2015b).

Notably NICE is one of the few agencies that has explicit end-of-life criteria. Norway and Sweden have criteria according to severity and need, and the Netherlands has criteria according to proportional shortfall (Stolk et al., 2004), which may benefit end-of-life interventions.

### 2.4.3. Earlier access to medicines

When making decisions around the approval of new drugs or indications, regulators face a trade-off between evidence development and timely access (Woodcock, 2012). Providing earlier access to medicines means that, other things being equal, decisions must be made under higher levels of uncertainty. This could lead to higher risks that the drug is not safe or efficacious. However, the consequence of delaying a licensing decision until the evidence base is beyond doubt is that patients who could benefit from treatment remain untreated. For patients with urgent and unmet need, this delay in access can be critical. They may die before the treatment is made available. These patients and their physicians may be willing to accept higher levels of uncertainty. For this reason, there have been a range of regulatory responses to expedite the development and licensing of medicines that have the potential to address serious or life-threatening conditions where there are currently few alternative treatment options. These can be broadly characterised into three "types": (1) earlier licensing decision, (2) pre-license access, (3) iterative licensing arrangements. Table 11 outlines their characteristics. Below we describe examples of each type, alongside current evidence regarding their impact.

**Table 11. Regulatory options for expediting patient access**

| | |
|---|---|
| (1) Earlier licensing decision | Examples: US breakthrough therapy designation (BTD); EMA priority medicines (PRIME):<br>• assigned based on promising data from early trials (phase 1 or 2)<br>• intensive regulatory guidance on efficient clinical trial design to expedite development and review times |
| (2) Pre-license access | Examples: autorisation temporaire d'utilisation (ATU), France; Early Access to Medicines Scheme (EAMS), UK<br>• considered for medicines under development or licensed elsewhere<br>• temporary authorisation, based on evidence to support a presumption of a positive benefit–risk ratio |
| (3) Iterative licensing arrangement | Example: EMA Adaptive Pathways, Europe<br>• staged regulatory approval, based on an evolving evidence base |

### (1) Earlier licensing decision

Examples: breakthrough therapy designation (BTD), US; European Medicine Agency (EMA)'s priority medicines (PRIME)

In the US, there are currently four expedited programmes, the newest of which is the breakthrough therapy designation (BTD), introduced by Section 902 of the FDA Safety and Innovation Act 2012. Whilst this is a US rather than an EU scheme, it has developed much traction internationally, and many regulatory bodies are considering mimicking or adapting this procedure, for example the EMA through its PRIME scheme. Therefore it is an important example. The concept for BTD was first discussed at a panel convened by the organisation Friends of Cancer Research and the Brookings Institute (Horning et al., 2013). BTD is considered based on the following criteria:

- The medicine is intended to treat a *serious or life-threatening* disease or condition.
- Preliminary clinical evidence demonstrates *substantial improvement over existing therapies* on one or more clinically significant end points.

Preliminary clinical data required to support a BTD application are generally from phase 1 or 2 clinical trials. Clinically significant end points include end points that measure an effect on irreversible mortality or morbidity, or on symptoms that represent a serious consequence of the disease (FDA, 2014). The FDA describes four key features of the BTD scheme:

1. Intensive guidance on efficient drug development. FDA supply timely advice to support sponsors with efficient clinical trial design, which minimises the number of patients exposed to a clearly less efficacious treatment (through smaller or shorter trials) and will meet subsequent FDA approval criteria.
2. Organisational commitment involving senior managers. Senior and experienced reviewers are assigned who offer regulatory health project management.
3. Rolling review. Manufacturers can to submit portions of an FDA marketing application as they become available, to expedite the final review process.
4. Other actions to expedite review. A medicine with BTD may also be eligible for priority review, another programme provided by the FDA.

By providing early and intensive guidance from the FDA, a BTD may speed up the process of development and review, thereby providing earlier access for patients by facilitating earlier marketing authorisation. The BTD programme has had positive traction

in industry, as evidenced by the high volume of applications: 337 since its inception in 2012 up to the end of 2015 (282 through the Center for Drug Evaluation and Research (CDER) and 55 through the Center for Biologics Evaluation and Research (CBER)) (information metrics provided by the FDA (FDA, 2016)). Around 30% of these (n = 104) have been granted BTD. By the end of 2015, 29 products with BTD status (27 drugs and two biologics) have so far gone on to receive marketing authorisation. Oncology products represent the largest disease area for approved BTD products, at just under 50% (Kwok, Foster and Steinberg, 2015).

As the BTD programme is still young, it is difficult to assess the impact of BTD on drug development times. Based on an analysis up to March 2014, by which time three (out of 41) BTD products had so far gone on to receive marketing authorisation, the average development time (measured between initiation dates of phase I trials and approval) was around five years, which appears to be shorter than average (Aggarwal, 2014; Mestre-Ferrandiz, Sussex and Towse, 2012; DiMasi, 2015).[16] Whilst further research is required, it appears that *BTD could reduce development times by three years* (Subramanian et al., 2013; Kwok et al., 2015). One study indicates an even more dramatic reduction in development time: Park et al. (2015) looked at 25 indications for oncology drugs which received FDA approval between November 2013 and December 2014 – nine of which had BTD status and 16 of which did not. For those NMEs without BTD, the median time from phase 1 trial to indication approval was two times longer compared with those with BTD (9.4 years versus 4.7 years), indicating a saving of over *four and a half years*. Median trial sample sizes were also smaller: 173 participants for BTD drugs versus 213 for non-BTD drugs. BTD drugs also had a higher proportion of single-arm and open-label studies compared with non-BTD drugs (Park et al., 2015).

Companies could be discouraged from applying for BTD if approval requirements in the US are different to those elsewhere, for example by the EMA. However, the EMA is currently considering an approval pathway with similarities to the BTD pathway: priority medicines (PRIME). Like the BTD, PRIME would facilitate early regulatory advice and interactions for medicines with high public health potential, focusing on efficient development of evidence and enabling accelerated assessment. The EMA launched a public consultation on the key priorities of the new PRIME scheme in October 2015 (European Medicines Agency (EMA), 2015). Consultation ended December 2015 and the programme is due to launch in the first quarter of 2016.

**(2) Pre-license access**

Examples: autorisation temporaire d'utilisation (ATU), France; Early Access to Medicines Scheme (EAMS), England.

Rather than compressing the development time, pre-license access arrangements, such as the ATU programme in France and EAMS in England, permit access to unlicensed drugs for patients with severe unmet need. These compassionate-use programmes are legislated in the EU through Article 83 of European Regulation 726/2004/EC, but are governed by individual member states (EMA, 2007). The ATU programme in France is well established, having been introduced in 1994. ATUs are granted by the French National Agency for Medicines and Health Products Safety (Agence nationale de sécurité

[16] Mestre-Ferrandiz et al. (2012) show development times (phases 1–3) at around 6.5 years (75–79 months) on average; Di Masi (2015) has recently shown these to be nearly 81 months.

du médicament et des produits de santé, ANSM), for medicines that are under development or are already licensed abroad, based on the following criteria:

- The medicine treats, prevents or diagnoses a *severe* (rare or serious disease) and *unmet* (no satisfactory alternative available) medical need.
- The benefit–risk ratio is presumed positive.

Temporary authorisation through ATU may be applied for a cohort (initiated by the manufacturer: "cohort ATU") or for a named patient (initiated by the clinician: "named-patient ATU"). ATU lasts for one year but is renewable. Drugs under ATU are reimbursed; since 2007 the manufacturer must pay back any difference between the price under ATU (freely set) and the negotiated price post-licensing (Degrassat-Théas et al., 2013). Periodic data reporting by the manufacturer is required. Over the 20 years between 1994 and 2014 around 125 medicines were granted a cohort ATU (Delval, 2014); 15 cohort ATUs were granted in 2012, and nine in 2013 (ANSM, 2014).

Degrassat-Théas et al. (2013) assessed all ATUs (nominative and cohort) that subsequently received marketing authorisation (MA) between January 2005 and June 2010 (n = 77). The authors find that, from a patient's perspective, average time to access was shortened by 36 months (three years). This included an average of 25 months of patient access before MA (10 months for those that had EMA approval), and a further 11 months of access over the normal processing time between MA and publication of price (therefore the opportunity for reducing the time to access may be lower in countries where price negotiations do not happen).

One problem noted by our French expert was that, when a product gains marketing authorisation for an indication, the ATU for that product in any other indication is discontinued.

Belgium is considering a similar model to the ATU, which has been initiated as part of the Cancer Plan and was inspired by the ATU scheme. Proposals for a law and royal decree are being developed.

The Early Access to Medicines Scheme (EAMS) in England was launched in April 2014. The scheme involves a two-step process. The first is a "promising innovative medicine" (PIM) designation by the Medicines and Healthcare products Regulatory Agency (MHRA), which gives an early signal that, based on preliminary clinical effectiveness, the medicine could be a possible candidate for EAMS. The second step is an early-access "scientific opinion" (SO), which, if granted, could facilitate access to the medicine before the marketing authorisation is awarded. By the end of 2015, there have so far been 13 PIMs and five SOs. Although SOs facilitate access to drugs pre-license, four of the five SOs have already expired (due to the drug receiving marketing authorisation). The average length of this period of early access was only 65 days - just over two months (range: 21 to 130 days). An important difficulty for industry is that no reimbursement is provided over the period of early access.

Currently in the UK there is an Accelerated Access Review being undertaken. To date an interim report has identified the factors that drive the rapid uptake of innovative products, and also the barriers to rapid uptake. These barriers include a lack of evidence, non-flexible budgets, issues of affordability and a lack of support for systems change. Final recommendations from the committee will not be made public until after the EU referendum.

**(3) Iterative licensing arrangements**

A third example of how regulatory mechanisms can bring forward patient access is the EMA Adaptive Pathways programme, currently in pilot phase in the EU. The idea is to reflect the fact that evidence is not generated as a one-off exercise pre-licensing. Rather, evidence is gathered iteratively over the course of development through clinical trials and then beyond the point of licensing through observational studies. An adaptive regulatory approach is one that reflects this gradually evolving evidence base. For example, an early licensing decision can be made for a narrow population base for which some evidence of efficacy exists, which could be revisited periodically and the licensing indication expanded based on new efficacy and safety data (Eichler et al., 2012). This is the basis of adaptive licensing, which has since been renamed "Adaptive Pathways" to reflect the broader stakeholder engagement that should be integrated into such a system, which, for example, must include the payer. The EMA pilot project launched in March 2014. Concurrently, the Innovative Medicines Initiative (IMI) is running the ADAPT-SMART project, a collaboration between HTA bodies, patient organisations, regulators, payers, academia and industry, to investigate the conceptual framework and methodologies that could be used in Adaptive Pathways (EMA, 2015).

All the schemes described above aim to speed up access to promising medicines for *patients who stand to benefit the most.*

In summary:

- Schemes such as the FDA's BTD in the US bring forward access by supporting a more efficient drug development process, thereby leading to earlier approvals. Around 50% of approved BTD drugs have so far been cancer drugs. The EMA may launch a similar pathway in 2016.
- Pre-license access provided through compassionate-use schemes, e.g. the French ATU and English EAMS, can provide access to life-saving treatments for patients in urgent need. Lack of funding for EAMS is a barrier for industry.
- Adaptive Pathways are likely to be adopted in Europe, which will involve early approvals for narrow populations, which can then be expanded alongside the evolving evidence base.
- The BTD and ATU schemes have shown that early-access programmes can bring patient access forward by three or more years.

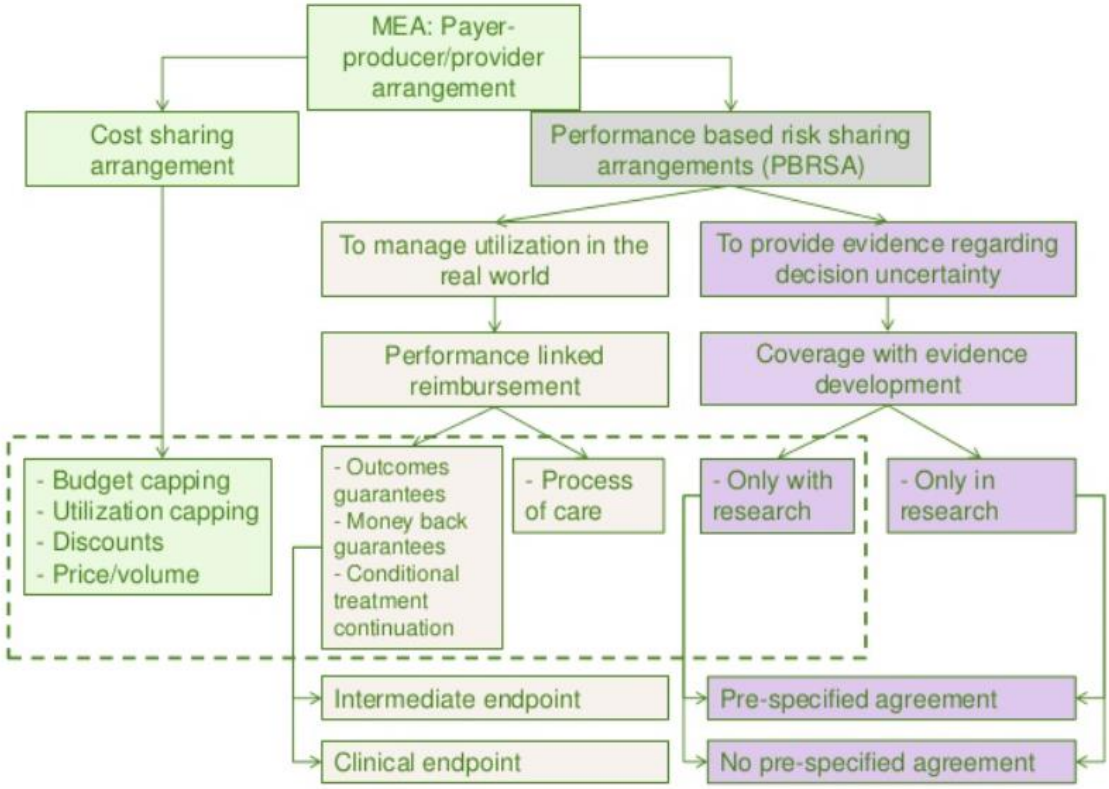
### 2.4.4. Managed-entry agreements

Early-access schemes, described in the previous section, aim to address the regulator's uncertainty and facilitate access to treatments for those patients with the most urgent need. Managed-entry agreements (MEAs), on the other hand, generally address the payer's uncertainty.

MEAs are known by many names, for example performance-based risk-sharing arrangements, outcomes-based schemes, pay-for-performance, and patient access schemes. They represent the formal use of real-world data to manage the entry of a product, and can be in many forms. For example, it could be a commitment to collecting confirmatory evidence of effectiveness in real-life settings. Alternatively, it could be a mechanism to link reimbursement directly to patient outcomes, or simply a way to cap expenditure. The type of scheme and its design will vary, depending on the type of uncertainty that the MEA is trying to address, for example clinical uncertainty, value for money, or budget impact.

There have been well over 250 examples of MEAs implemented internationally to date, with most cases arising in Italy and Sweden, but also in the UK, Australia, the US and the Netherlands.[17] Belgium also uses MEAs, which are facilitated through Article 81 and can be requested after a negative reimbursement decision or in the absence of a reimbursement decision. Many taxonomies exist to categorise MEAs. Figure 43 outlines the categorisation produced by the ISPOR Task Force.

**Figure 43. Taxonomy of managed-entry agreements**




Source: PBRSA ISPOR Task Force (Garrison et al., 2013).

As demonstrated in the diagram, MEAs can be divided into three main categories:

1. Cost-sharing arrangements. These address the payer's concerns around budgetary impact. An example is a dose-capping scheme, whereby the manufacturer agrees to pay for the medicine beyond a certain number of doses.
2. Performance-linked reimbursement. These schemes can address a payer's concerns around the clinical or cost-effectiveness of the intervention. They ensure that the payer receives value for money, by explicitly linking payments with the product's performance. An example is an outcomes guarantee, whereby reimbursement is based on the patient obtaining a specified outcome, or potentially a "rebate" for non-responders.
3. Coverage with evidence development (CED). These schemes can address a payer's concern that there is insufficient evidence to know whether the intervention is clinically effective or cost-effective. CED is where the product is reimbursed for a specified period of time, whilst further evidence (through clinical

[17] Source: University of Washington PBRSA database, May 2015.

trials or the collection of observational data) is collected. The decision on whether to remimburse the intervention will then be revisited in light of this new evidence.

All MEAs address payer uncertainty, and provide further tools for payers and industry to help address gaps in the evidence base, where these gaps would otherwise mean that the payer could not provide reimbursement for the product. MEAs are likely to become increasingly relevant as the R & D environment changes and decision makers are challenged to make access, pricing and reimbursement decisions based on more limited evidence, for example because of regulatory decision points being reached earlier (early-access schemes, adaptive pathways) and/or the stratification of medicines and the evidentiary challenges associated with small population sizes.

However, there are significant challenges in the implementation of MEAs, which mean that in reality they can be difficult to implement. They can involve substantial administrative burden, and be complicated to negotiate – particularly in systems where these negotiations must take place with multiple providers. For coverage with evidence development, sufficient time needs to be allowed in order to address uncertainty, and that uncertainty must be resolvable. In addition, experience in the Netherlands has demonstrated that, where the product was found not to be cost-effective after the period of conditional reimbursement, it is not straightforward to "delist" a drug that has already been provided to patients (Boon, Martins and Koopmanschap, 2015). Another critical factor is the health system's capacity for data collection, which is critical to support the implementation of MEAs. Below we describe the issues in Europe.

Europe dominates the number of MEA arrangements implemented, and the most common therapeutic area for the implementation of MEAs has been oncology (Jonsson et al., 2016). This may be due to the increasing number of new oncology drugs and high prices, as well as the availability of short-term response measures.

A recent comparative analysis of MEAs across Belgium, England, the Netherlands and Sweden found considerable variation across countries, with regard both to whether MEAs were implemented for the same medicine, and to whether, for the same medicine, the characteristics of the MEA were the same (Ferrario and Kanavos, 2015). Many of these differences appeared to be driven by the governmental structure. This means it can be difficult to determine which country has the most success with MEAs.

In summary:

- Managed-entry agreements (MEAs) help to ensure that payments are linked explicitly with value. They can be in many forms, depending on what type of uncertainty they address: clinical, value-for-money or budget impact.
- MEAs are important tools to ensure that the payer receives value for money. They enable conditional access to treatments, where the evidence base is not sufficient to provide unconditional reimbursement.
- The evolving R & D landscape could contribute to the increasing relevance of MEAs, as payers are asked to make decisions under increasing levels of uncertainty.

### 2.4.5. Real-world data to support decisions

Real-world data (RWD) are data that are collected outside an experimental clinical trial setting (Garrison et al., 2007), and could be in many forms, for example electronic health records, clinical registries, pharmacy data, observational data from cohort studies and patient-level surveys. The innovative regulatory and reimbursement mechanisms

described above, which could improve the health system's efficiency in introducing beneficial new interventions, rely on the use of RWD to support them. Integral to this is the need to understand the impact of interventions in the real world, which can sometimes deviate from the efficacy results obtained through randomised controlled trials (RCTs). RWD can thereby provide information on how an intervention works in real-life settings and in representative populations (who could have multiple co-morbidities). Below we briefly describe the current RWD capabilities in Europe, and then outline two major issues for its use: information governance and methodological challenges.

### *RWD capabilities for cancer in Europe*

Capacity for collecting RWD varies across countries. Specific data sets that are collected for cancer are described in the country pro-formas.

Having sufficient infrastructure to collect RWD is critical, but not the whole story. For example, collection of data through registries in Italy is advanced, and integrated into the way medicines are prescribed and reimbursed. However, data access for research purposes is poor (Cole et al., 2015). With regard to RWD in Italy specific to oncology, the Italian Association for Cancer Registers (AIRTUM) collects at the country level information from regional cancer registers (*registri tumori*). The coverage of this initiative is approximately 43% of the national population. The information is typically epidemiologic.

Different countries have implemented different policies to improve the collection of RWD for cancer. In Belgium, for example, for facilities to be recognised as providing oncological care programmes, providers are legally obliged to appoint a data manager for the organisation and delivery of data records, to be submitted to the Public Health Institute and the College of Oncology. Hospitals must register all new cancer diagnoses. Whilst data submission to cancer registries is also mandatory in other countries, the very high coverage in Belgium (over 95% complete (Henau et al., 2015)) may be attributable to the other incentives provided in Belgium for submission of data, e.g. linking submission with reimbursement for certain activities. Financing a data manager (part of the Cancer Care Plan in Belgium) has also contributed to high registration rates.

Additional incentives for data submission exist; for example, to receive financial compensation for a multidisciplinary team meeting, physicians must complete a registry form containing patient, tumour and treatment characteristics. The Belgian Cancer Registry (Fondation registre du cancer, BCR) is a population-based cancer registry, written into law and authorised to use each patient's national social security number, which facilitates data linkage. The database is thought to be over 95% complete (Henau et al., 2015). A further important initiative in Belgium is the Belgian Virtual Tumourbank, whose aim is to centralise the data of residual human tumour samples in one database. Currently, 11 hospitals are recognised and financed by this initiative. These (coded) data are then available to research groups to perform queries based on specific search criteria; the idea is that the increased availability of tumour samples will lead to the identification of new diagnostic (bio)markers and the development of new therapies.

In Denmark, the collection of RWD is well advanced, and there are many datasets available for research purposes. The Danish Health Data Authority registers all newly diagnosed cases of cancer in Denmark in the Danish Cancer Registry, which contains registry data dating back to 1943. The Danish Clinical Registries (RKKP) comprise national clinical quality databases and Danish multidisciplinary cancer groups, and aims

to improve the utilisation of clinical registries for clinical, managerial and research purposes. The Danish Cancer Biobank contains data on tissues and blood samples, and is a national collaboration between hospital departments treating cancer patients. Coverage of clinical registers in Denmark is high.

In France, there is a central network of cancer registries called FRANCIM (France Cancer Incidence and Mortality). This network is designed to harmonise registration practices, coordinate and facilitate the work of existing cancer registries, and provide useful indicators of epidemiological knowledge in cancer. There are 14 "general registries" which cover approximately 24% of the population. In addition, there are eight "specialised registries" that cover specific cancers. There are two national registries specific to children which cover all cancer patients aged between 0 and 14 years: the National Registry of Hematologic Malignancies in Children (Registre national des hémopathies de l'enfant, RNHE) and the National Registry of Solid Tumours in Children (Régistre national des tumeurs solides de l'enfant, RNTSE).

In England, RWD for oncology is collected through the National Cancer Intelligence Network (NCIN), which is operated by Public Health England. The aim of NCIN is to provide a near real-time comprehensive data collection and quality-assurance system over the whole cancer pathway for patients treated in England. The cancer outcomes and services data set (COSD) collects data across diagnoses, demographics, referral, staging, imaging, treatment, surgery, recurrence, etc., which can then be integrated with other data sets such as cancer waiting times, national audits and ONS data, as well as the Systemic Anti-cancer Therapy Dataset (SACT). SACT collects data on all drug treatments and submission has been mandated in England since May 2014.

In Germany, no centralised data collection on cancer treatments exists. Collection of data is regionalised and regulated by individual legislations, and therefore data collation and linkage are difficult. However, there are some efforts to close this gap, through umbrella organisations such as Gesellschaft der epidemiologischen Krebsregister in Deutschland e.V. (GEKID) and Arbeitsgemeinschaft Deutscher Tumorzentren e.V. (ADT), which, through nationwide collaboration between registers, aim to move towards methodological unification to ensure comparability of data. There are epidemiological cancer registers and clinical cancer registers; the latter are used for quality assurance in the 50 tumour centres. A registration law was introduced in 2013 which makes registration mandatory (Krebsfrüherkennungs- und Registergesetz).

The Netherlands Comprehensive Cancer Organisation (IKNL) is the Dutch institute for oncological research. The IKNL cancer registry documents (basic epidemiological) data on all cancer patients in Netherlands (nationwide coverage). In recent years, various patient registries have been set up for the specific purpose of monitoring quality of care or for collecting real-world evidence on a specific procedure that is being evaluated through the coverage with evidence development scheme.

In Poland, the National Cancer Registry had been maintained since 1963 (by the Cancer Epidemiology and Prevention Division of the Maria Sklodowska-Curie Memorial Centre – Institute of Oncology). The records of new cases of cancer are collected by the voivodeship cancer registries on the basis of the cancer registration forms. Then data in electronic form are sent to the National Cancer Registry, where these data are verified in terms of the logical and essential correctness and are added to the nationwide annual data set. Completion of the registry is estimated to be 94%.

In Sweden, there is a centralised cancer register collecting data from six regional cancer registers. Registration of data is mandatory and the register began in 1958.

### *Information governance for RWD*

As discussed, there is an increasing availability of and need for RWD in health care. Personal data must be processed in an ethical and responsible manner, and different health care systems have established different ways to achieve this. Information governance arrangements for health care data encompass the core principles and legislation in place which guide how patient data can be generated, accessed and used. They include rules around transparency, confidentiality and credible utilisation. Country variation is thought to be based mainly on risk management in granting exemption to patient consent, sharing identifiable data and granting access to data (Oderkirk, Ronchi and Klazinga, 2013). The Organisation for Economic Co-operation and Development (OECD) have published two major reports on health data governance, one in 2013 and one in 2015. Both take an international perspective and offer a detailed analysis of the strengths and weaknesses in data collection and use across OECD countries, as well as assessing the privacy protection challenges and how they are dealt with (OECD, 2015a; 2013b). The more recent report offers eight key data governance mechanisms to maximise the value of health data and minimise data security risks: (1) health information systems which support care quality improvements as well as research; (2) permitted secondary uses of data for public health, research and statistical purposes, subject to safeguards specified in the data protection framework; (3) public consultation on collection and processing of personal health data; (4) an accreditation process for health data researchers; (5) a project approval process; (6) best practices in data de-identification; (7) best practices in data security and management; and (8) periodic review of governance mechanisms at an international level.

In a report published by the OHE, Cole and colleagues assess the governance arrangements in place in eight countries and develop an illustrative framework of a top-performing data governance model to support a favourable environment for the development and use of RWD (Cole et al., 2015). The authors find that different countries perform differently across the various criteria. For example, in Italy data collection is strong but data access is challenging. They found that national data linkage networks, such as that established in Australia, offer huge potential. However, transparency is essential: the UK and the Netherlands provide examples of public trust breaking down, thus impeding RWD programmes. Sweden and the US performed well across the proposed framework; Germany and France were found to be more restrictive.

The core objective of data governance is to balance public interest with privacy interest: in advancing our understanding of medical treatments through evaluation and research on the one hand, and protecting individuals' privacy on the other. Different countries have different ways of addressing these (often competing) objectives. In Europe, EU legislation offers an overarching framework for the protection of patient data, which affects national legislative arrangements. The current EU Data Protection Directive (Directive 95/46/EC) has been in place since 1995 and provides a unifying framework for national policies around data protection, which extend to the protection of health care data. Whilst the directive provides a framework, it is widely acknowledged to leave considerable room for interpretation, and its implementation into national legislation has led to considerable variation between countries (Oderkirk et al., 2013). These differences manifest most noticeably around the requirements for patient consent.

In response to this heterogeneity in national data protection policies, the European Commission is looking to revise current arrangements with the objective of harmonising data protection and privacy across the EU, as well as to respond to changes in the technological environment. The change was first proposed through a "communication" in 2010, and put forward formally by the European Commission in 2012 as a legislative proposal for a General Data Protection Regulation (European Commission, 2012), and subsequently amended by the European Parliament (European Parliament, 2012). Critically, the implementation of a new regulation (rather than directive, as it stands currently) leaves no room for manoeuvre or interpretation at a national level, and individual countries in the EU will be obliged to implement it (NHS European Office, 2015a). This could therefore have a significant impact across Europe.

The major controversy over the initial proposal for changes, made the European Parliament in 2012, was around the general prohibition of processing data in the absence of patient consent. Whilst in most countries certain exemptions to this rule can be permitted if various criteria are met (in general that the benefit to society of the research it permits outweighs the risk to privacy), the proposed changes eliminated this possibility. Reacting to these proposals, Di Iorio and colleagues commented that (if the amendments were to stand as written) "the right to privacy is likely to override the right to health and health care in Europe" (Di Iorio, Carinci and Oderkirk, 2014, p.491). The proposals would severely restrict the use of personal data for scientific research purposes without specific consent. The concern around these clauses has led to significant debate at the European level, up until the very last minute of negotiations. For example the European Data in Health Research Alliance – an alliance established by multiple academic, patient and research organisations for this specific purpose – raised a petition whose signatures they presented to parliamentarians in November 2015. These efforts to work towards a more flexible legal framework than that initially proposed appear to have been successful. On 15 December 2015 the European Parliament, the Council and the Commission reached an agreement on the new data protection rules, which includes provisions to support scientific research (European Data in Health Research Alliance, 2015). In practice, this means that the legal framework governing patient consent and research will be similar to that currently in place. According to the UK-based NHS European Office, these negotiations have been successful in avoiding the disproportionate limits on the use of personal data that were proposed and that would have threatened crucial studies across Europe. In addition, the provisionally agreed legal framework now supports the sharing of data across functions such as between health and social care, and "will not hamper the NHS's ability to conduct essential life-saving research" (NHS European Office, 2015b). A formal announcement is likely to be made in early 2016.

### *Methodological challenges*

A major challenge in the use of RWD – beyond its collection and processing – is how to utilise the data to generate useful evidence. Whilst evidence of effectiveness that is collected in real-world settings is by nature more generalisable, this higher external validity must be balanced with lower internal validity and potential biases (Luce et al., 2010). The quality of data may be low, and/or highly variable or incomplete. Even where data are complete, it may be challenging to compare groups of patients, as it is difficult to capture all relevant baseline characteristics (differences which are minimised when treatment allocation is randomised).

These challenges in the treatment of observational data are well recognised, and methodological developments in dealing with the "messy data" are emerging. For example, the IMI Get Real project was launched in 2013 as a three-year project to investigate new methods of real-world evidence collection and synthesis, to support health care decision making and R & D. However, significant progress still needs to be made.

In summary:

- Real-world data (RWD) are important in understanding real treatment effects, and in supporting streamlined or managed entry schemes. This is imperative to ensure we are investing in effective and cost-effective treatments, in order that we can improve the efficiency of health care spend.
- Collection of RWD in cancer is relatively advanced compared with other fields, but there is considerable room for improvements.
- Clear, transparent and robust information governance must support the collection and use of RWD. Recent agreements at the European level appear to support the scientific use of RWD for research.
- There are methodological challenges in the utilisation of RWD (observational data) in providing evidence. In order for decision makers to be able to use RWD, further development of methods is required.

## 2.5. *Efficiency of the generics market*

The WHO define a generic drug as "a pharmaceutical product, usually intended to be interchangeable with an innovator product that is manufactured without a licence from the innovator company and marketed after the expiry date of the patent or other exclusive rights" (WHO, 2015a). In this subsection, characteristics affecting the efficiency of generic markets in Europe are discussed. Particular attention is given to the regulations and market factors of the nine selected countries. (see Section 3 for an assessment of the savings that can be generated from the generics and biosimilars market).

For simplicity, in this section we are considering only technical efficiency. The main question answered by technical efficiency is whether it is possible to squeeze more value out of our existing resources while still sustaining the same outcomes. In this regard, a generics market that is technically efficient is one in which all the potential economic savings of substituting off-patent branded drugs with generic medicines are extracted without any negative effect on the health status of the population. Resources thus released can be used to cover unmet needs, for instance financing new health technologies that have proved to be cost-effective. According to IMS, in 2014 Europe saved €100 billion due to patent expiration, albeit with high variations between countries (IMS, 2015). However, in the coming years a smaller number of patents will expire, and therefore there will be fewer opportunities for extracting the related savings (IMS, 2015). Therefore European countries face the challenge of improving efficiency in the generics market such that all the possible economic benefit from competition can be achieved.

First, in order to identify the drivers of technical efficiency in the generics market, a non-systematic literature review has been conducted. Limited to the period from 2009 to

2015, the criteria "Europe" and "generic"[18] were used to find articles in the PubMed database. In order to complete the search the first 100 results from a Google scholar search based on the same criteria and period were also analysed. Additional publications were identified by a review of the references and of articles known to the authors. Articles with a focus on a particular country were excluded from the sample. Second, based on the titles of the articles, a sub-sample considered relevant to capture the efficiency of the European generics market was selected. Third, based on the abstracts, and given the time constraints, a selection of the 20 most relevant articles was undertaken. The following results are extracted from these articles and from the databases gathered by the European Federation of Pharmaceutical Industries and Associations (EFPIA).

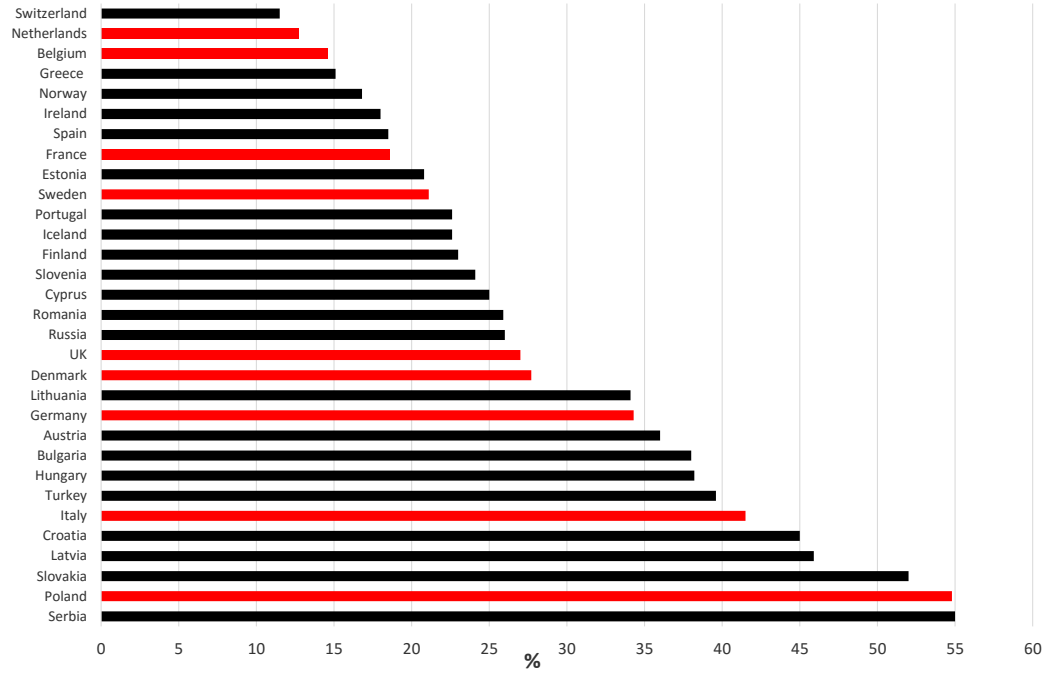
The standard method in the literature to evaluate generics market penetration is through a comparison of the share of the generics as a percentage of volume uptake (hereafter "volume share") and the share as a percentage of the total sales (hereafter "value share"). It is worth mentioning that the volume data used in this section refer to the retail market, Rx (prescription) only.

Figure 44 shows the value share estimated based on ex-factory prices. Ex-factory prices are the manufacturer's posted (list) prices, which do not reflect discounts or other incentives offered by manufacturers to pharmacies, which result in an effective (net) price smaller than the manufacturer's price (WHO, 2015b). Nevertheless, the ex-factory prices are before adding pharmacists' and distributors' margins, for which regulation varies from country to country. Analysis using wholesale or retail prices is affected by differences in regulations about margins.

In Figure 44 it is possible to observe the high variability of the value share between the European countries. Between the nine selected countries (highlighted in red) there are countries at both extremes of the distribution range. Poland shows the highest value share of the sample. At the other end of the scale, the Netherlands and Belgium, together with Switzerland, show the lowest value share of Europe.

[18] Criteria use in the PubMed database: (europe[Title/abstract]) AND generic[Title/abstract])]).

**Figure 44. Share (%) accounted for by generics in pharmaceutical market sales value (at ex-factory prices): country comparison (2013*)**

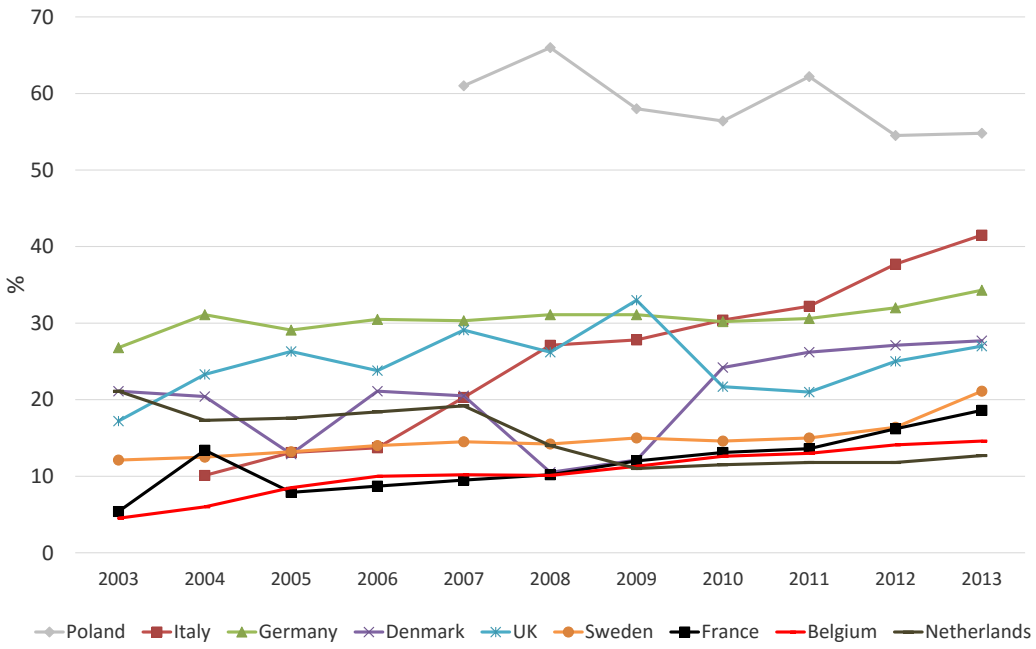



* Serbia, Cyprus and Iceland values are from 2010, Slovakia's values from 2011 and Hungary and Norway values from 2012. Source: Data from the annual reports of EFPIA (EFPIA, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015).

The evolution of the value share over time is displayed in Figure 45. Poland stands out with consistent differences over time of 30% with respect to the other eight countries. Italy has a clear increase in the value share during the period. Similarly, Belgium has also experienced an increase over the period, but less than Italy. There is no clear pattern in the evolution of the value share of the remaining six countries, and it is not possible to extract meaningful results by observing only the generics value share; it is also necessary to compare this with the relative importance of generics in the volume share of total pharmaceutical products consumed by patients. A health system with an efficient generics market would show a high level of generics volume share and a comparative low importance of generics in terms of value, in which case the entry of generics is releasing resources into the health budget for other uses, including buying cost-effective new health technologies that satisfy the unmet needs of the population (Dylst, Vulto and Simoens, 2015).

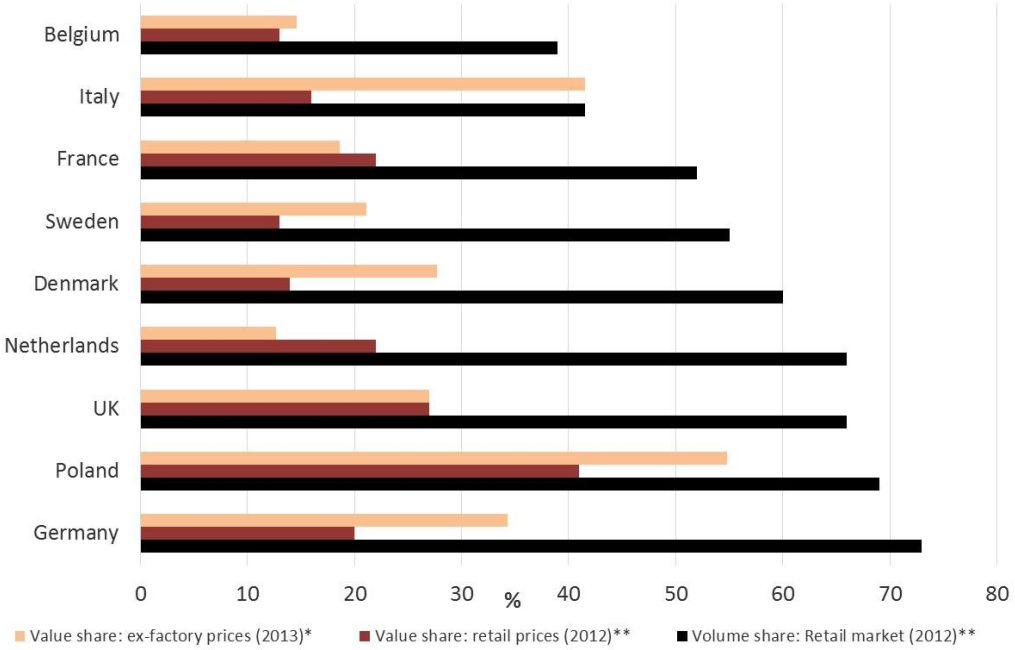
Figure 46 displays the volume share as well as the value share, the latter measured at manufacturer (ex-factory) and at retail prices. As expected, both measures of value share are smaller than the volume share for all countries. Germany, together with Poland, displays the highest rate of generics penetration in terms of volume; however, there are important dissimilarities in terms of value share between the countries. Germany shows a sharp difference between sales and volume shares, while in the case of Poland the data indicate a small distance between volume and value shares. In the case of Italy, the value share (ex-factory prices) and the volume share have similar levels. At the other end, the volume share of Belgium is lowest amongst the nine selected countries.

**Figure 45. Share (%) accounted for by generics in pharmaceutical market sales value (at ex-factory prices): evolution for the selected countries**




Source: Data from the annual reports of EFPIA (EFPIA, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015).

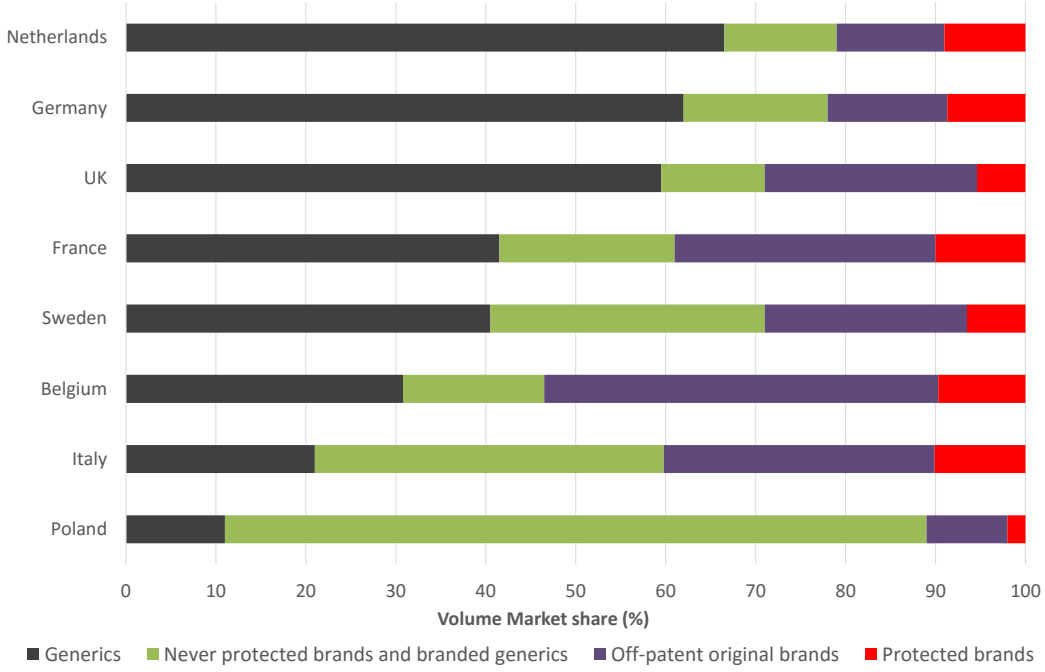
**Figure 46. Share (%) accounted for by generics in pharmaceutical markets**




Source: * EFPIA, 2013(EFPIA, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015) , ** data from Albrecht et al. derived from IMS Health MIDAS database (Albrecht et al., 2015).

It is worth highlighting the difference between the two measures of value share in Figure 46. In most countries the share of generics by value measure using ex-factory prices is higher than when using retail prices. This could be an indication of the presence of higher retail markups for branded products than for generic medicines. Analysis by Kanavos et al. (Kanavos, Schurer and Vogler, 2011), however, in which the components of the retail price are compared between generic and branded drugs, finds the opposite. In Denmark, Germany, Netherlands, Sweden and the UK, the wholesale and pharmacist absolute margins have a higher relative impact on the pharmacy retail price of generics than on the retail price of branded drugs; while for Belgium, France, Italy and Poland there are no significant differences. In the case of France, the pharmaceutical margins are designed in a way that there is no difference between dispensing a brand medicine and dispensing a generic. This again illustrates the difficulties of carrying out comparisons based on retail prices between countries.
The differences between the volume share of generics in comparison with the volume share of branded generics also reflect the level of evolution of the generics market. Figure 47 shows the pharmaceutical market divided according to the patent status of the products. Netherland, Germany and the UK, three countries with an important volume share of generics, show a high penetration of generics, while in the case of Poland the market is dominated by "never-protected brands" (i.e. products that never had patent protection in that country) or by branded generics. In the case of Belgium the market is principally supplied by off-patent original brands.

**Figure 47. Pharmaceutical market of the selected countries: protected and off-patent markets (2014)**




Source: Data from the IMS (IMS, 2015).

Based on the results shown in Figure 44 to Figure 47, it is possible to divide the selected countries into four groups:

- First, those countries with high generics penetration in terms of volume, relatively low value share and a market dominated by generics and not by branded generics:

Netherlands, Germany and the UK. This group can be considered the most efficient, since high levels of volume share with low value share indicate that the health system is taking advantage of low generics prices, releasing resources back into the health budget.

- Second, those markets in which there are middle levels of generics penetration measured by volume, and middle levels of value share, and in which the participation of generics net of branded generics is around 40% of the market: France, Sweden and Denmark.
- Third, countries with low volume and value shares that are dominated by branded generics or branded drugs: Belgium and Italy.
- Fourth, Poland, which has high volume and value shares and a market of mainly "never-protected brands" and branded generics. According to data collected by EFPIA (2015), the volume share of generics is particularly high in newer EU member states that had difficulties historically in providing intellectual-property protection. Poland belongs to this group.

Experts agree that an improvement in generics penetration requires consistent generics policies that can be implemented in a reliable way (Vogler and Zimmermann, 2012). With this in mind, in the following subsection the main policies implemented in the nine selected countries are discussed and listed.

### *Demand-side policies*

Demand-side polices aim at affecting the decision of the three main stakeholders in the pharmaceutical market: patients, physicians and pharmacists. A summary of the main demand-side policies is presented in Table 12.

The literature mentions three measures that can promote the use of generics by patients (Simoens, 2013). First, information campaigns that can enhance the acceptance of generics. For instance, France carried out a promotional campaign to promote the use of generics (Dylst, Vulto and Simoens, 2013). Second, improvement in communication between patients and health care professionals. This is key not only for increasing the use of generics but also for preventing confusion and misperception in their use, which could negatively affect the health status of the population (Dylst et al., 2015). For instance, in the Netherlands patients are usually registered and serviced in the same pharmacy, which creates trust and enhances communication between patient and pharmacist (Dylst et al., 2015). Third, financial incentives created by the co-payment policy of the country have the largest impact on the acceptance of generics by patients. These are related to the patient's contribution to the cost of the medicines. Therefore it could be expected that those countries with high co-payments and high out-of-pocket expenses would have a higher generics penetration, since the patients would be encouraged to buy the cheaper option.

The second group of demand-side policies are those targeting pharmacists. These refer mostly to incentives that affect remuneration. In this regard, one key aspect is whether the country's policies allow generics substitution, in which case the pharmacist can offer the option to the patient of receiving a cheaper generic option instead of a branded drug. The level of enforcement of a policy, in this case generics substitution, could affect the success in promoting the use of generics (Vogler, 2012a).

**Table 12. Demand-side policies that could affect generics penetration in the country**

| | Country | Patient co-payments | | Pharmacist | | | | Physicians | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Type[c] | Varies by[c] | Generic subs.[d] | Discount legally allowed[e] | Dispensing fee per item (€)[e] | Pharmacy margin as % [e] | INN Prescribing[d] | Prescription Guidelines[c] (for all or a subgroup of conditions) | Prescription patterns[c] | Other[f] |
| 1 | Germany | Fixed/ percentage | – | Mandatory | Natural rebates from manufacturers prohibited | 8.1 | PPP (fixed) | Indicative | Compulsory | Discussion groups (the QCPs)[f] | |
| 1 | Netherlands | Not under 170 euros | – | Indicative | Yes | 7.5–10.00 | Not fixed (depends on discounts) | Indicative | Non-compulsory | Monitored/Discussion groups | |
| 1 | UK | Fixed[a] | Condition /socio-economic status[a] | Not allowed | Yes | yes | Not fixed (depends on discounts) | Indicative | Non-compulsory | Monitored and compared to others | Prescribing targets |
| 2 | Denmark | Fixed/ percentage | Condition | Mandatory | Yes | 1.34 | PPP (fixed) | Not allowed | Non-compulsory | Monitored and compared to others | |
| 2 | France | Fixed/ percentage | – | Indicative | Branded (2.5%) /generics (17%) | 0.53 | MSP (regressive) | Indicative | Compulsory | Monitored (based on the Répertiore de médicaments génériques) | Prescribing targets/Media campaigns (affect also patients) |
| 2 | Sweden | Percentage (decrease with consumption) | Type of drug | Mandatory | Yes | – | 16% on average (regressive) | Not allowed | Non-compulsory | Monitored | Prescribing targets |
| 3 | Belgium | Percentage (decrease with consumption) | Condition/socio-economic status | Not allowed | Yes | 3.88 | PPP and the MSP (regressive) | Indicative | Non-compulsory | Monitored and compared to others | Prescribing targets |
| 3 | Italy | Fixed | Condition /socio-economic status | Indicative | Yes | – | Pre-tax PRP (fixed) | Indicative | Compulsory | – | |
| 4 | Poland | Fixed/ percentage | Condition | Indicative | Yes | – | (regressive) | Indicative | – | – | |

[a] The UK co-payment information refers to England information.

[b] 2006 Drug Savings Law (AVWG): pharmacies lost the right to obtain "natural rebates" from manufacturers and wholesalers. This involved the provision of free stock or other non-monetary rebates for bulk orders from predominately generic companies, which pharmacies could subsequently claim full reimbursement for (Macarthur, 2007).
PPP pharmacy purchase price, MSP manufacturer selling price, PRP pharmacy retail price, INN international non-proprietary name, QCP Quality circles for pharmacotherapy.
Sources: [c] (Barnieh et al., 2014), [d] (Vogler, 2012b), [e] (Dylst, Vulto and Simoens, 2012), [f] (Dylst et al., 2013).

Table 12 shows that three of the nine countries have a mandatory policy of substitution, Denmark, Germany and Sweden, while in the UK and Belgium it is prohibited.

In addition to the issue of generic substitution, a key consideration for fostering generics is the economic incentive for the pharmacist. It is common practice across European countries to have a legally mandated margin for pharmacies, which is a percentage value of price (Table 12). This policy disincentivises dispensing cheaper generic drugs as the absolute gain to the pharmacist is lower than that from dispensing a more highly priced branded medicine (Bongers and Carradinha, 2009; Dylst et al., 2012; IMS, 2015; Simoens, 2013). Therefore European policies are evolving to a fee-per-item system. This evolution can be observed in Table 12, in which six countries have a mixed system including fee-per-item and a percentage margin. Another form of fostering generics efficiency is the fee-for-performance remuneration in the form of a fee for particular pharmaceutical care. Countries such as the Netherlands and Belgium are moving to this form of remuneration (Dylst et al., 2012).

Demand-side policies targeting physicians are those discussed most frequently in the literature (Bongers and Carradinha, 2009; Simoens, 2013). Inside this group, a well-known policy is the request for prescribing by international non-proprietary name (INN). With the exception of Sweden and Denmark, the INN is applied in almost all selected countries (Table 12). Although a common practice in Europe, prescription by INN has faced opposition from physicians who fear that the substitution of the branded drug by the generic could negatively affect the current health status of the patient, either because they consider that the generic is not a perfect substitute for the previously used branded drug or because they do not trust the pharmacists' capacity to correctly inform patients (Johnston et al., 2011; Godman et al., 2010).

Although enforcement is particularly important for INN prescribing success in improving generics market efficiency (Vogler, 2012a), none of the selected countries apply INN in a compulsory way, which is partly due to physicians' opposition. This means that physicians' patterns of prescribing are still key to the substitution decision. Consequently, there are a number of other policies that seek to encourage the prescription of generics, such as compulsory and non-compulsory prescription guidelines, monitoring and comparing prescription patterns, and setting prescribing budgets, accompanied by financial incentives or penalties (Bongers and Carradinha, 2009) (Simoens, 2013; Godman et al., 2010). In addition, information campaigns aimed at dispelling uncertainties and building trust between physicians have been carried out, such as the French case (Dylst et al., 2013). Computerised prescribing is another practice that is spreading across Europe, according to a study from the EGA (Bongers and Carradinha, 2009). In 2009, France, Italy, Denmark, Germany, the Netherlands, Sweden and the UK were using computerised prescribing.

Amongst the demand-side policies, it was not possible to find any particular policy that the more efficient (group 1) or less efficient (group 3) countries shared. However, the literature suggests that no one policy, but rather a combination of policies, is needed for successful improvement in generics market efficiency (Godman et al., 2010; EGAS, 2015; Simoens, 2013; Vogler and Zimmermann, 2012).

### *Supply-side policies*

Supply-side policies include those that affect the level of prices for generic drugs. Table 13 shows a summary of the main supply-side policies that affect the level of prices of generics.

**Table 13. Supply-side policies that could affect generics penetration in the country**

| | Country | Price control for generics at[b]: | | | Generics price linkage[b] | IRPS[b] | ERPS[c] | |
|---|---|---|---|---|---|---|---|---|
| | | Ex-factory price level | Wholesale level | Pharmacy retail level | | | Calculation | Basket[a] |
| 1 | Germany | Reimbursable | Reimbursable | Reimbursable | no | With broad cluster | Not defined | 15 |
| 1 | Netherlands | Prescription only | Prescription only | Prescription only | no | With broad cluster | Average | 15 |
| 1 | UK | Indirect price control for reimbursable | Reimbursable | Reimbursable | no | No IRPS | No ERPS | |
| 2 | Denmark | | Reimbursable | All except OTC medicine sold outside pharmacies | no | At ATC 5 | Average | 9 |
| 2 | France | Reimbursable | Reimbursable | Reimbursable | 50% below originator | At ATC 5 | Average | 4 |
| 2 | Sweden | | Reimbursable | Prescription only | no | No IRPS | No ERPS | |
| 3 | Belgium | All generics | All generics | All generics | 20–50% below originator | At ATC 5 | Average | 6 |
| 3 | Italy | Reimbursable | Reimbursable | Reimbursable | 20% below originator | At ATC 5 | Average | 26 |
| 4 | Poland | | Reimbursable | Reimbursable | 20–50% below originator | With broad cluster | Benchmark in negotiations | 30 |

[a] Number of reference countries
OTC: over-the-counter
Source: [b] Vogler(Vogler, 2012b), [c] EFPIA (EFPIA, 2014).

In all nine selected countries some form of price control is applied. This control is linked, for instance, to the reimbursement status or to whether the generic is an OTC medicine or requires a prescription (Table 13). In this regard it is worth mentioning the analysis conducted by Puig-Junoy (Puig-Junoy, 2010) in which the results indicate that generics price cap regulations have the negative effect of levelling off manufacturer prices at a higher level than without these policies.

In order to determine an optimal level of medicine pricing, one of the methods applied in Europe is the external reference price system (ERPS), which is based on the prices from a basket of countries (EFPIA, 2014). Table 13 shows that out of the nine countries, only two, the UK and Sweden, do not apply an ERPS. Moreover, Vogler states (Vogler, 2012b) that although Germany has been traditionally considered a free market, recent reforms have resulted in the introduction of price controls and ERPS for some new medicines but not for generics, where an internal reference price system (IRPS) for off-patent medicines is used.

For the particular case of generics, it is common to use an IRPS. This involves the identification of an identical or similar group of medicines that can be compared to the new generic. For medicines within the group, the minimum or average of national prices is estimated and used to define the price of the new generic product (Vogler, 2012b). Apart from Sweden and the UK, the IRPS affects generics prices in all the selected

countries (Table 13). In the study of Puig-Junoy (Puig-Junoy, 2010), findings indicate that use of IRPS results in an almost compulsory reduction in the price of all medicines subject to the policy. Moreover, the IRPS appears to be more efficient than price cap regulation, since the IRPS establishes a lower level of prices. However, a negative consequence of the IRPS is that it appears to inhibit reductions in prices related to market competition. Prices decrease only as a result of a change in the reference price and not in competitor prices (Puig-Junoy, 2010). There is a one-off effect.

An important and criticised supply policy is the application of a price limit to the generics price linked to the brand price. The price of a generic medicine is set at a particular percentage below the price of the branded drug (Simoens, 2013; Vogler, 2012b). This means that the manufacturer of the branded drug defines the generic entry price. They could discourage the entry of generics producers in the market by lowering the branded price, thus limiting competition. In an analysis done by Vogler (Vogler, 2012a), she determines that high differences in prices between branded and generic medicines are observed between those countries that do not apply generics price linkage, such as Denmark and Sweden. On the contrary, those countries that applied generics price linkage have low or no differences between the originator and the price of the generic, such as Belgium. It is worth highlighting that the countries in group 1 do not apply generics price linkage, while the countries in group 3 and 4 define the price of the generic product as between 20% and 50% of the originator's price (Table 13).

The tendering system for medicines can also be considered a supply-side policy. Tendering refers to the process whereby a purchaser, such as the health insurance fund, based on a competitive bidding process, acquires medicines that are produced by multiple manufacturers. This is considered an efficient mechanism for achieving the lowest possible prices, and thus releasing part of the health budget which can be used for other purposes. However, this prompts concerns about the long-run sustainability of the generics market. To lose a tender could be fatal for small companies, which as a result could even be forced to close, and the competence would be reduced for the next tender. In Germany, tendering is a common practice; however, the number of companies tendering has been decreasing and the average price increasing (Albrecht et al., 2015).

The economic crisis in Europe has resulted in the intensification of some of the supply-side policies. For example, in Italy further restrictions on reimbursement for the cheapest generic drug have been applied, while in the Netherlands there is an increase in the number of drugs acquired through tendering (Simoens, 2013). Efficiency in the generics market is important in order to extract maximum benefit from decreases in prices; however, a long-term vision is essential to maintain competitiveness, and thus low prices in the market.

### *Market-entry barriers and market characteristics*

Although a consistent generics policy is essential for the improvement of generics market efficiency, it is important to consider the particular characteristics of the market for each treatment. In this regard, the number of generic entrants is a key driver of competition, and is affected by different factors depending on the particular drug and disease. For instance, it has been proved that market size for the branded medicines at the time of the expiration of the patent is a good predictor of the number of generic products to enter the market (Bianchi et al., 2014). Additionally, the complexity of the formulation

and the manufacturing process, as well as the availability of raw materials, are also factors that affect entry of new competitors into the market (Bianchi et al., 2014).

One of the main factors enabling the achievement of maximum benefit from the entry of generics in the market is the efficiency of the system in approving and adopting a price and reimbursement level for a new generic. An extensive and complicated process can be considered a barrier to the entry of new generic competitors in the market. In this regard, the time between authorisation for a generic drug to be sold in the market, and the point at which a price and/or a reimbursement level is agreed, varies substantially between European countries. According to data collected by Simoens (Simoens, 2013), Poland requires 180 days for the assignation of the price and reimbursable level for generics, as set out in the data presented in Table 14. Based on information collected in 2007 by the European Generic Medicine Association (EGA), Table 14 shows the time delay in price and reimbursement decisions for generic drugs after the granting of marketing authorisation. Germany and the UK have no delay, which responds to the fact that generic drugs obtain price and reimbursement approval automatically on market authorisation (Bongers and Carradinha, 2009). It is also worth noting that the countries in group 3, Belgium and Italy, show important delays on price decisions.

**Table 14. Time delay (days) in the decision of reimbursement level and price for a generic medicine after marketing authorisation**

| | Average delay for price decision | Average delay for reimbursement decision | Price and reimbursement are defined at the same time? |
|---|---|---|---|
| Belgium | 90* | 120 | yes |
| Denmark | 14 | 14 | yes |
| France | 75 | 75 | yes |
| Germany | 0 | 0 | yes |
| Italy | 135 | 135 | yes |
| Netherlands | – | 45 | yes |
| Poland | 180 | 180 | yes |
| Sweden | 30 | 30 | yes |
| UK | 0 | 0 | yes |

* Belgium delay value extracted from GaBI (GABI, 2011).
Source: Bongers and Carradinha (Bongers and Carradinha, 2009).

Another important barrier to the entry of generics is the extension of patents through, for instance, the introduction of medicines similar to the off-patent drugs but with changes in non-essential features, so-called "evergreening" (Roox et al., 2008).

### *Benefits of generics*

The literature suggests that other benefits are derived from the introduction of generics in the pharmaceutical market, as well as cost-saving:

- *Improvement in adherence*. One of the main reasons why patients discontinue the use of their medication before the end of the treatment in countries with high patient co-payments or requiring out-of-pocket purchase of many medicines is the financial impossibility of buying the medicine. The introduction of lower-priced generics decreases the economic stress, thus increasing adherence. However, this positive effect depends on differences between the originator and the branded product (i.e. package, shape, colour, taste) not confusing the consumer. In this regard, the role of clinicians and pharmacists in advising and answering any doubts from patients is key to achieving efficiency in the generics market (Dylst et al., 2015; Albrecht et al., 2015). Although co-payments in Europe are not as high as in the USA, positive impacts on adherence have been observed in Italy.

- *Improvement in access to pharmacotherapy*. The entry of generics and the subsequent decrease in costs allows the commencement of treatment for which the branded drugs were not cost-effective. This will result in the selection of more optimal treatments and an improvement in the health status of the population (Dylst et al., 2015). For instance, NICE in the UK recommended the use of statins for a wider population after the market was opened to the entry of generics and prices fell substantially.
- *Incentive for innovation*. Competition generated by the entry of generics is vital for fostering innovation in the pharmaceutical market. The reduction of market share and profits faced by branded producers is an incentive for investment in R & D in order to discover new treatments to bring to market. In addition, competition also represents an incentive for generics companies to create added value by distinguishing themselves from other producers in ways that can benefit patients, such as changes in packaging to reduce waste or improve adherence (Dylst et al., 2015).

### *Summary*

Based on the value share and the volume share, we were able to split the nine countries into four groups. Group 1 has high generics uptake combined with low value share, therefore it is considered the most efficient group. Group 2 shows medium values of both value share and volume uptake, which suggests that these countries need to continue progressing to improve generics penetration. Group 3, with low value and volume shares, appears to be the least efficient group. In this regard, it is worth mentioning that Belgium has been introducing a number of policies to improve generics uptake, whose effect is reflected in a modest but consistent increase in value share. Finally, Poland stands alone in group 4 with a high-volume uptake accompanied by a high value share, as well as an important role of branded generics in the market. This suggests that although Poland has a long tradition of using generics, it is still necessary to apply policies that improve competition. This is likely to generate reductions in pharmaceutical prices.

Among the demand- and supply-side policies the only one that appears to match the division of the countries into the four groups is generics price linkage. This is applied in groups 3 and 4 but not in group 1. As we have indicated, there is evidence that such price linkage is not efficient. The literature also suggests that a policy cannot be successful in isolation, but needs a coherent country policy for promoting the penetration of generics responding to the needs of the health system, and the particular barriers linked to that market.

## 2.6. *Section summary: efficient practices and policies in cancer care delivery*

Cancer is a complex disease, whose determinants are numerous, including healthy behaviours, the environment, genetic predisposition and the prevalence of some infectious diseases. This means that the role of government in tackling cancer is particularly important. A wide range of government policies must be employed, which in addition need to address the socio-economic inequalities in cancer incidence and outcomes. Relevant policy levers include tobacco control, population-based vaccination, screening services, health education to promote healthy behaviours, health care services and environmental regulation.

In this section we have outlined some key aspects of the delivery of cancer care, as well as the processes for the provision of cancer medicines, across Europe which have contributed or could contribute to improved care for patients. In Appendix IV – Country Summaries we provide a brief overview of the pertinent factors across these themes for each of the nine European countries studied individually.

Below, we provide some of the headline policies and practices that may be leading to the inefficient or efficient delivery of cancer care in Europe. Sources of evidence include the data set out thus far, as well as further literature analysis and existing policy recommendations.

### 2.6.1. Policies and practices that may be leading to the *inefficient* delivery of cancer care in Europe

#### *Fragmented care delivery and decision making*

Decentralisation and duplication of effort. The separation of activity in cancer care can lead to duplication of effort and inequalities between regions.

Dichotomisation between care providers. Where services are not integrated in the way they provide care for patients, inefficiencies arise.

#### *Poor availability of data to support decision-making*

Collection of data alongside clinical practice. This is key both to managing a patients' pathways of care, and to evaluating treatment outcomes and providing evidence to payers and regulators for decision making. Lack of data collection, or suboptimal use or application of data that is already collected, could be a key source of inefficiency.

#### *Slow uptake and access to medical treatments*

Delays by regulators and payers in providing access to cost-effective drugs. Unnecessary and unequal delays in access can be a source of inefficiency and inequality. Moreover, unless there is coordination between regulators and payers, progress in accelerating access to treatment through innovative adaptive pathways will be hindered.

#### *Perverse incentives*

Expenditure caps and Silo budgets. Expenditure caps for certain aspects of care funded by different parts of the health care budget can create a system whereby incentives to maximise whole-system value are hindered.

### 2.6.2. Policies and practices that could improve the *efficient* delivery of cancer care in Europe

#### *Objective: reducing the cancer burden*

Supporting a healthier European population. More than one-third of cancers are preventable. Governments should have a responsibility in the promotion of healthier lifestyles through public campaigns and awareness to facilitate behaviour changes to reduce the burden of cancer in the population. The major lifestyle factors associated with cancer risk are smoking, unhealthy diet and physical inactivity, but other factors that can reduce cancer risk include consuming less alcohol, being careful with sun exposure, eating less processed and red meat, eating less salt, minimising risk factors at work, minimising certain infections (like HPV and Hepatitis), minimising radiation, minimising time spent on HRT, and breastfeeding if possible.

Implementation of screening programmes. Early diagnosis is the most powerful tool in successfully treating cancer. Appropriate well-evidenced screening programmes are an effective tool to increase accurate early diagnosis. The best-evidenced and -implemented population screening programmes in Europe are those for cervical, colorectal and breast cancer. However, coverage for these programmes varies to a large degree. Late presentation of cancers (for which outcomes are much worse and costs are much higher) which could have been detected much earlier through well-implemented screening programmes is an important source of inefficiency.

### *Organisation of clinical pathways and care delivery*

Concentration of expertise in the delivery of cancer care. The cancer care delivery landscape in many countries has undergone a process of centralisation of service delivery into "hubs" of high and specialist experience. The use of minimum activity levels, for example, ensures that skills are developed and maintained. This concentration of expertise can also create space for organisational innovation. It must be balanced by ensuring adequate access, continuity of care and integration with primary care.

Coordination of cancer services through networks. Effective oncology networks can facilitate multidisciplinary cancer care in setting national standards and delivering care that can take account of the whole patient pathway.

Clinical guidelines. The creation of clinical guidelines to optimise the treatment pathway of a patient is imperative. This is also key to reducing inequalities.

### *Patient-centred care*

Survivorship. Mortality from cancer is declining, but incidence and prevalence rates are rising. This means there is a growing population living with or beyond cancer. The care we give to cancer patients must adjust to reflect this, for example recognising and managing patients with multiple morbidities. Understanding these changes (survivorship and multiple morbidities) is necessary to ensure that care is effective and efficient both to improve patient quality of life and to avoid unnecessary and expensive emergency admissions.

### *Streamlining access to treatment*

Ensuring quick access to treatment in urgent cases. In many countries, the specification of waiting times in treatment and referral pathways has been important.

Early-access schemes. Early-access schemes that are in place or being piloted to manage earlier access to treatments where the evidence is uncertain but the need is high.

### *Matching reimbursement with value*

Evidence-based recommendations. Recommendations for treatment should be based on high-quality evidence of value to patients and to the health care system.

Investing in services that provide high value for money. Address underinvestment in high-impact and high-value services, such as radiotherapy.

Managed-entry agreements can help to ensure that payments are tied to the value a product provides, and can help payers in managing uncertainty.

# SECTION 3: CASE STUDIES TO ACHIEVE EFFICIENCY

Within a constrained budget it is important to understand how utilising the given resources in a different way could improve patient outcomes or reduce health care expenditure. These resources could in turn be used to fund new approaches that have been proven effective.

In this section, we model the mortality and economic costs and benefits of three cancer interventions across the spectrum of prevention, detection and treatment:

- smoking prevalence and its effect on lung cancer and lung cancer care
- expansion of screening programmes for colorectal cancer
- the potential economic gains of biosimilars.

These interventions were selected due to the availability of high-quality, comparable data on resource use and health outcomes. In addition, to increase the potential impact on policy, it was desirable to investigate interventions with considerable heterogeneity in terms of current use across the nine European countries.

Additionally in this section we discuss options for increasing the funding available to cancer by exploring alternative funding models, including ring-fenced funding and tobacco taxation.

## 3.1. *Smoking prevalence and its effect on lung cancer and lung cancer care*

### 3.1.1. Background

Tobacco use, particularly cigarette smoking, is one of the leading causes of cancer. Apart from the well-documented causal effect of smoking on lung cancer, a recent report by the US Surgeon General presented evidence on causal relationships between smoking and cancer of the bladder, cervix, colon, kidneys, larynx, leukocytes, lungs, liver, oesophagus, oral cavity, oropharynx and stomach (Warren et al., 2014).

Agudo et al. (2012), using data from the European Prospective Investigation into Cancer and Nutrition (EPIC) study, estimated the proportion of cancer attributable to smoking (Table 15). The relationship was estimated for cancers classified as causally related to smoking, so-called tobacco-related cancers (TRCs), by the International Agency for Research on Cancer (IARC). The study was based on 441,211 participants in eight European countries,[19] and 34.9% of all TRCs were found to be attributed to smoking, translating to about 270,000 new cancer diagnoses per year in the eight countries.

[19] Denmark, Germany, Greece, Italy, the Netherlands, Spain, Sweden and the UK.

**Table 15. Fraction of cancer cases attributed to smoking**

| Tobacco-related Cancer (TRC) | Attributable fraction [a, b] |
|---|---|
| Larynx | 84% |
| Lung | 82% |
| Lower urinary tract | 50% |
| Oropharynx | 49% |
| Oesophagus | 35% |
| Oral cavity | 33% |
| Liver | 25% |
| Stomach | 21% |
| Colon and rectum | 14% |
| Uterine cervix | 14% |
| Pancreas | 13% |
| Myeloid leukemia | 13% |
| Kidney | 8% |

[a] The attributable fraction measures the public health burden of a risk factor by estimating the proportion of cases of a disease that would not have occurred in the absence of this risk factor (Steenland and Armstrong, 2006).
[b] Estimates were adjusted for sex, age, education, body mass index, physical activity, alcohol consumption, total energy intake and consumption of fruit and vegetables, assuming a population equally distributed by sex.
Source: European Prospective Investigation into Cancer and Nutrition (Agudo et al., 2012).

In addition, Agudo et al. (2012) estimated the impact of smoking cigarettes on cancer risk. The impact was defined as the hazard ratios[20] of cancer incidence for current and former smokers compared to the population. The hazard ratios are presented in Table 16, together with yearly mortality data (Eurostat, 2015g) for the target countries.

**Table 16. Yearly cancer-related mortality for the target countries and hazard ratios of current and former smokers for TRCs in the EPIC cohort**

| Cancer type | Mortality in the 9 target countries | Hazard ratio |
|---|---|---|
| Larynx | 7 023 | 16.04 |
| Lung | 191 029 | 13.60 |
| Lip, oral cavity and pharynx | 18 729 | 4.26 |
| Bladder | 28 415 | 3.54 |
| Colorectal | 103 338 | 1.31 |
| Oesophagus | 23 562 | 3.50 |
| Liver | 35 194 | 1.88 |
| Stomach | 38 036 | 1.81 |
| Cervix uteri | 6 056 | 1.79 |
| Pancreas | 56 884 | 1.74 |
| Kidney | 20 991 | 1.39 |

The largest cancer risk increase for smokers was found for lung cancer (13.60) and laryngeal cancer (16.04). In addition, lung cancer has the highest mortality rate of the

[20] Note that a hazard ratio of one means that there is no difference between the two groups. A hazard ratio of greater than one means that cancer risk was higher in one of the groups compared, for example a hazard ratio of 2 means that mortality rate is twice as high.

TRCs and is responsible for over 190,000 deaths per year in the target countries; thus lung cancer stands out as the most important case study. The causal relationship between smoking and cancer means that reduced smoking would result in less cancer and consequently a reduced cost of cancer.

There are several ongoing initiatives that aim to reduce smoking across the globe (UK Department of Health, 2015; European Commission, 2014c; Health Canada, 2007); some even envision a smoke-free society (Motion in the Swedish Riksdag, 2015; New Zealand Ministry of Health, 2015; World Health Organization (WHO), 2015). Examples of interventions to reduce smoking are (US Department of Health and Human Services, 2014):

1. community interventions engaging a diverse set of local organisations
2. counter-marketing and health information campaigns
3. programme policies and regulations
    - taxes (see subsection 3.4.2)
    - restrictions on smoking
    - bans on tobacco advertising
    - access to better cessation treatments
4. surveillance and evaluation of potential issues, such as smuggling.

There are a number of different policy interventions to reduce smoking and this case study focuses on the effects of reduced smoking rather than evaluating a specific policy intervention. This case study evaluates the implications of a hypothetical 25% reduction in smoking prevalence on cancer incidence, mortality and the cost of lung cancer. A 25% reduction was chosen based on historical smoking patterns in a number of European countries and may be seen as a realistic long-term goal (for example, between 2003 and 2011, a 25% reduction was seen in UK men (ONS, 2013)).

### 3.1.2. Method

Smoking results in increased incidence of lung cancer (Agudo et al., 2012), and fewer active smokers is thus expected to result in lower lung cancer incidence and mortality. These health gains are expected to result in less health care consumption, in less informal-care utilisation and in production gains, in terms of both market production and unpaid production.

#### *The model*

A model was constructed using Microsoft Excel® 2013 to compare the current smoking prevalence with a hypothetical scenario where the smoking prevalence is reduced by 25% in the long term. The model calculates and compares the disease burden and the costs of lung cancer in the two scenarios.

**Change in lung cancer incidence and mortality**

The increased risk of lung cancer for smokers of 13.60 was derived from the previously mentioned study (Agudo et al., 2012). The ratio was used across countries, genders and age groups. Smoking prevalence in 2012 was collected from a study that estimated the prevalence of daily smoking in 187 countries (Ng et al., 2014), while lung cancer incidence was collected from EUROCAN (European Cancer Observatory, 2012). The distribution of lung cancer incidence between age groups and genders was derived from the distribution of Eurostat mortality data (Eurostat, 2015g). This information was used

to calculate the effect of reduced smoking prevalence on lung cancer incidence and mortality (Table 17).

**Table 17. Current and hypothetical smoking prevalence, in millions of people, by country**

| | Current | Hypothetical | Difference |
|---|---|---|---|
| Belgium | 2.64 | 1.98 | 0.66 |
| Denmark | 0.87 | 0.65 | 0.22 |
| France | 16.57 | 12.43 | 4.14 |
| Germany | 17.52 | 13.14 | 4.38 |
| Italy | 12.71 | 9.54 | 3.18 |
| Netherlands | 2.98 | 2.23 | 0.74 |
| Poland | 8.90 | 6.67 | 2.22 |
| Sweden | 1.08 | 0.81 | 0.27 |
| UK | 11.40 | 8.55 | 2.85 |

### Resource utilisation associated with lung cancer

Information on the average health care consumption for lung cancer patients in terms of outpatient visits was collected from a cost study of non-small-cell lung cancer (NSCLC) care in the Netherlands (van der Linden et al., 2015).[21] An average lung cancer patient was assumed to have 18.23 inpatient days and 43.87 outpatient visits (van der Linden et al., 2015). Unit prices for inpatient days and outpatient visits were derived from the study of the economic burden of cancer in Europe (Luengo-Fernandez et al., 2013). In addition, costs for radiotherapy, drugs and other health care were as in the Dutch study.

Lung cancer is a severe health condition that results in production loss. The production of a healthy individual was estimated by multiplying the HICP adjusted average wage rates in each country (Luengo-Fernandez et al., 2013; Eurostat, 2015d) by the corresponding employment rates by age and gender (Eurostat, 2015a). As a conservative assumption, no production costs were calculated for individuals aged 80 or older.[22]

Unpaid production, i.e. volunteer work and informal care provided to others by the cancer patient, was calculated by multiplying expected work hours by country-specific minimum wage rates. Expected unpaid work in hours were derived from the Multinational Time Use Study (MTUS) (Centre for Time Use Research at the University of Oxford, 2016) and the cost per hour was assumed to equal country-specific minimum wages. Minimum wages for most countries were collected from Eurostat (Eurostat, 2015g); for Italy it was assumed to equal the minimum wage debated for implementation (The Local, 2015) and for the Scandinavian countries it was set to the agreed minimum wage in collective agreements between employers and large labour unions (The Confederation of Danish Industry, 2014; Kommunal - the Swedish Municipal Workers' Union, 2015). As a conservative assumption, no unpaid work was calculated for individuals aged 80 or older.

The production loss for an average individual diagnosed with lung cancer was assumed to equal one year of market production, and for lung cancer-related mortality the remaining expected lifetime production is lost. As a reduction in smoking also reduces

[21] Note that NSCLC constitutes 85% of all lung cancers type so is an appropriate surrogate for all lung cancer resource utilization.
[22] Note that the employment rate amount people aged 75 years and older was 1.3% (Eurostat, 2015a).

lung cancer morbidity and mortality rates, production gains were estimated accordingly. As with paid production, an average individual diagnosed with lung cancer was assumed to lose an equivalent of one year's worth of unpaid work relative to their age- and gender-matched equivalent.

Consumption of informal care, provided by a family member or friend to a person with lung cancer, was collected from the study of the cost of cancer in Europe (Luengo-Fernandez et al., 2013). The source presented the yearly cost of informal care for a person with lung cancer, and the cost per case was thus derived by dividing the yearly cost by the number of incident lung cancer cases.

**Model inputs and outputs**

Unit costs are presented in Table 18. Details on market production as well as unpaid production are presented in the Appendix (see Table 127 to Table 130).

Costs were adjusted to 2015 price levels using HICP indices for September each year, when needed (Eurostat, 2015d). The average exchange rate for September 2015 from the ECB was used when needed (European Central Bank, 2016). Unit costs collected for one country only were translated into national price levels using purchasing power parity (PPP) indices from Eurostat (Eurostat, 2015k).

**Table 18. Unit costs, 2015 €, by country**

| Country | Inpatient days | Outpatient visits | Radiotherapy[a,b] | Drugs[a,b,c] | Informal care, per year [a] | Other[a,b,d] |
|---|---|---|---|---|---|---|
| Belgium | 59 | 556 | 4,698 | 6,171 | 16,285 | 9,092 |
| Denmark | 88 | 718 | 5,742 | 7,542 | 13,528 | 11,113 |
| France | 135 | 911 | 4,680 | 6,148 | 10,772 | 9,059 |
| Germany | 88 | 592 | 4,438 | 5,829 | 18,822 | 8,588 |
| Italy | 78 | 707 | 4,280 | 5,622 | 29,978 | 8,283 |
| Netherlands | 120 | 585 | 4,655 | 6,115 | 16,760 | 9,009 |
| Poland | 58 | 204 | 2,447 | 3,214 | 4,532 | 4,736 |
| Sweden | 402 | 494 | 5,605 | 7,363 | 13,019 | 10,849 |
| UK | 151 | 593 | 4,962 | 6,518 | 12,072 | 9,603 |

[a] Refers to cost per lung cancer case.
[b] PPP-adjusted using the Eurostat index (Eurostat, 2015k).
[c] Including targeted therapy, chemotherapy and concomitant drugs.
[d] E.g. phone consultation, lab testing, biomarkers, intensive care, ICU days, imaging, pathology.

The model generates both changes in cost and lung cancer-related health effects. The model's cost output is presented as cost savings, while health effects are presented as incidence reduction, mortality reduction and life years gained. The life years gained were calculated based on the avoided deaths in each age group, and quantified using age-dependent remaining life expectancy at the time of the avoided death.

In addition to the main results that assume a 25% reduction in smoking prevalence, the results are evaluated in less detail for reduced smoking prevalence between 0% and 50%.

### 3.1.3. Results

A population tree of the nine target countries, presenting the number of smokers and non-smokers in the current situation as well in the hypothetical scenario is illustrated in

Figure 48. The 25% reduction in smoking prevalence yielded a reduction of smokers from 21% to approximately 16% of the population.

**Figure 48. Population tree of the target countries, divided into smokers and non-smokers in the current situation and the hypothetical scenario**

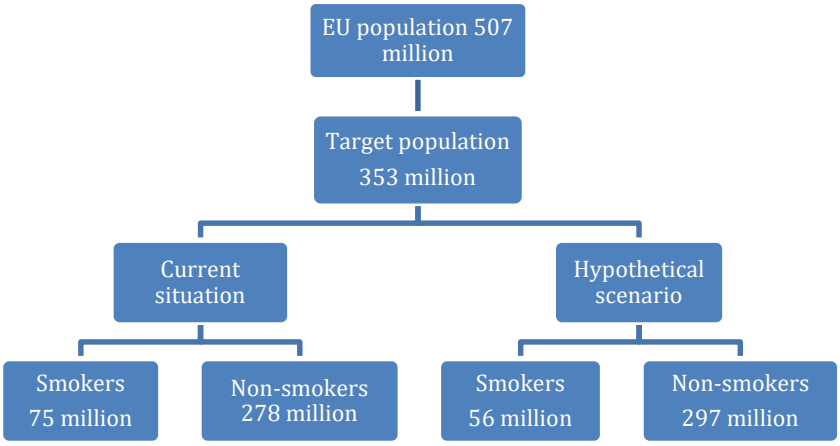
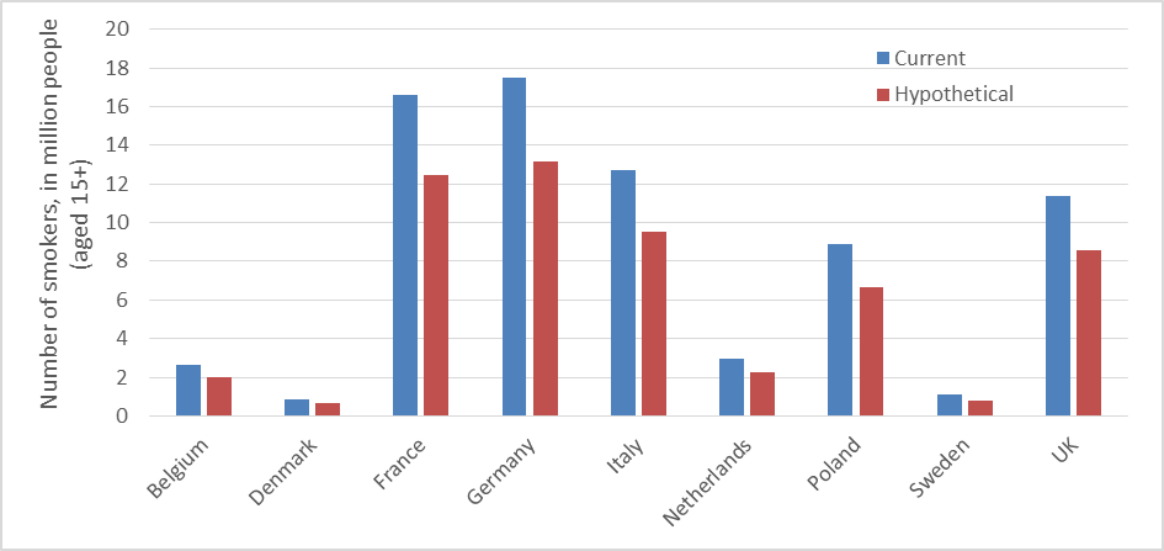


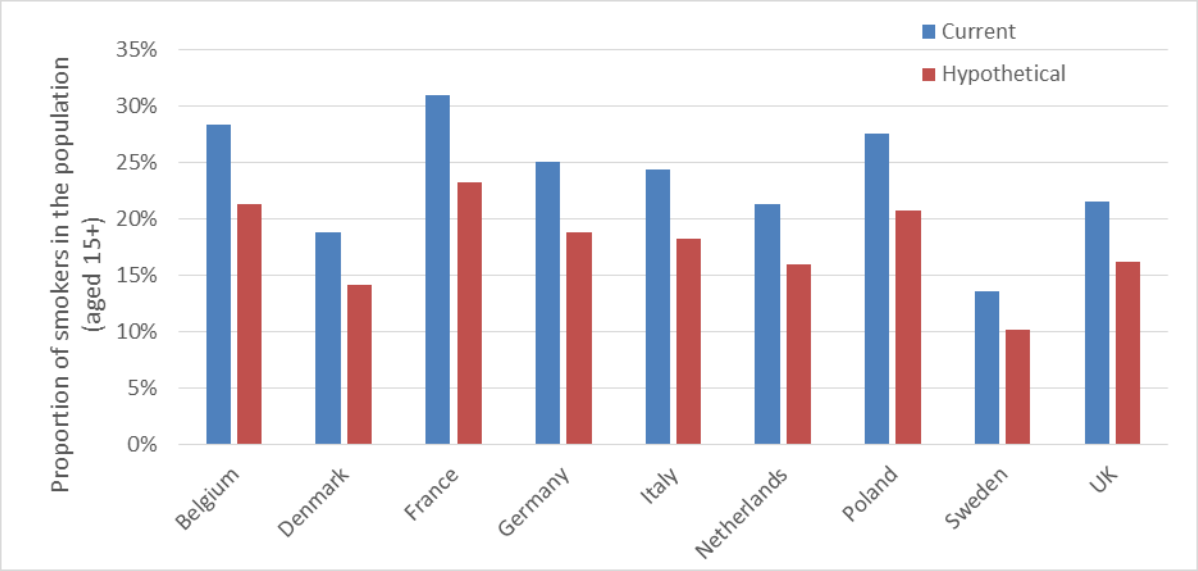

Figure 49 represents the number of smokers, in millions, in each of the target countries both in the current situation and in the hypothetical scenario. As shown, the absolute numbers of smokers vary significantly across countries, but so does population size.

**Figure 49. Numbers of smokers in the current and the hypothetical situations, presented in thousands, by country**




The proportion of smokers in each country is presented in Figure 50. As in absolute numbers, the proportion of smokers varies significantly between countries. For example, the current smoking prevalence is 14% in Sweden and 31% in France. In the hypothetical scenario the corresponding numbers would be 10% and 23%.

**Figure 50. Proportion of smokers in the population, both in the current and in the hypothetical situations, by country**




Lung cancer incidence and mortality for both scenarios are presented in Table 19. Not all lung cancer is related to smoking, and the 25% decrease in smoking prevalence therefore corresponds to a 15–20% decrease in lung cancer incidence and mortality. This means that even at 100% reduction in smoking, i.e. if nobody smoked, it would not eliminate all lung cancer.

**Table 19. Incremental yearly improvements in lung cancer incidence caused by a reduced smoking prevalence by 25%, by country**

| | Current situation | | Hypothetical scenario | |
|---|---|---|---|---|
| Country | Lung cancer incidence | Lung cancer mortality | Lung cancer incidence | Lung cancer mortality |
| Belgium | 7,794 | 6,334 | 6,223 | 5,058 |
| Denmark | 4,566 | 3,780 | 3,787 | 3,135 |
| France | 40,043 | 30,833 | 31,835 | 24,513 |
| Germany | 50,813 | 44,511 | 41,006 | 35,920 |
| Italy | 37,238 | 33,451 | 29,903 | 26,862 |
| Netherlands | 11,968 | 10,350 | 9,781 | 8,459 |
| Poland | 26,230 | 22,667 | 20,985 | 18,135 |
| Sweden | 3,891 | 3,577 | 3,290 | 3,024 |
| UK | 40,382 | 35,510 | 33,167 | 29,166 |

The incremental health gains are summed in Table 20. A 25% reduction in smoking would prevent 43,000 new lung cancer cases and save 36,700 lung cancer deaths per year in the target countries. In addition, Table 20 presents life years gained from a 25% reduction of smoking prevalence, which sum to over 600,000 life years gained each year. The largest impact of reduced smoking is found in Germany, i.e. the largest of the target countries.

**Table 20. Incremental health gains of reducing smoking prevalence by 25%, by country**

| Country | Change in lung cancer incidence | Change in lung cancer mortality | Life years gained |
|---|---|---|---|
| Belgium | – 1,571 | – 1,276 | 21,080 |
| Denmark | – 779 | – 645 | 10,147 |
| France | – 8,208 | – 6,320 | 121,130 |
| Germany | – 9,807 | – 8,591 | 145,887 |
| Italy | – 7,335 | – 6,589 | 104,145 |
| Netherlands | – 2,187 | – 1,891 | 31,994 |
| Poland | – 5,245 | – 4,532 | 75,010 |
| Sweden | – 601 | – 553 | 8,690 |
| UK | – 7,215 | – 6,344 | 98,784 |

Table 21 presents the economic effect of the reduction in lung cancer incidence and mortality. A 25% smoking reduction would result in significant cost decreases in all cost categories – treatment, market production, unpaid work and informal care – in all target countries. The largest economic gains result from reduced treatment costs, and gains in production and the target countries would save approximately €6 billion. Again, the largest effect in absolute terms, i.e. euros saved, is found in Germany.

**Table 21. Cost reduction due to reduced smoking by 25%, by cost category and country, in €millions, in 2015**

| | Treatment | Production | Unpaid work | Informal care | Total |
|---|---|---|---|---|---|
| Belgium | 71 | 90 | 17 | 26 | 204 |
| Denmark | 41 | 75 | 19 | 11 | 145 |
| France | 511 | 491 | 98 | 88 | 1,188 |
| Germany | 465 | 1,026 | 175 | 185 | 1,850 |
| Italy | 383 | 273 | 10 | 220 | 886 |
| Netherlands | 104 | 197 | 51 | 37 | 389 |
| Poland | 156 | 117 | 17 | 24 | 314 |
| Sweden | 29 | 40 | 12 | 8 | 89 |
| UK | 350 | 426 | 77 | 87 | 940 |

These results are highly dependent on the assumption of a 25% reduction in smoking. Therefore analyses for reductions in smoking in the range between 0 and 50% (Figure 51). The across-country differences shrink as the proportion of smokers decrease in all countries.

**Figure 51. Smoking prevalence as a percentage of the population, under 0–50% reduction in smoking prevalence compared with the current situation in each of the nine target countries**

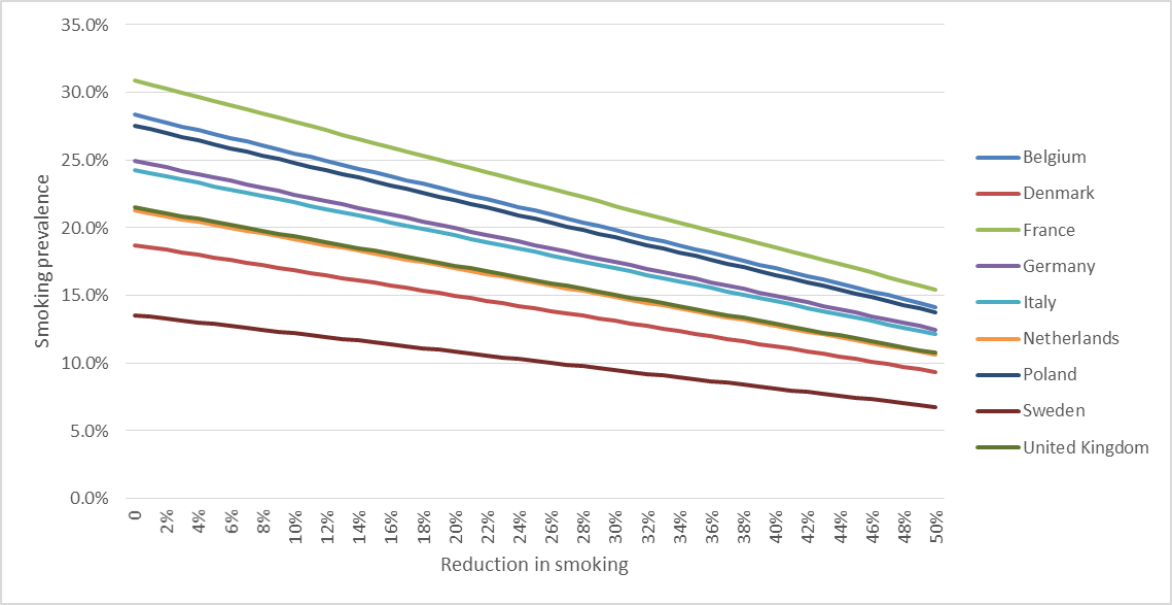



Figure 52 shows the reduction in lung cancer incidence resulting from the different levels of smoking presented in Figure 51. Again, interventions to prevent smoking have the largest absolute effect in countries with high initial levels of lung cancer incidence and/or large populations.

**Figure 52. Lung cancer incidence in absolute numbers, for each of the nine target countries, under 0–50% reduction in smoking prevalence**

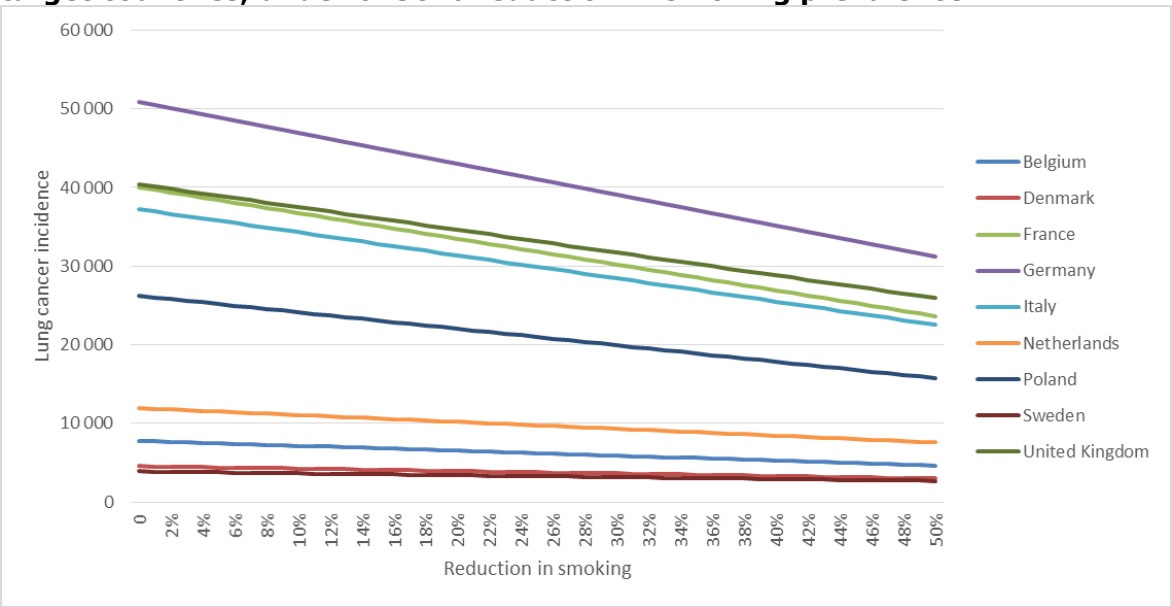



Figure 53 presents the relationship between smoking reduction and lung cancer-related mortality in the target countries. As in the case of lung cancer incidence, reducing smoking has the largest impact in countries with high initial lung cancer-related mortality. The large discrepancies between countries in the current situation would even out, but not disappear, with decreasing smoking prevalence.

**Figure 53. Lung cancer-related mortality, in absolute numbers, for each of the nine target countries, under 0—50% reduction in smoking prevalence**

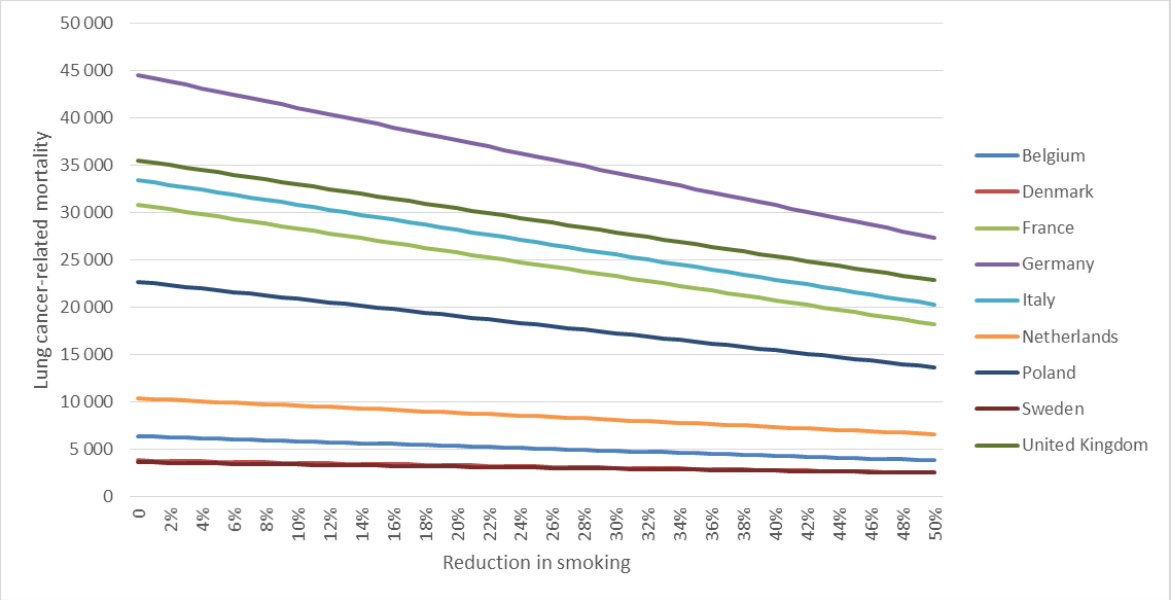
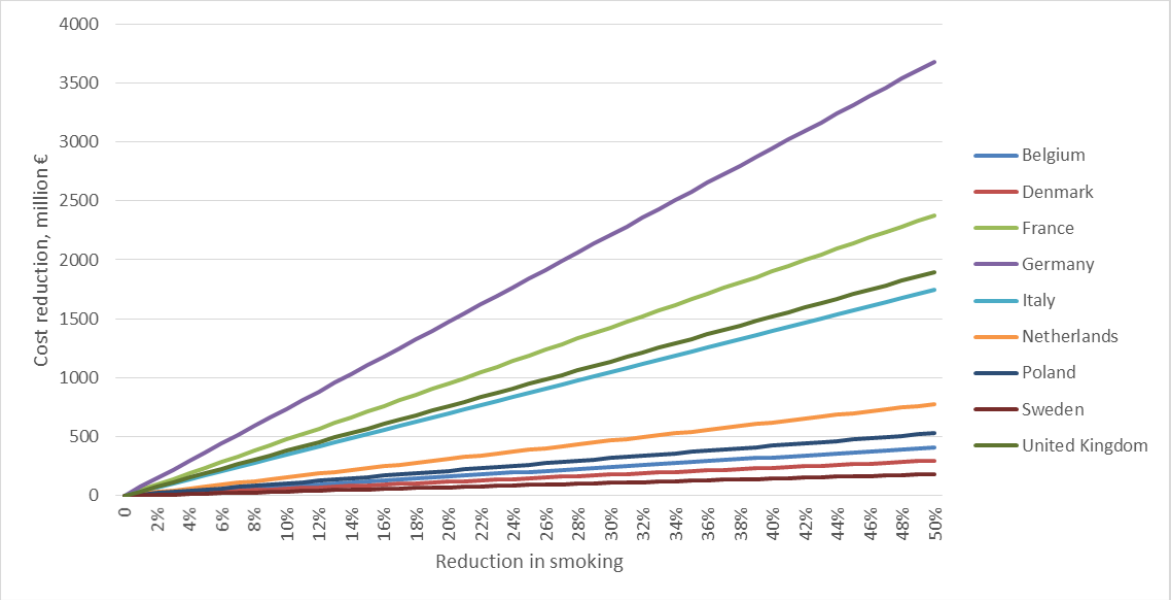



Figure 54 presents the reduction in lung cancer costs resulting from reduced smoking. The reduced costs, i.e. savings, increase with falling smoking prevalence. In absolute terms, Germany has the most to gain from interventions to lower smoking prevalence, while the absolute economic gains are smaller in the Scandinavian countries.

**Figure 54. Cost reduction corresponding to a reduced smoking prevalence of 0–50%, in each target country**




### 3.1.4. Concluding remarks

In terms of efficiencies, reduced smoking frees up resources for alternative use; for example:

1. A part of the cost reduction could be used to finance the policy interventions to promote smoking reductions, i.e. a way to self-finance such interventions.
2. The reduction in treatment costs may fund other health care, specifically in lung cancer but also in other sectors of the health care system.

3. Better health generates production gains and increases unpaid work, which leads to economic benefits both at societal and personal levels.
4. The reduced need for informal care also results in alternative utilisation of resources.

Note that this case study only included cost reductions resulting from a reduction in lung cancer. In addition to cost reductions from reductions in other tobacco-related cancers, a smoking reduction would also lead to significant cost reductions from reduction in other smoking-related diseases, e.g. other diseases, cardiovascular and metabolic diseases (US Department of Health and Human Services, 2014).

If the policy intervention to promote reduced smoking were financed by the introducing additional tobacco taxes, the additional tax revenue could be earmarked and directed towards the funding of treatment for lung cancer and other smoking-related diseases (see subsection 3.4.4).

## 3.2. *Improving screening: colorectal screening*

### 3.2.1. Background

Colorectal cancer (CRC) ranks as the third-most-common cancer worldwide (Schreuders et al., 2015) and is the second-largest cause of cancer deaths (Kanavos and Schurer, 2010). Screening of colorectal cancer has documented effects on both incidence and mortality, yet it is only offered to a small portion of the target population (Schreuders et al., 2015).

The European Guidelines for Quality Assurance in Colorectal Cancer Screening and Diagnosis (von Karsa, Patnick and Segnan, 2012) recommend colorectal cancer screening, but have left the exact details of the screening programme to the member states (Moss et al., 2012).

The guidelines outline targets for key performance indicators, such as invitation and participation rates, where a sufficient invitation rate was defined as 95% and an adequate participation rate as 65% or more (Moss et al., 2012). Nevertheless, there are widespread variations in the status and strategy of screening programmes across Europe. Differences can be attributed to geographical variation in CRC incidence, resource availability, and health care system structure, as well as infrastructure to support screening such as the ability to identify the target population at risk and information management via cancer registries (Schreuders et al., 2015).

This case study aims to map out inefficiencies in the current colorectal cancer screening programmes in the target countries and to explore potential improvements. The effects of said improvements will then be evaluated not only in terms of costs but also in terms of health outcomes, such as reduction in new colorectal cancer cases and resulting deaths.

### 3.2.2. Method

#### *Screening methods*

The purpose of screening programmes is to identify and remove cancer precursors and thereby reduce colorectal cancer incidence and mortality. Early detection enables preventive actions that have potential to lower disease morbidity and mortality (Schreuders et al., 2015).

Screening for colorectal cancer can be performed through a non-invasive or an invasive test. The non-invasive stool tests include tests that detect microscopic amounts of blood, i.e. the guaiac faecal occult blood test (gFOBT) and the fecal immunochemical test (FIT). The invasive tests consist of imaging techniques and include flexible sigmoidoscopy (FS) and colonoscopy. Colonoscopy is generally considered the gold standard for the detection of colorectal neoplasia, but it is also the most invasive and most costly screening method (Schreuders et al., 2015).

Effectiveness data for the different screening methods were collected from a recent study that surveyed existing colorectal cancer screening programmes (Schreuders et al., 2015). Effectiveness of screening programmes can be expressed as prevented cancer cases and prevented cancer deaths. The resulting risk reductions for both incidence and mortality for each type of screening programme, compared with no screening, are presented in Table 22.

**Table 22. Risk reduction for incidence of colorectal cancer and mortality caused by colorectal cancer of screening compared with no screening, for each screening method**

| | gFOBT | FIT | FS | Colonoscopy |
|---|---|---|---|---|
| **Incidence reduction** | – | – | 18% | 69% |
| **Mortality reduction** | 15% | 22% | 28% | 68% |

In terms of what age range should be covered by the screening programme, there are no fixed target groups. The European guidelines mention a minimum range of between 60 and 64 for gFOBT and FIT but invite screening for both older and younger individuals. It is said that colonoscopy should not be performed on individuals younger than 50 or older than 74, and the same discontinuation age is recommended for FS (Lansdorp-Vogelaar, von Karsa and International Agency for Research on, 2012).

### *Current and potential screening status*

This case study considers the current screening programme of colorectal cancer in each of the nine countries, including its current coverage and participation rate, and analyses the effects of implementing or extending the current programme to a formal (i.e. where invitations are sent out) population-based screening programme with full coverage (100%) and target participation rate – set to 65% of the covered individuals, according to the European guidelines (Lansdorp-Vogelaar et al., 2012). The extended programme entails different changes in each target country; i.e. for some countries this implies implementing a nationwide screening programme, while it only requires improved participation in others.

When assessing what screening programme is currently in place in the nine countries, only established programmes are considered if nothing else is mentioned. This discrimination of screening programmes under introduction is motivated by screening programmes primarily having long-term effects, and the effects of programmes in the implementation phase thus being invisible in the data. If there were any ongoing roll-outs, the current coverage of the roll-out was set to zero while a full coverage was assumed to be the future goal. This includes changes in the type of screening used.

Below follows a description of the current colorectal cancer screening programme along with the assumptions for a baseline screening programme and a tailored extended scenario for each of the target countries.

### Belgium

Belgium can be divided into two regions when it comes to colorectal screening: Wallonia and Brussels on the one hand and Flanders on the other. Forty-three percent of the population lives in Wallonia and Brussels, while the remaining 57% lives in Flanders (Eurostat, 2015h). Wallonia and Brussels screen using gFOBT and the programme has full coverage, but reports a participation rate of only 7% in an evaluation of the cancer plan (Krankercentrum - Centre du cancer, 2012). The age-range screened is 50–74 in Wallonia and Brussels. Flanders, on the other hand, does not have gFOBT screening but started a roll-out of FIT for individuals aged between 56 and 74 in 2013 (Schreuders et al., 2015). The modelled screening conditions for Belgium are presented in Table 23.

**Table 23. Baseline and potential screening programme in Belgium**

| Screening programme | Baseline programme | Extended programme |
|---|---|---|
| **Method** | gFOBT | FIT |
| **Formal or opportunistic** | Formal | Formal |
| **Interval** | 24 months | 24 months |
| **Age group** | 50–74 | 50–74 |
| **Coverage** | 43% | 100% |
| **Participation rate** | 7% | 65% |

### Denmark

Denmark started an introduction of FIT in 2014 for the population aged between 50 and 74, with a screening interval of 24 months (Schreuders et al., 2015). As the programme is not yet fully implemented, it is set to zero at baseline. The modelled screening conditions for Denmark are presented in Table 24.

**Table 24. Baseline and potential screening programme in Denmark**

| Screening programme | Baseline programme | Extended programme |
|---|---|---|
| **Method** | – | FIT |
| **Formal or opportunistic** | – | Formal |
| **Interval** | – | 24 months |
| **Age group** | – | 50–74 |
| **Coverage** | – | 100% |
| **Participation rate** | – | 65% |

### France

France has FIT for 100% of the population every two years in the 50–74 age group. France thus seems to have complete coverage and no suggested changes of the screening programme are made (Schreuders et al., 2015). However, the current participation rate is as low as 34.3%, which leaves room for improvement (Leuraud et al., 2013). The modelled screening conditions for France are presented in Table 25.

**Table 25. Baseline and potential screening programme in France**

| Screening programme | Baseline programme | Extended programme |
|---|---|---|
| **Method** | FIT | FIT |
| **Formal or opportunistic** | Formal | Formal |
| **Interval** | 24 months | 24 months |
| **Age group** | 50–74 | 50–74 |
| **Coverage** | 100% | 100% |
| **Participation rate** | 34.3% | 65% |

### Germany

Germany offers opportunistic screening in several steps. It starts at the low age of 50, where individuals aged between 50 and 54 are being offered a yearly gFOBT test (Schreuders et al., 2015) with a participation rate of 18% (Stock et al., 2011). Since 2002, this has been followed by offering individuals aged 55 and older colonoscopy screening every 10 years. The opportunistic programme covers 100% of population (Pox et al., 2012) and has a participation rate of about 25% (Brenner et al., 2015). For patients not willing to undergo colonoscopy, an alternative with gFOBT screening every other year is suggested (Pox et al., 2012), which 22% undergo (Stock et al., 2011; Schreuders et al., 2015).

In the extended programme for Germany, the target participation rate of 65% was assumed to be reached with the preferred screening method of colonoscopy. Therefore no additional screenings with the gFOBT method were assumed. As no upper age limit for screening was found in Germany, three colonoscopies were used (at age 55, 65 and 75). The modelled screening conditions for Germany are presented in Table 26.

**Table 26. Baseline and potential screening programme in Germany**

| Screening programme | Baseline programme | Extended programme |
|---|---|---|
| **Method** | gFOBT/colonoscopy or gFOBT | gFOBT/colonoscopy |
| **Formal or opportunistic** | Opportunistic | Formal |
| **Interval** | 12 months/120 months or 24 months | 12 months/120 months |
| **Age group** | 50–54/55–75 | 50–54/55–75 |
| **Coverage** | 100%/100% | 100%/100% |
| **Participation rate** | 18%/25% and 22% | 65%/65% |

### Italy

Italy applies the FIT method in screening programmes for ages 44–75 and the test is offered every other year (Schreuders et al., 2015). According to a country expert, the coverage is 53%, but differs vastly across the country. The coverage is higher in northern Italy (82%) compared with central (59%) and southern Italy (12%). The participation rate is 48% (Zorzi et al., 2012). The modelled screening conditions for Italy are presented in Table 27. Note that we assume the age group in the extended programme as per the current programme.

**Table 27. Baseline and potential screening programme in Italy**

| Screening programme | Baseline programme | Extended programme |
|---|---|---|
| **Method** | FIT | FIT |
| **Formal or opportunistic** | Formal | Formal |
| **Interval** | 24 months | 24 months |
| **Age group** | 45–74 | 45–74 |
| **Coverage** | 53% | 100% |
| **Participation rate** | 48% | 65% |

### Netherlands

In 2014, the Netherlands started introduction of a FIT screening programme where the test is offered every other year in the 55–75 age group (Schreuders et al., 2015). As the programme is not yet fully implemented, it is set to zero at baseline. The modelled screening conditions for the Netherlands are presented in Table 28.

**Table 28. Baseline and potential screening programme in the Netherlands**

| Screening programme | Baseline programme | Extended programme |
|---|---|---|
| **Method** | – | FIT |
| **Formal or opportunistic** | – | Formal |
| **Interval** | – | 24 months |
| **Age group** | – | 55–74 |
| **Coverage** | – | 100% |
| **Participation rate** | – | 65% |

### Poland

Poland currently offers nationwide opportunistic screening via colonoscopy every ten years between ages 55 and 66 (Schreuders et al., 2015). The Polish screening programme currently has a low participation rate of 18% (Polish Oncological Society, 2014). It is plausible to improve participation through an invitation to participate in a population-based screening programme. For Poland, two colonoscopies were used in the analysis (at age 55 and 65). The modelled screening conditions for Poland are presented in Table 29.

**Table 29. Baseline and potential screening programme in Poland**

| Screening programme | Baseline programme | Extended programme |
|---|---|---|
| **Method** | Colonoscopy | Colonoscopy |
| **Formal or opportunistic** | Opportunistic | Formal |
| **Interval** | 120 months | 120 months |
| **Age group** | 55 and 65 | 55 and 65 |
| **Coverage** | 100% | 100% |
| **Participation rate** | 18% | 65% |

### Sweden

There are currently no nationwide screening programmes in Sweden (Schreuders et al., 2015). One region, covering about 25% of the population, screens through FIT every other year in the 60–69 age group (Törnberg et al., 2010). The participation rate in the regional screening programme is 64% (Törnberg et al., 2010). However, there are recommendations from the National Board of Health and Welfare to screen individuals using FIT aged between 60 and 74 every other year (National Board of Health and Welfare (Socialstyrelsen), 2014). The modelled screening conditions for Sweden are presented in Table 30.

**Table 30. Baseline and potential screening programme in Sweden**

| Screening programme | Baseline programme | Extended programme |
|---|---|---|
| **Method** | FIT | FIT |
| **Formal or opportunistic** | Formal | Formal |
| **Interval** | 24 months | 24 months |
| **Age group** | 60–69 | 60–74 |
| **Coverage** | 25% | 100% |
| **Participation rate** | 64% | 65% |

### UK

The UK currently has a nationwide screening programme using gFOBT for individuals aged between 60 and 74 (Schreuders et al., 2015). The screening is repeated every other year with a participation rate of 58%, according to a national expert. Scotland screens ages 50–74 (Schreuders et al., 2015), but as it is a relatively small part of the UK, the age interval in England, Wales and Northern Ireland is applied in the analysis.

In 2013, England started to add one FS test to the gFOBT screening. The test is performed for individuals at the age of 55 (Schreuders et al., 2015) and is included in the extended programme of this analysis. The modelled screening conditions for the UK are presented in Table 31.

**Table 31. Baseline and potential screening programme in the UK**

| Screening programme | Baseline programme | Extended programme |
|---|---|---|
| **Method** | gFOBT | gFOBT/FS |
| **Formal or opportunistic** | Formal | Formal |
| **Interval** | 24 months | 24 months/once |
| **Age group** | 60–74 | 60–74/55 |
| **Coverage** | 100% | 100%/100% |
| **Participation rate** | 58% | 65%/65% |

## *Modelling*

A model was constructed using Microsoft Excel® 2013. The model considered baseline and extended screening programmes in the target countries. The calculations for the extended programme are set to a state where the programme has reached its full potential (100% coverage, 65% participation, etc). The model calculates the incremental effect, i.e. differences in costs and health outcomes between the baseline and the

extended-programme scenario, in a cross-sectional analysis, i.e. resulting from one year of screening.

Population size per five-year age groups from 2014 were collected (Eurostat, 2015i) to calculate the number of individuals invited to screening and the number of screened individuals, and to quantify the resulting health benefits. The effects of the screening programmes were based on absolute colorectal cancer mortality and incidence in each country, multiplied by relative change in mortality and incidence (Schreuders et al., 2015). The incidence data (European Cancer Observatory, 2012) were divided by age and sex. Mortality data (Eurostat, 2015g) were distributed by the age and sex allocation in the incidence data. The effectiveness of each screening modality (Table 22) was used in the model. While the mortality reductions from gFOBT and FIT were applied instantaneously in the model, the incidence and mortality reductions following FS and colonoscopy were modelled during a 10-year period. The latter was based on the screening interval for colonoscopy being ten years and that these modalities remove pre-cancerous polyps.

The colorectal cancer screening process is initiated by inviting individuals to screening through sending out invitations. Those who wish to be screened turn up for the appointment and the county's selected screening test is performed. If the test is positive, the patient is invited to a follow-up diagnostic colonoscopy (unless the initial test was a colonoscopy). It was assumed that 2.6% (62/2,351) screened with gFOBT, 4.6% (137/2,975) screened using FIT and 10.2% (141/1,386) screened with FS were given follow-up colonoscopies (Hol et al., 2010). All screening modalities were assumed to reduce colorectal cancer deaths, while colonoscopy and FS also reduced colorectal cancer incidence.[23]

Several costs can be identified through the screening process for colorectal cancer, such as the cost of invitation, performing the test and diagnostic colonoscopy. Screening costs were derived from an Irish cost-effectiveness study of different types of screening for colorectal cancer (Sharp et al., 2012). Information on treatment costs for colorectal cancer were derived from a French study from 2008 (Clerc et al., 2008). The study estimates the overall health care costs of different stages of cancer (stage I-IV). This case study applies the overall health care cost of stage I colorectal cancer as a proxy for the health care cost of incidence, and the difference between overall health care costs of stage IV and stage I is used as a proxy for mortality. The assumption that the cost of mortality is similar to the cost difference between stage I and stage IV is based on the notion that the mortality reduction mainly is an effect of stage shifting.

The unit costs used in the model are presented in Table 32. Costs were adjusted to 2015 price levels using HICP indices for September each year, when needed (Eurostat, 2015d). The average exchange rate for September 2015 from ECB was used when needed (European Central Bank, 2016).

[23] Note that colonscopy removes mainly adenomas – which can progress – thereby reduces the incidence of cancer (by reducing the risk) as well as reducing mortality by finding cancers earlier.

**Table 32. Unit costs, 2015 €**

| Intervention | | Invitation | Test | Total |
|---|---|---|---|---|
| **gFOBT** | | 1.7 | 8.0 | 9.8 |
| **FIT** | | 3.9 | 11.9 | 15.8 |
| **FS** | | 1 | 154 | 155 |
| **Colonoscopy, screening** | | 1 | 699 | 670 |
| **Colonoscopy, diagnostic** | | – | – | 669 |
| **Health care costs** | Incidence | – | – | 20,676 |
| | Mortality | – | – | 20,520 |

Colorectal cancer is a severe health condition that will result in production loss and loss of unpaid work. The expected production and unpaid work of a healthy individual was calculated as in subsection 3.1.2.

Both colorectal cancer incidence and mortality were assumed to cause production losses and loss of unpaid work. Therefore the screening programmes result in production gains and gains of unpaid work. For prevented colorectal cancer deaths the gain refers to the expected production and unpaid work during the expected remaining lifetime. For prevented colorectal cancer cases, one year's worth of production gain and unpaid work was used as a conservative assumption.

### 3.2.3. Results

The resulting costs of implementing the extended screening programme in the target countries are presented in Table 33. The cost changes are presented separately for screening costs, treatment costs (related to mortality and incidence), production losses and loss of unpaid work.

Implementing the extended screening programme increases the screening costs in all countries, which is according to expectation. However, all other costs decrease, including treatment costs, production loss and loss of unpaid work. As the additional cost of screening exceeds the aggregated cost decrease of the other cost categories, the cost of screening is not fully self-financed, however this overlooks the productivity gains that could be realised with a screening programme (see below). The total cost increase varies substantially between the target countries. Possible explanations include variations in screening modality, current coverage and participation rate, as well as differences in colorectal cancer incidence and mortality between the countries.

**Table 33. Cost changes of the extended screening programmes compared to the baseline screening programmes, per cost category (€millions)**

| | Health care costs | | | Production loss | Loss of unpaid work | Total |
|---|---|---|---|---|---|---|
| | Screening | Mortality | Incidence | | | |
| **Belgium** | 44.9 | –3.2 | 0.0 | –9.7 | –2.7 | 29.2 |
| **Denmark** | 26.7 | –2.5 | 0.0 | –15.5 | –4.8 | 3.9 |
| **France** | 121.8 | –8.4 | 0.0 | –20.9 | –7.2 | 85.3 |
| **Germany** | 763.1 | –98.1 | –130.1 | –310.6 | –70.3 | 153.9 |
| **Italy** | 220.4 | –13.2 | 0.0 | –38.9 | –1.5 | 166.9 |
| **Netherlands** | 60.9 | –6.6 | 0.0 | –27.0 | –10.5 | 16.8 |
| **Poland** | 295.4 | –34.2 | –108.7 | –39.7 | –7.9 | 105.0 |
| **Sweden** | 14.0 | –2.1 | 0.0 | –5.3 | –2.6 | 3.9 |
| **UK** | 136.6 | –6.5 | –20.1 | –73.1 | –9.8 | 27.1 |

However, the reduction in colorectal cancer incidence and mortality have values beyond reduced treatment costs and productivity gains. The relationship between mortality reduction and screening coverage is plotted in Figure 55, where the baseline screening programme is represented by the leftmost indicator and the extended programme by the rightmost indicator. More effective screening programmes result in steeper slopes, for example in Germany and Poland.

**Figure 55. Mortality reduction versus coverage from base case to extended screening for each country**

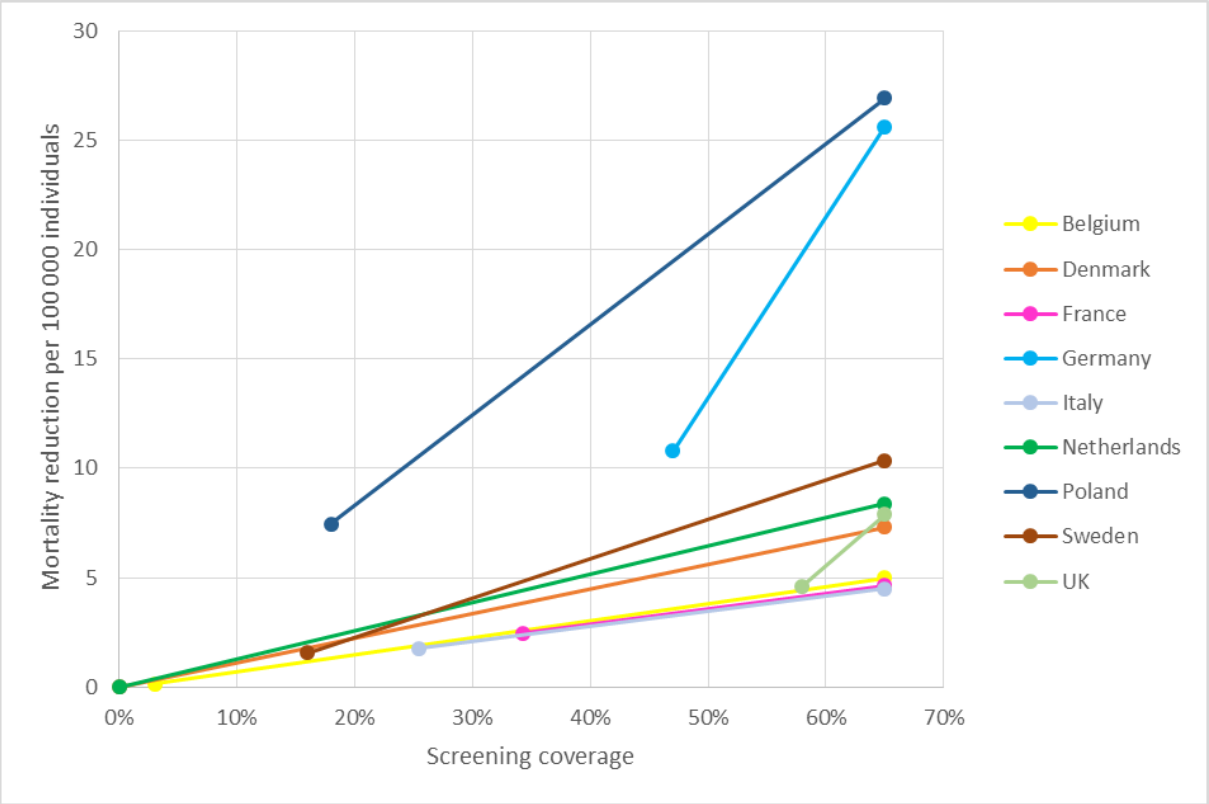



Table 34 quantifies the absolute changes in colorectal cancer incidence and mortality as well as the resulting life years gained from implementing the extended screening programme. Note, however, that the estimate of life years gained does not take reduction in incidence into account as it is calculated from mortality.

Implementation of the extended screening programme results in substantial health gains in all countries, primarily in Germany. There may be several reasons why the health gains in Germany stand out; in addition to its being the largest target country it also has the most ambitious screening programme in the model, which includes colonoscopy at ages 55, 65 and 75.

**Table 34. Aggregated health gains of the extended screening programmes compared to the baseline screening programmes, in terms of mortality, incidence and life years**

| | Mortality reduction | Incidence reduction | Life years gained |
|---|---|---|---|
| **Belgium** | 155 | (no change) | 3,241 |
| **Denmark** | 123 | (no change) | 2,415 |
| **France** | 407 | (no change) | 9,178 |
| **Germany** | 4,779 | 6,294 | 70,954 |
| **Italy** | 646 | (no change) | 14,516 |
| **Netherlands** | 322 | (no change) | 6,512 |
| **Poland** | 1,664 | 5,259 | 30,313 |
| **Sweden** | 103 | (no change) | 1,937 |
| **UK** | 317 | 973 | 7,893 |

Total cost increase is presented alongside life years gained in Table 35. The relationship between costs and health outcomes indicate efficiency in all countries. However, Italy, Belgium and France have a slightly higher cost compared to gained life years than the other countries. These differences may be caused by differences in screening modalities, intervals and the age groups screened. In addition, low initial mortality associated with colorectal cancer may be of importance, especially in low age groups where screening may be less effective, i.e. more costly per life year gained.

**Table 35. Cost–consequence analysis of the extended screening programmes compared with the baseline screening programmes**

| | Cost (€million) | Life years gained |
|---|---|---|
| **Belgium** | 29 | 3,241 |
| **Denmark** | 4 | 2,415 |
| **France** | 85 | 9,178 |
| **Germany** | 154 | 70,954 |
| **Italy** | 167 | 14,516 |
| **Netherlands** | 17 | 6,512 |
| **Poland** | 105 | 30,313 |
| **Sweden** | 4 | 1,937 |
| **UK** | 27 | 7,893 |

### 3.2.4. Concluding remarks

Implementing the extended screening programme entails increased screening costs in all countries. However, the increased screening cost is partly financed by reductions in treatment costs, productivity gains and gains in unpaid work. This degree of self-financing varies between countries.

Naturally, the reductions in colorectal cancer incidence and mortality have values beyond reduced treatment costs and productivity gains. The resulting relationship between costs and life years gained indicated that implementation of extended colorectal screening is an efficient practice.

## 3.3. *Potential economic gains of biosimilars and small-molecule generic entry*

### 3.3.1. Background

Generics market entry is permitted after the expiry date of the patent of the original branded drug. A generic drug is intended to be interchangeable with a branded drug, and has the same characteristics, such as molecular structure, form, dosage, route of administration, safety and intended use. Although a generic drug is equivalent to its branded counterpart it is generally sold at a substantial discount from the branded price. Following generic entry, prices have been shown to fall by 70–80% (IMS Health, 2011). The economic gains from generic entry can be used to finance new cost-effective technologies or cover other unmet needs.

There are a number of important cancer medicines currently facing patent expiry and resulting competition. A specific feature of the market for cancer medicines over the next five years is the number of biologicals moving off-patent. This is a novel development and there is uncertainty around how competition will develop and how health care systems will respond.

Biologic medicines represent an increasing part of the pharmaceutical marketplace. In 2009, the sales of biologics accounted for 17% of global pharmaceutical sales. In 2007 in Europe, the market share of oncology biologics was found to be larger than that of branded small-molecule oncology pharmaceuticals. Innovator or 'originator' Innovator biological medicinal products are pharmaceuticals made by, or derived from, a biological source such as a bacterium, or yeast or mammalian cells using recombinant DNA technology but are however much larger and more complex structurally than simple chemical drugs. By using the same manufacturing processes, there. There are biological medicinal products similar in terms of quality, safety and efficacy to originator biological medicines already authorised for use – these are called biosimilars (European Medicines Agency (EMA), 2013). In other words, biosimilars can be thought of as akin to the generic product of an innovative biological medicinal product, except that they are similar with equivalent biologic efficacy to the innovator product rather than exactly the same.

Because biosimilars are derived from a biological synthesis, even a small deviation from manufacturing processes may alter them and cause potential adverse events in patients. Also, biosimilars need official approval before entering the market, which can first be sought when the original product's patent expires (European Medicines Agency (EMA), 2013). Since 2005, the EMA has provided a pathway for assessing biosimilars (Grabowski et al., 2014). An extensive comparability exercise, including clinical research, is required to demonstrate quality, safety and efficacy similar to those of the reference product (Mestre-Ferrandiz, Towse and Berdud, 2016). The process is different from, and more complex than, that of generics, but less extensive than the one for new biologics or chemical products (Niederwieser and Schmitz, 2010).

Biosimilars and generics can, upon patent expiry, free up health care resources to fund future innovations in areas of unmet need. There are strong incentives for governments to encourage market efficiency and competition in the off-patent sector to ensure resources are released to provide patients with greater access to treatments providing the greatest value to patients. These freed-up resources can be used to fund future innovations in areas of unmet need.

Relative to small-molecule pharmaceuticals, biological medicinal products have larger and more complex active ingredients which are harder to manufacture and harder to copy in a laboratory setting. This results in biosimilars having more costly development processes than generics, and requiring additional evidence on clinical safety and efficacy to demonstrate similar outcomes. These particularities characterising the development, approval and manufacturing of biosimilar medicines entail several entry barriers to the biosimilars market (Blackstone and Joseph, 2013).

As a result, lower and more variable market shares have been reached by biosimilars compared to generics, additionally lower price reductions have been observed following market entry. The introduction of generics has been shown to cause prices to fall by 70–80% (IMS Health, 2011) with gained market shares of 30% after one year, and 45% after two years in an European setting (Albrecht, 2015). Correspondingly, the price effect of the introduction of biosimilars typically implies a decrease of 25–30% relative to approved reference-brand prices, absent rebates (IMS Health, 2011; Grabowski et al., 2014). However, biosimilars are still relatively rare and only available for a limited set of biological pharmaceuticals. Given the lack of competition for biosimilars, and that the main effect on sale prices seems to occur when more than one competing product has entered the market (Albrecht, 2015), the price fall of biosimilars may not yet have reached its full potential.

Biologic medicines represent an increasing part of the pharmaceutical marketplace. In 2009, the sales of biologics accounted for 17% of global pharmaceutical sales. In 2007 Europe, the market share of biological oncology biologics were found to be larger than that of branded small molecule oncology pharmaceuticals. In particular, two oncology biologics stood out as market leaders (Courage and Parsons, 2011).

Some 22 biosimilars have been approved by the EMA in three classes: erythropoietins (EPOs), granulocyte colony-stimulating actors (GCSFs) and human growth hormone. Competitive performance of biosimilars has been shown to vary both between countries and between products within countries. For example, market penetration of biosimilars tends to be higher in Germany and Sweden compared with France and Italy (Grabowski et al., 2014). The reason for the between-country variation is related to varying structures for implementation of biosimilars, in terms of reimbursement, incentives and medical practice. Germany, with strong incentives to encourage biosimilar uptake, had penetration rates for EPO and GCSF markets of 60% and 50% respectively in volume terms by the end of 2011, but only around 30% for growth hormone, where physicians had expressed concerns about efficacy and safety in pediatric populations; this may have acted as a barrier to entry. Penetration rates for biosimilars of EPO and GCSF in Sweden have exceeded 60%. In the UK, biosimilars have reached 80% entry in the GCSF market but only 10% in the EPO market; this is a result of discounting by competing brands prior to biosimilar entry (Mestre-Ferrandiz et al., 2016). Biosimilar EPO uptake is around 15% in France and Italy, while GCSFs have approached 60% and 45% respectively, where medical considerations and reimbursement policies would have favoured the entry of GCSFs (Mestre-Ferrandiz et al., 2016).

Incentives and regulations encouraging biosimilar competition vary across European countries. This is a key driver of the differences in biosimilar entry between markets and therapeutic areas. For example, there are targets or quotas for prescribing biosimilars in Germany and Italy but not in the other countries (Grabowski et al., 2014). Table 36 compares incentives for biosimilars in five European countries.

**Table 36. Incentives for biosimilars in different European countries**

| | Germany | France | Italy | UK | Sweden |
|---|---|---|---|---|---|
| **High generic usage** | Yes | No | No | Yes | Yes |
| **Quotas** | Yes | No | Yes | No | No |
| **Reference price system for biosimilars** | Yes | No | No | No | No |
| **Price relative to reference brand** | Variable | Fixed | Fixed | Variable | Variable |
| **Patient co-payments** | Capped | Mixed | Mixed | No | Capped |

Source: Grabowski et al. (2014).

Additionally, Italy, Spain and Norway are using tenders to facilitate biosimilar entry and price competition. Norway is a case particularly worthy of mention as outcome studies exploring the impact of switching to biosimilars are being promoted, aimed at encouraging a substitution culture. This innovative approach to incentivising biosimilar entry clashes with the policy adopted by Austria, where the same "price-relative-to-brand-medicine" generics pricing policy has been applied to biosimilars, discouraging biosimilar entry and competition (Mestre-Ferrandiz et al., 2016).

The within-country variation between products can be explained by the introduction of second-generation biological medicines before biosimilar entry. Second-generation improvements on "reference products" have cannibalised sales of the first-generation products across EU countries (Mestre-Ferrandiz et al., 2016). These second-generation products require substantially fewer infusions over a course of treatment, with potential benefits to patients and lower administration costs (Grabowski et al., 2014). They have gained significant market shares in some diagnostic fields, reducing the potential of biosimilars to generate savings as they exclusively compete with first-generation products whose market share has narrowed.

While biologics and biosimilars are not truly interchangeable like generics, there is still potential for the biosimilar market to generate potential gains. This is evidenced by the high penetration shares that some biosimilars across different therapeutic areas have reached in a number of European countries. Although the current price drop of 25% is smaller than that of generics, it still generates economic gains such that appropriate incentives and policies should be implemented by countries in the near future. Given additional market approval for biosimilar products, and competitors of existing biosimilars and of biosimilars within additional diagnostic fields, the biosimilar market is likely to expand. Increased competition is often followed by reduced prices and the future biosimilar market may yield additional economic benefits as clinicians gain confidence that biosimilar products in a particular therapy area offer the same benefits as the innovator product. Of the various interventions that governments may use in biosimilar markets, incentives to budget holders to use lower-cost products, and supporting the generation and use of high-quality outcomes data on the effectiveness and safety of biosimilars and originator products, appear to be most appropriate in order for governments and payers to maximise long-term savings from biosimilars (Mestre-Ferrandiz et al., 2016).

In addition, there are a number of branded small-molecule cancer medicines with significant sales moving off-patent between 2016 and 2020. This subsection aims to evaluate and discuss the potential benefits of biosimilars and generics entry particularly

within oncology. Key for both analyses are two variables to measure competition by new entrants: prices for the new entrant and market share achieved. The first analysis compares two different hypothetical scenarios characterised by different market shares and price reductions used to evaluate potential gains, for two important cancer medicines. The second analysis complements and extends the first, modelling the expected actual impact of biosimilar and generic competition through to 2020.

### 3.3.2. Potential savings from two medicines facing biosimilar and generics competition

#### *Method*

To assess the potential economic impact of market competition, two market-leading oncology drugs facing competition, one branded biologic and one branded small-molecule medicine, have been modelled.

The branded biologic is a targeted monoclonal antibody for human epidermal growth factor receptor 2-positive (HER2-positive) breast cancer. When the targeted monoclonal antibody for breast cancer was granted market authorisation in the year 2000, it was a therapeutic breakthrough representing the new generation of targeted anti-cancer therapies (Pearson, Ringland and Ward, 2007). It targets the growth of breast cancer cells by binding to HER2, which is overexpressed in around 25% of breast cancer patients (Pearson et al., 2007). The European patent for the targeted monoclonal antibody for breast cancer expired in July 2014 (Genetic Engineering & Biotechnology News, 2014). Thus far, no biosimilars of the targeted monoclonal antibody for breast cancer have been approved, but there are several products in the pipeline expected to enter the market in the next few years (Generics and Biosimilar Initiative, 2014).

The small-molecule therapy is a well-established tyrosine kinase inhibitor (TKI) for the treatment of chronic myeloid leukaemia (CML) and results in long-lasting tumour regression (O'Brien et al., 2003). The tyrosine kinase inhibitor was, upon introduction, an innovative therapy that changed the treatment of CML, which does not respond to conventional chemotherapy. The drug was granted EMA approval in 2001. The European basic patent for the TKI for CML expired in March 2013 (Generics and Biosimilar Initiative, 2015), but the drug acquired a supplementary protection certificate (SPC) to protect it from competition from generics until its expiration in mid-2016 (The Wall Street Journal, 2014). However, the first generic version received EMA approval in 2012, and several others have followed (Generics and Biosimilar Initiative, 2015). As a consequence, there are already generics on the market, both within and outside the European borders. In Europe, Poland was the first country to introduce a generic version of the TKI for CML in 2014. Thereto, the patent application was rejected in India, opening up competition on the generics market from the start (Gabble and Kohler, 2014).

#### *Two hypothetical market share and pricing scenarios*

Although the biologics market is growing rapidly (Blackstone and Joseph, 2013), the market for biosimilars can still be said to be unexplored. It is, hence, difficult to pinpoint its reachable level of market share and to determine the possible magnitude of the consequent price competition. There are several parameters affecting the market, such as the introduction of new innovative medicines or the substantial entry barriers that should be considered. It has been estimated that developing a biosimilar takes seven to eight years at a cost of between $100 million and $250 million; this may be even higher

for monoclonal antibodies. Thus it may be that biosimilars will only be available for biologics with substantial sales and profits. So even though all evidence points to an expansion of the biosimilar market, e.g. an increasing biologics market and the upcoming expiration of essential patents, the development of the biosimilar market is still uncertain. Evidence of a similar impact on patient outcomes as between a biosimilar and an originator product in a post-launch setting (i.e. RWE) is likely to speed up acceptance of biosimilars in that therapy area. In European markets, clinicians' receptiveness and willingness to use biosimilars determine their adoption rate. Outcomes studies can reinforce prescribers' confidence in biosimilars. Government, payers and industry should collaborate to find ways to generate these outcome data; this would be helpful in promoting biosimilar competition and its subsequent benefits for patients and payers (Mestre-Ferrandiz et al., 2016). This report evaluates two hypothetical scenarios for the included biosimilar (and price levels).

The first hypothetical scenario, Scenario A, is based on experiences from existing biosimilars. This scenario represent a reasonable market at entry for current biosimilars. A study of five European countries (France, Germany, Italy, Sweden and the UK), with the aim of understanding potential future uptake of biosimilars in both the US and Europe, used IMS data of existing biosimilars and found an uptake of between 6.1 and 42.2% for the EPO market and an uptake of between 8.9 and 33.2% for the GCSF market (Grabowski et al., 2014). The level of uptake may depend on the number of years passed since biosimilar market entry and the cases with well-working biosimilar markets seemed to level off at a market share of around 30%. Previous research also found that biosimilar prices are typically about 25% lower than the price of the branded biologics, absent rebates (Grabowski et al., 2014). Scenario A is thus based on a biosimilar market share of 30% and a price corresponding to 75% (–25%) of the original drug price.

The second hypothetical scenario, Scenario B, is based on experiences from the general chemical generics market. This scenario represent the potential of an improved market for biosimilars. A typical price drop following the introduction of generics has been found to be 70–80% (IMS Health, 2011). A European study of the value of generic medicines presented the market share of pharmaceuticals accounted for by generics, ranging from 39 to 73% for the target countries, with a median of 60% (Albrecht, 2015). This is in line with an outlook of the biosimilar market that forecast that the overall market share of biosimilars within the off-patent biological market would reach 50% in 2020 (IMS Health, 2011). Scenario B is thus based on a biosimilar market share of 60% and a price corresponding to 30% (–70%) of the original drug price.

Scenarios A and B are summed in Table 37.

**Table 37. Matrix of the two scenario analyses performed for each country**

| | Scenario A | Scenario B |
|---|---|---|
| **Market share** | 30% | 60% |
| **Price relative to protected original brand (absent discounts)** | 75% | 30% |

### *Modelling*

A model was constructed using Microsoft Excel® 2013. The model compares the current total sales per year of the targeted monoclonal antibody for breast cancer and the tyrosine kinase inhibitor for CML, in euros, with the sales of the targeted monoclonal antibody for breast cancer and the TKI for CML and their respective biosimilars under biosimilar competition. The model compares states with biosimilars and generics, i.e. states where Scenarios A and B are fully reached, with the state without biosimilars or generics. In other words, this report rather considers potential market outcomes with biosimilars and generics than the introduction phase. The results are presented as cost savings in each of the three hypothetical scenarios.

The model assumes full uptake of the branded product at patent expiration, i.e. that there is no additional market to expand annual sales. The total sales of the two medicines represent the maximum yearly saving potential. No change in price of the branded products is assumed; the analysis only incorporates the impact of the price and uptake of the biosimilars.

The estimated annual sales per yearly mortality case as reported for 2013 (Jonsson et al., 2016) are used to calculate the total sales in each country (Table 38). Sales for France and Italy are not included (Jonsson et al., 2016), instead the average of the countries included in the source is used as a proxy. Population figures for 2013 are obtained from Eurostat (Eurostat, 2015h). Mortality and incidence data are obtained from EUCAN (European Cancer Observatory, 2012) and used to calculate total sales in each country.

Exact numbers can be found in Table 123 and Table 125 in the Appendix.

**Table 38. Total sales in €thousand, by country, 2013**

| Country | Targeted monoclonal antibody for breast cancer | Tyrosine kinase inhibitor for CML |
|---|---|---|
| Belgium | 54,329 | 31,609 |
| Denmark | 25,884 | 12,818 |
| France | 305,346 | 212,582 |
| Germany | 252,998 | 218,448 |
| Italy | 218,686 | 163,298 |
| Netherlands | 61,077 | 37,653 |
| Poland | 48,739 | 45,218 |
| Sweden | 35,404 | 24,768 |
| UK | 206,030 | 128,833 |

Source: Jonsson et al., 2016

### *Results*

The results (Table 39) indicate potential savings ranging from €1 to €23.3 million depending on country and treatment for Scenario A, and from €5.4 to €130.5 million for Scenario B. The potential savings depend on the population size in each country, in addition to the yearly mortality rate of the specific cancer type. It is therefore difficult to compare sales reductions between countries. The results are presented graphically for the biosimilar in Figure 56 and for the generic in Figure 57.

**Table 39. Annual million euros saved in Scenarios A and B for both the targeted monoclonal antibody for breast cancer and the tyrosine kinase inhibitor for CML, by country**

| | Scenario A | Scenario B |
|---|---|---|
| **Belgium** | | |
| Targeted monoclonal antibody for breast cancer | €4.10 | €22.80 |
| Tyrosine kinase inhibitor for CML | €2.40 | €13.30 |
| **Denmark** | | |
| Targeted monoclonal antibody for breast cancer | €1.90 | €10.90 |
| Tyrosine kinase inhibitor for CML | €1.00 | €5.40 |
| **France** | | |
| Targeted monoclonal antibody for breast cancer | €18.60 | €104.40 |
| Tyrosine kinase inhibitor for CML | €13.00 | €72.70 |
| **Germany** | | |
| Targeted monoclonal antibody for breast cancer | €23.30 | €130.50 |
| Tyrosine kinase inhibitor for CML | €20.10 | €112.70 |
| **Italy** | | |
| Targeted monoclonal antibody for breast cancer | €16.40 | €91.80 |
| Tyrosine kinase inhibitor for CML | €12.20 | €68.60 |
| **Netherlands** | | |
| Targeted monoclonal antibody for breast cancer | €4.60 | €25.70 |
| Tyrosine kinase inhibitor for CML | €2.80 | €15.80 |
| **Poland** | | |
| Targeted monoclonal antibody for breast cancer | €3.70 | €20.50 |
| Tyrosine kinase inhibitor for CML | €3.40 | €19.00 |
| **Sweden** | | |
| Targeted monoclonal antibody for breast cancer | €2.70 | €14.90 |
| Tyrosine kinase inhibitor for CML | €1.90 | €10.40 |
| **UK** | | |
| Targeted monoclonal antibody for breast cancer | €15.50 | €86.50 |
| Tyrosine kinase inhibitor for CML | €9.70 | €54.10 |

**Figure 56. Cost reduction with biosimilars for the targeted monoclonal antibody for breast cancer, in million euros, by country**

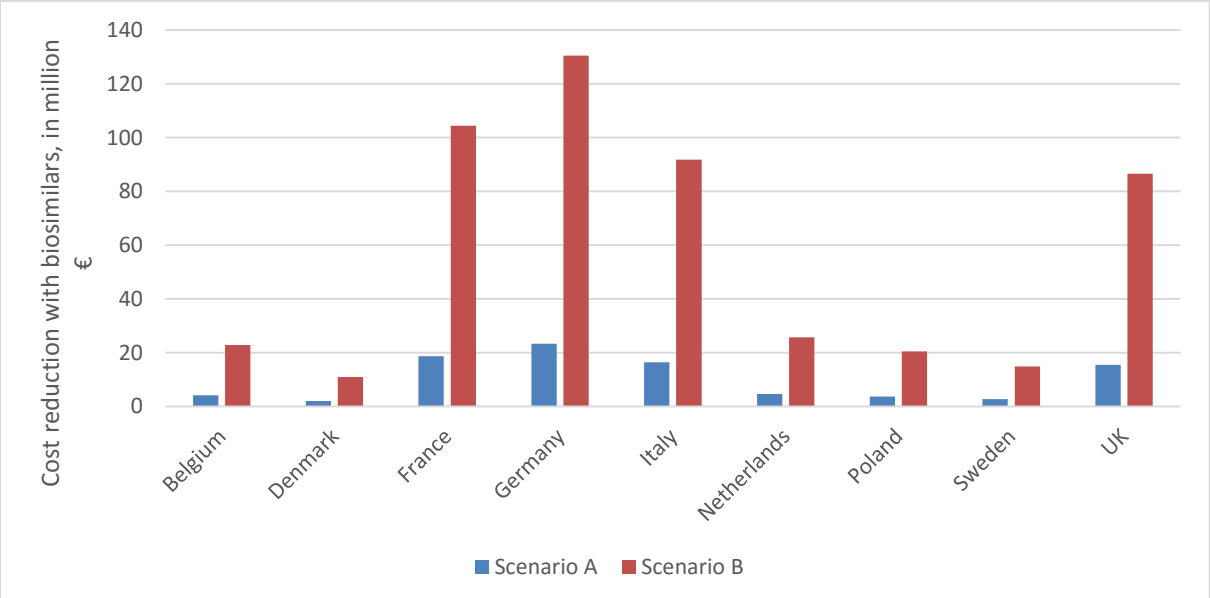
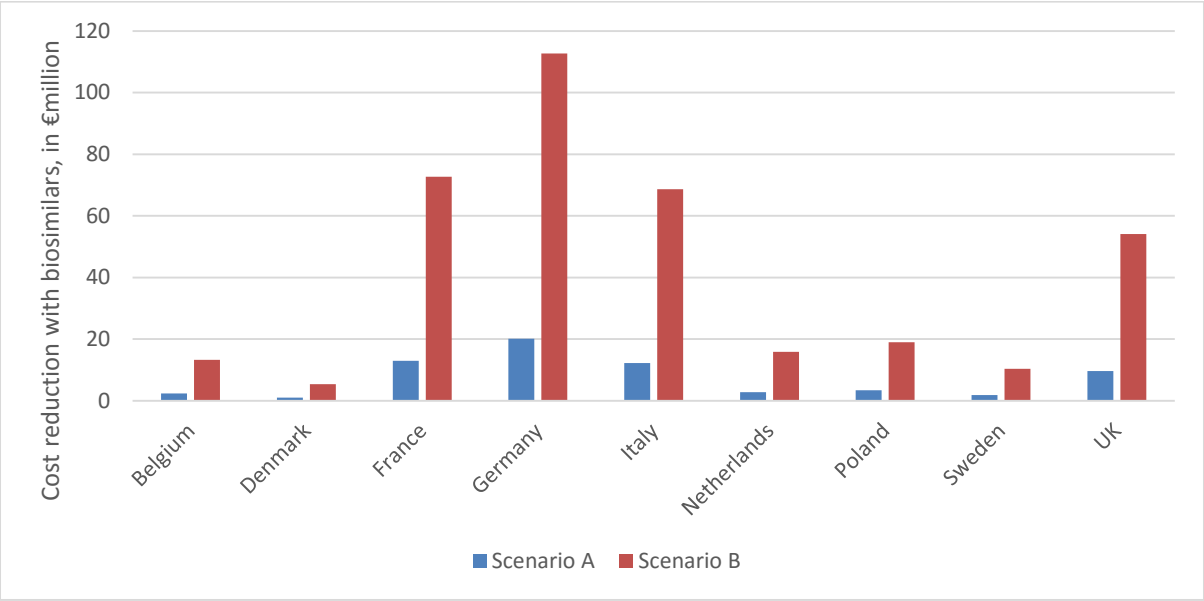


**Figure 57. Cost reduction with generics for the tyrosine kinase inhibitor for CML, in million euros, by country**




### 3.3.3. Assessing the impact of generic and biosimilar competition for cancer medicines moving off-patent between 2016 and 2020

The aim of this analysis is to estimate the impact of generic and biosimilar competition for cancer medicines moving off-patent between 2016 and 2020. The period under consideration is 2015 to 2020. This extends the previous analysis by modelling the impact for *all* cancer medicines facing patent expiry. It adopts a similar approach, using assumptions about maximum market share and price reductions for the biosimilar or the generic. As it dynamically models the impact of competition between 2015 and 2020, an additional set of assumptions were required, measuring the time to impact for market share and price assumptions. The considerations made during the first analysis should be borne in mind when assessing the assumptions used.

This case study compares the forecast value of sales for the sample of medicines between 2015 and 2020, assuming that biosimilar and generic competition does not happen, with one where there is entry of biosimilars and generics. The differences between the two are considered savings generated through competition. Savings here are the reduction in costs from the perspective of the payer.

#### *Method*

Models were created for each of the target countries and for EU26 as a total. Cancer medicines facing loss of legal protection through the period 2015–20 were identified using IMS Lifecycle Patent Focus and IMS MIDS Market Segmentation. In total, seven biological and 17 small-molecule medicines were included in the sample. EU26 sales for these, at ex-factory prices, in 2015 totalled €15.8 billion.

For the sample ten years of quarterly IMS MIDAS, sales data were extracted. IMS MIDAS is a propriety database tracking sales though primary and secondary care channels. For France, Germany and the UK this was the 10 years to quarter 3 2015, for the remaining six markets and EU26 the period was 10 years to quarter 4 2015. Variables extracted

from the database were sales in local currency at ex-factory prices and standard units by IMS molecule. From these, (list) price per standard unit can be imputed.

A baseline projection to quarter 4 2020, in standard units, was then undertaken using exponential smoothing. Quarters were then combined to produce results per calendar year. This was then converted into sales values per medicine per year using imputed prices. To facilitate comparisons between markets, where necessary, local currency values were converted to euros using fixed exchange rates.[24] Individual cancer medicines were classed as either small-molecule or biological and grouped. Results are presented for each group.

To model the impact of generic competition three variables were populated:

1. Maximum market share, percentage share of branded drug lost to generics or biosimilar competition, expressed as a percentage.
2. Maximum price differential, price per standard unit for the generic or biosimilar, expressed as a percentage reduction relative to the price of the branded drug at loss of exclusivity.
3. Time to impact, number of quarters elapsed to point of maximum market share and maximum price differential.

For each market, and for small molecules and biosimilars as a group, *analogues* were used to populate the variables. Analogues are classes of medicine considered to have the closest characteristics to the two groups of cancer medicine and which have been subjected to generic or biosimilar competition. For small-molecule cancer medicines all small molecules were used. For biological cancer medicines the only four with biosimilars in the market were the comparators. Average market share, price differentials and time to impact were calculated for each sample of analogues. An assumption is made that in all cases loss of legal protection coincides with loss of exclusivity – the point at which both legal protection is lost and at least one generic or biosimilar has entered the market.

The baseline forecast was then adjusted using each of the variables, applied from the quarter of loss of patent exclusivity for each medicine. Brand-drug market share was reduced by apportioning an increasing proportion of maximum market share to reach time to impact. A generic or biosimilar equivalent for the brand drug was created using the market shares lost by the brand drug. The generic or biosimilar market shares were converted to value using their eroding price differentials; they were also apportioned using time to impact. These results were annualised and converted to euros where necessary. Lastly, results were grouped into small-molecule and biological markets.

By comparing the values of the two markets (unadjusted) with those adjusted for loss of exclusivity, savings due to loss of exclusivity can be calculated.

To test the sensitivity of the results, two types of adjustment to the data and modelling were made. As the analogues used for modelling biologicals' loss of exclusivity (LOE) were a small sample, and may not be representative, market share and price variable assumptions were adjusted. First, both market share was decreased and price differential was increased, by 50% (i.e. there was 50% less market share loss of the brand drug and prices for the biosimilar were 50% greater). To test the sensitivity of the results to an underestimate of biosimilar competition, market share was increased and

[24] For the UK this was quarter 3 2015 and the remaining quarter 4 2015.

price differentials were decreased by a relative 50%. The final adjustment is a recognition that in many countries manufacturers' prices (i.e. list prices) may be above actual prices paid. This may in turn reduce the value of savings achieved. As actual discounting is often commercially sensitive, a general assumption imputing that prices for EU26 are 20% above actual paid was applied.

### *Results*

Figures 92 and 93 plot the estimated savings for the EU26 market as a whole. Figure 58 is for the biological market. As can be seen, reported savings (represented by the shaded area) in this market are €2,597 million; this represents cumulative savings over the period, the difference between sales with and without LOE adjustment.

**Figure 58. Cost savings due to cancer biological LOE – medicines facing LOE between 2015 and 2020 (EU26), sales to 2020**

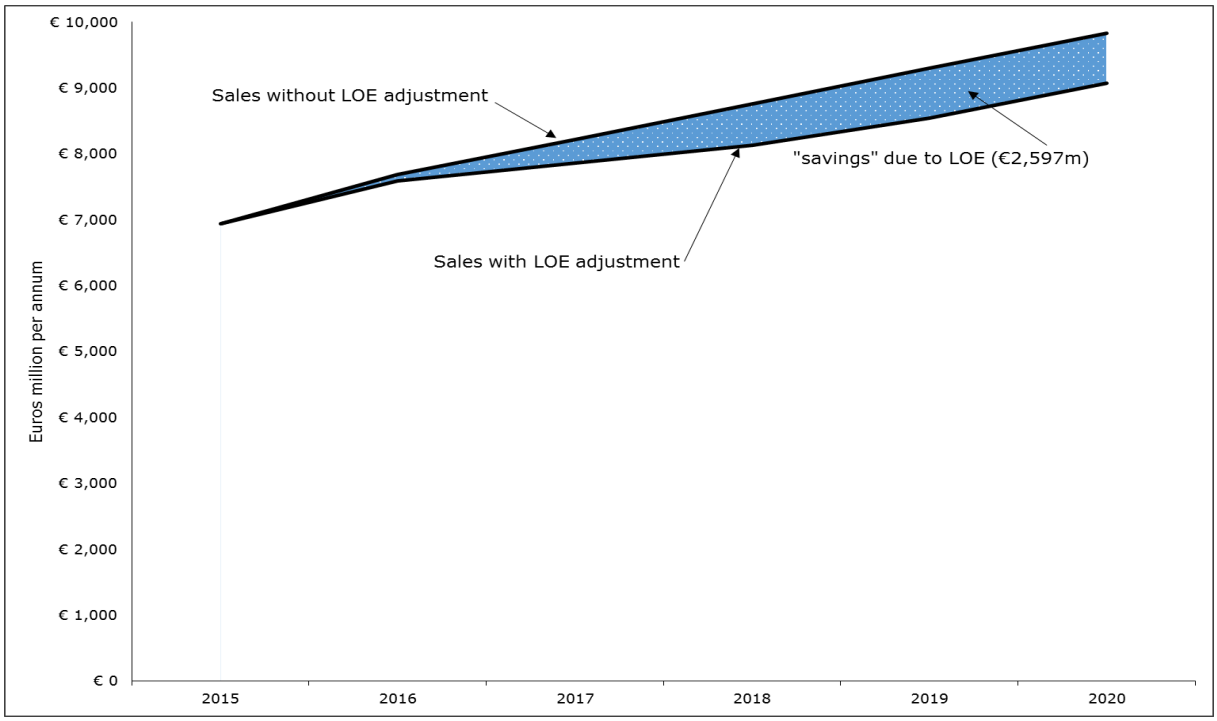
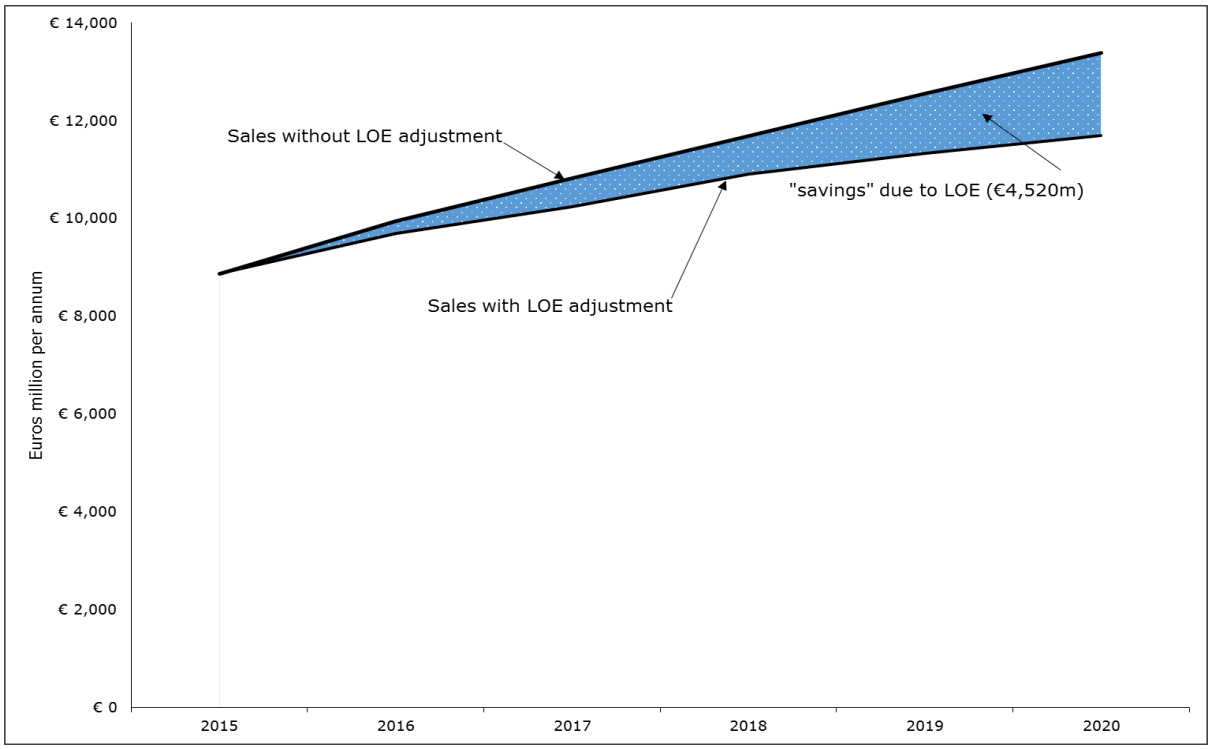



Figure 59 presents the results for small molecules. Total savings of €4,520 million are almost double that for biologicals. The total estimated savings for cancer medicines through generic and biosimilar competition for medicines facing LOE between 2015 and 2020 is estimated to be €7,118 million across EU26.

**Figure 59. Cost savings due to cancer small -molecule LOE – medicines facing LOE between 2015 and 2020 (EU26), sales to 2020**

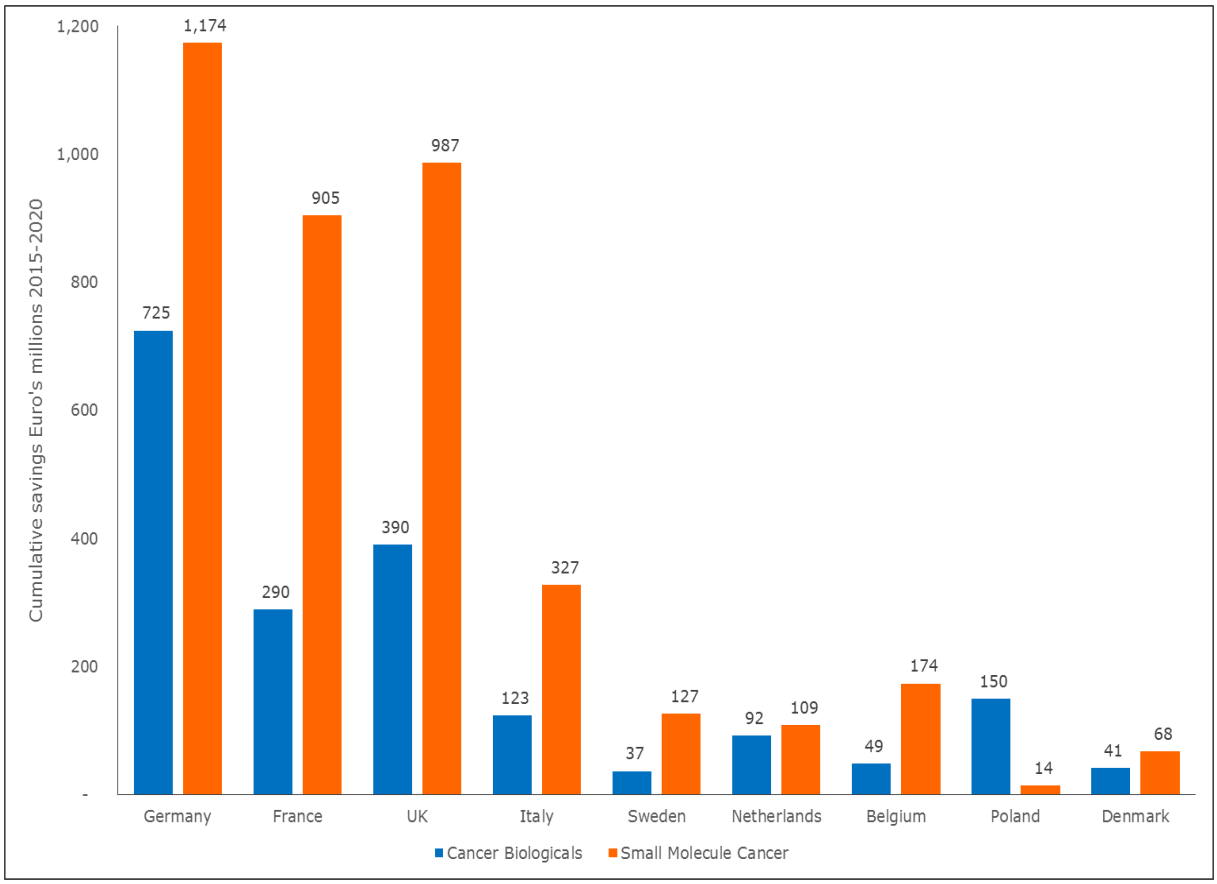



Results for the nine target countries are presented in Table 40 and Figure 60.

**Table 40. €millions savings due to LOE for cancer medicines facing LOE between 2015 and 2020, for EU26 and by country**

| | LOE savings 2015–20 | | |
|---|---|---|---|
| | Cancer biologicals (€millions) | Small-molecule cancer (€millions) | Total (€millions) |
| Germany | 724.54 | 1173.87 | 1,898.42 |
| France | 289.54 | 904.95 | 1,194.50 |
| UK | 390.09 | 986.94 | 1,377.03 |
| Italy | 123.41 | 326.91 | 450.32 |
| Sweden | 36.88 | 126.56 | 163.44 |
| Netherlands | 91.77 | 108.58 | 200.36 |
| Belgium | 48.83 | 173.63 | 222.46 |
| Poland | 150.06 | 14.27 | 164.33 |
| Denmark | 41.02 | 67.94 | 108.96 |
| EU26 | 2,597.14 | 4520.42 | 7,117.56 |

**Figure 60. €millions savings due to LOE for cancer medicines facing LOE between 2015 and 2020, by country**




Results for each of the markets can be found in Appendix VI.

### *Sensitivities*

The use of analogues for populating the assumptions relating to generic competition has strengths and weaknesses. An important consideration is whether the nature of competition demonstrated by the analogue is translatable to the therapy area being modelled. In some instances, such as chronic primary care tablet formulation medicines, this approach has been successful. Of the two markets in the current analysis, that for cancer biologicals is the one associated with greater uncertainty on this issue. To test the impact of changes to the analogues used, two sensitives were applied to the biologics markets. In one, lower prices for the biosimilar and greater market share for the originator were modelled. The second made the opposite assumption, higher prices and lower levels of market share. For each market, relative 50% adjustments to the baseline assumptions were made to test the sensitivities. For example, if the baseline price reduction for the biosimilar was 30% then the sensitivities modelled were 15% and 45%.

Figure 61 plots the impact of adjusting the market share and price assumptions on the EU26 market. This shows that total savings realised between 2015 and 2020, through flexing the LOE assumptions, range from €5.8 billion to €0.6 billion. Compared with the previous analysis (in subsection 3.5.2), the upper range is similar in most markets to Scenario B. This is where biosimilars enter a market with similar characteristics to that faced by small molecules.

**Figure 61. €millions savings due to LOE for biological cancer medicines facing LOE between 2015 and 2020, EU26 – baseline, high and low sensitivities**

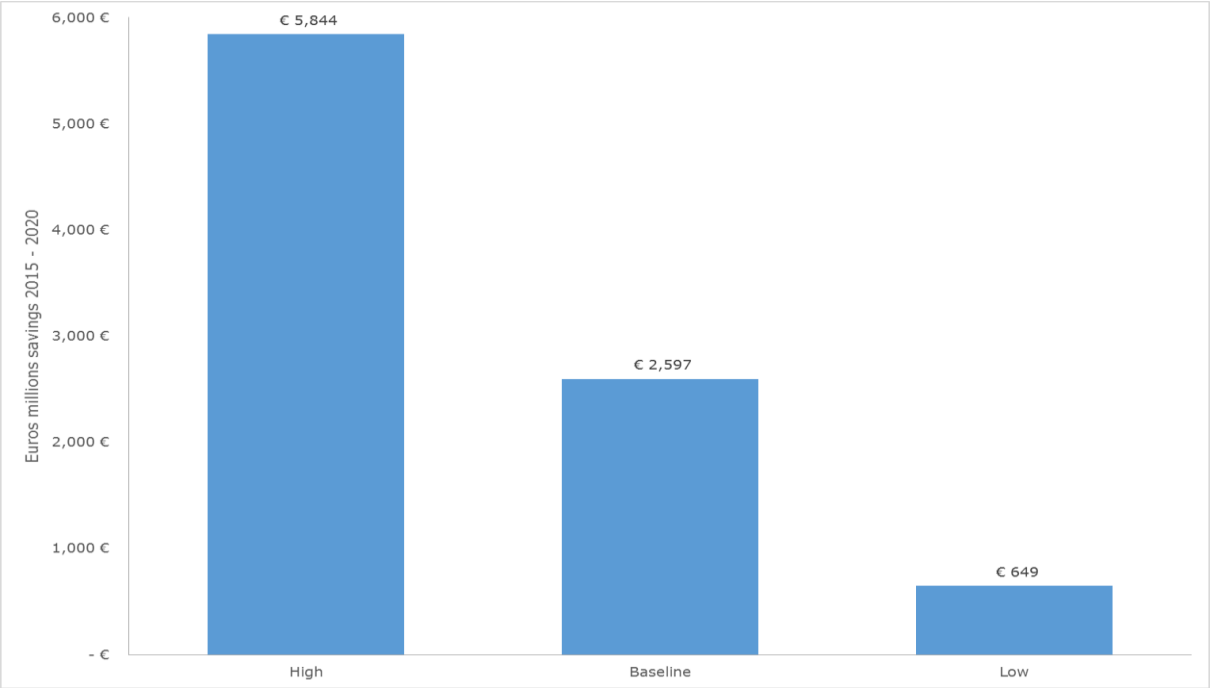



Table 41 below details the impact of applying the sensitivities to each of the specific country markets. Wide ranges are evident when the analogues are adjusted to reflect greater biosimilar price and market share competition, particularly in Germany and Poland.

**Table 41. €millions savings due to LOE for biologic cancer medicines facing LOE between 2015 and 2020, for EU26 and by country baseline, high and low sensitivities**

| EU26 | | | Netherlands | | |
|---|---|---|---|---|---|
| High €m | Baseline €m | Low €m | High €m | Baseline €m | Low €m |
| 5,844 | 2,597 | 649 | 166 | 92 | 27 |
| **Italy** | | | **Sweden** | | |
| High €m | Baseline €m | Low €m | High €m | Baseline €m | Low €m |
| 278 | 123 | 31 | 83 | 37 | 10 |
| **Denmark** | | | **Poland** | | |
| High €m | Baseline €m | Low €m | High €m | Baseline €m | Low €m |
| 64 | 41 | 10 | 189 | 150 | 38 |
| **Germany** | | | **France** | | |
| High €m | Baseline €m | Low €m | High €m | Baseline €m | Low €m |
| 1,630 | 725 | 181 | 653 | 290 | 73 |
| **Belgium** | | | **UK** | | |
| High €m | Baseline €m | Low €m | High €m | Baseline €m | Low €m |
| 105 | 49 | 12 | 878 | 390 | 98 |

The use of ex-factory prices may also overstate the level of savings generated through LOE. Prices used in this analysis are list. For many cancer medicine markets, prices lower than list are more reflective of what is actually paid by the health care system. Where this is the case the market share and price differentials will be applied to a larger value of sales than is actually paid by the health care system; this will result in the expected savings being overstated. As previously noted, details of discounts are frequently commercial, in confidence or associated with complex arrangements which make their translation to a price difficult. In the absence of detailed figures for each market this was tested for sensitivity by applying a 20% discount to all medicines for the EU26 market only. For both the biologics and small-molecule markets this resulted in a 25% reduction in the value of savings achieved. This reduces savings by €519 million for the biologics market and €904 million for the small molecules market, for a total of €1.4 billion. This in turn reduces total savings for the EU26 between 2015 and 2020 from €7.1 billion to €5.7 billion.

### 3.3.4. Concluding remarks

The introduction of generics and biosimilars offers an opportunity to reduce treatment costs while maintaining the same treatment standards, but to what extent is uncertain. The size of the savings depends on the market share, and how far the price will fall on the entry barriers to the market and the number of competitors entering the market. For biosimilars, it is also influenced by the difficulty of producing each biosimilar.

There is variation in the ability of the health care systems under consideration to deliver efficiencies though competition in generics. Results from the first case study show significant potential gains that should incentivise countries to implement policies targeted at driving the current biosimilars market (Scenario A) towards a generics-market-like scenario (Scenario B). In turn, if a market for biosimilars were to become more like Scenario B then the upper sensitivities in the second analysis, and hence greater savings across the EU, could be anticipated. The second case study estimates that economic gains of €7.1 billion could be made through generic and biosimilar competition in the oncology market, of which €4.5 billion in the generics market and €2.6 billion in the biosimilars market.

As health care budgets continue to face fiscal constraints it is reasonable to anticipate that markets will adopt policies to deliver greater efficiencies – policies including the promotion of biosimilar and generic competition.

The presented analyses could be expanded as there are possible effects in addition to a reduced drug price from the introduction, or expansion, of these markets, particularly the fledgling biosimilars market. There are reasons to believe that the total volume of the sales of biological medicines will increase as a result of an increasing biosimilars market. Such a development has been seen in the generics market (Albrecht, 2015), due both to prolonged treatment durations and to more prescriptions following significant price falls. This development is not applicable in all diagnostic fields or for all biologic medicines. The potentially increased sales volumes could increase the total drug costs, and bring additional health gains, but that it is not considered in this analysis.

Another potential effect of an expanded biosimilars market is a price reduction of branded products. Branded products will always have a price premium but will have to compete on price once off-patent. This effect is not included in either analysis; it is more than plausible that it will happen in the presence of an efficient biosimilars market. However, while clinicians' concerns about the actual "similarity" between biosimilars and

their reference products remain, there will always be a loyal segment of the market willing to pay a higher price for following the reference product (Chauhan, Towse and Mestre-Ferrandiz, 2008). To persuade clinicians of "similarity", and to ensure patient safety, governments are supporting outcomes studies in collaboration with payers and industry. Examples include the NOR-SWITCH study in Norway and the BIO-SWITCH study in the Netherlands (Mestre-Ferrandiz et al., 2016).

## 3.4. *Funding models to improve the efficient allocation of resources to cancer treatments*

This subsection explores funding options that have been implemented in practice to (1) increase the proportion of resources allocated to cancer, and in particular cancer drugs, from the health care budget, and (2) increasing the level of resources allocated to health care in general and, when needed, to cancer via additional funding mechanisms (in addition to the available health care budget).

### 3.4.1. Ring-fenced budgets

#### *Ring-fenced budget: arguments in favour*

We discuss below two examples of ring-fenced budgets introduced in England and Italy.

In England and Wales, cancer drugs recommended via the standard NICE technology appraisal process are funded in the same way as all other drugs. Some cancer drugs may be eligible for additional weighting if they meet the criteria for being considered "life-extending, end-of-life" treatments (NICE, 2009) (see above). If so, the cost-effectiveness requirements would be less strict than usual but they would still be funded in the same way as other drugs approved by NICE.

In addition, a ring-fenced Cancer Drugs Fund (CDF) has been in place in England since 2011 to improve access to cancer medicines that have not been recommended by NICE and that are not routinely available in the NHS. The intention of the CDF is to "enable cancer treatments to be funded by the NHS where society values their benefits more than the benefits that could be provided by spending the funding on other treatments, elsewhere in the NHS" (Department of Health, 2010). It was intended originally to operate as an interim measure until 2014 but was extended; it was recently reviewed and from April 2016 it is will become a managed-access fund.

One argument in favour of having special funding arrangements for new cancer medicines is that there are concerns that standard HTA methods do not capture the value of the health gains offered by these medicines that are deemed important by cancer patients. This is what NICE (2008) refers to as an example of a scientific value judgement. Another is that, even if the health gains are measured and valued accurately, society may wish to give higher priority to certain types of treatment – including those for cancer and other terminal illnesses – than to others (Rawlins et al., 2010; Department of Health, 2010). This is an example of social value judgement (NICE, 2008). If this is the case, then both NICE's end-of-life policy and the CDF could be said to reflect the views of society.

Information on society's preferences can be drawn from a number of sources, including politicians, ethicists and surveys of samples of the general population. The evidence on whether society is willing to fund life-extending end-of-life treatments that would not meet the cost-effectiveness criteria used for other treatments is limited and inconclusive

(Shah, 2015). The evidence on society's preferences regarding cancer specifically is even more limited, with one study reporting evidence that suggests that the CDF is not consistent with the preferences of the general public (Linley and Hughes, 2013). A further issue is that even if society does indeed support giving higher priority to cancer patients, it is unclear why there should be funding arrangements for cancer drugs but not for other types of cancer care.

England is unusual in that it has introduced special and explicit arrangements for the assessment and funding of cancer treatments. Other countries, including those that recommend the use of cost-effectiveness analysis, also tend to assess technologies with reference to criteria other than costs and health gains alone. Such criteria include severity, innovation, need or necessity, and the availability of alternative treatment options. For example, there is a relatively large (and international) body of evidence that suggests that society wishes to give higher priority to those who are severely ill (Shah, 2009; Nord and Johansen, 2014). Including severity as a factor in HTA alongside costs and health benefits would likely result in improved access to treatments for certain forms of cancer. However, severity is not inherently cancer-specific, and its inclusion may not benefit those with milder or early-stage disease. Indeed, whether the application of these wider criteria in HTA will improve or worsen access to cancer treatments relative to treatments for other conditions is an empirical question.

An example of a non-cancer-specific ring-fenced budget is the innovation fund established in Italy. The degree of innovation of new therapies is defined based on a number of dimensions, including severity and unmet need. The innovation budget is funded through part of expected savings from expiring patents of specific products. In addition to getting access to additional funding, products classified as highly innovative can be approved under conditional reimbursement and might be in a more favourable position when negotiating the price compared to non-innovative products. Although the innovation budget and the innovation status are not specific to cancer, it is likely that a number of oncology products might meet the criteria for inclusion, particularly those in the later stages, as pointed out above.

### *Ring-fenced budget: the practice and the issues*

The Cancer Drugs Fund (CDF) was initially established in October 2010 as an entity separate to NICE with the specific objective of providing patients with access to cancer drugs not routinely available in the NHS. Originally the CDF was intended to operate only until 2014 as an interim measure prior to the proposed (but later aborted) roll-out of a new "value based pricing" reimbursement system that had been expected to replace the long-standing Pharmaceutical Price Regulation Scheme (PPRS). Instead, the CDF was extended until the end of March 2016, with a total lifetime budget of £1.27 billion (National Audit Office, 2015b).

By March 2015, 74,000 cancer patients had accessed drugs through the CDF, the majority of which had been appraised by NICE but not recommended for routine NHS use because they were not deemed to be cost-effective (other drugs funded by the CDF were drugs that were in the process of being appraised, or had not yet been appraised by NICE) (National Audit Office, 2015b). However, numerous reports have been critical of the fact that no data have been collected on the health impact for patients who have benefited from the CDF.

In November 2015, NHS England put out to consultation a proposal that, from March 2016, the CDF should become a "managed-access" fund that would pay for promising

new drugs during the period after market authorisation and before NICE decides whether the drugs should be recommended for routine use (the consultation states that all cancer drugs will receive draft guidance from NICE before market authorisation, and final guidance within 90 days of market authorisation being granted). Most of the proposal put forward in the consultation has been approved, such that from April 2016 the new CDF is to be integrated into existing NICE technology appraisal processes and now will no longer support the provision of drugs that have been appraised but not recommended by NICE.

This change from the original terms of the CDF shows a number of issues with the implementation of ring-fenced budgets created to fund specific interventions, including that, without appropriate conditions, it can require national health systems to allocate resources to interventions that do not necessarily result in the greatest health gains or to introduce rationing mechanisms and price cuts to manage the ring-fenced budget.

### 3.4.2. Alternative funding mechanisms: tobacco taxation

We discuss the experience of a number of European countries which have introduced tobacco taxes.

Tobacco use, in particular the use of cigarettes, is one of the leading contributors to cancer. The best-known link is probably the relationship between smoking and lung cancer; however, in a recent report by the US Surgeon General, it is stated that there is now enough evidence to infer a causal relationship between smoking and cancer of the bladder, cervix, colon, kidneys, larynx, leukocytes, lungs, liver, oesophagus, oral cavity, pharynx and stomach (U.S. Department of Health and Human Services. Centers for Disease Control and Prevention. National Center for Chronic Disease Prevention and Health Promotion. Office on Smoking and Health, 2014)

In the European Prospective Investigation into Cancer and Nutrition (EPIC), a cohort study of 444,211 individuals in eight European countries,[25] it was estimated that the proportion of tobacco-related cancers attributable to smoking was 34.9% (Agudo et al., 2012). Table 13 shows a breakdown of the attributable fraction by cancer type. For cancer of the larynx and the lung, more than 80% of all cases can be attributed to smoking.

Not surprisingly, strategies to reduce smoking have been identified as a public health priority. The WHO has introduced the MPOWER measure to assist in country-level implementation of effective interventions to reduce the demand for tobacco. The measures include six components, of which raised taxes on tobacco are one (World Health Organization, 2008).

[25] Italy, Spain, the UK, the Netherlands, Greece, Germany, Sweden, Denmark.

**Table 42. Fraction of cancer cases attributable to smoking**

| Cancer | Population-attributable fraction |
|---|---|
| **Larynx** | 84% |
| **Lung** | 82% |
| **Lower urinary tract** | 50% |
| **Oropharynx** | 49% |
| **Oesophagus** | 35% |
| **Oral cavity** | 33% |
| **Liver** | 25% |
| **Stomach** | 21% |
| **Colon and rectum** | 14% |
| **Uterine cervix** | 14% |
| **Pancreas** | 13% |
| **Myeloid leukemia** | 13% |
| **Kidney** | 8% |

Source: European Prospective Investigation into Cancer and Nutrition (Agudo et al., 2012).

### 3.4.3. The evidence base for tobacco taxation

There are many studies investigating the effect of tobacco taxation, and several reviews have been published. When the American Heart Association reviewed the evidence for population-based methods to improve lifestyle-associated risk factors, taxation of tobacco received the strongest classification (I A) in terms of strength of evidence (Mozaffarian et al., 2012). This echoes the findings of an earlier review by Hopkins and colleagues concluding that there is strong evidence that economic measures are effective in reducing tobacco use (Hopkins et al., 2001). Focusing on high-risk sub-populations, Bader and colleagues concluded that most studies found that raising cigarette prices through increased taxes is a highly effective measure for reducing smoking among youth, young adults and persons of low socio-economic status, but that there seems to be a data gap when it comes to studies investigating the effect on long-term heavy smokers and persons with dual diagnoses (smokers who are diagnosed with mental health and/or non-nicotine substance abuse disorders (Bader, Boisclair and Ferrence, 2011)). Thomas and colleagues focused on social inequalities and concluded that in terms of reducing social inequalities in smoking, there was better evidence to support increasing the price of tobacco products than to support more visible interventions such as health warnings and advertising restrictions (Thomas et al., 2008).

The studies mentioned so far have focused on the effects of price increases through taxation on the use of tobacco. Given the causal link not only to cancer but also to coronary heart disease, stroke and respiratory diseases such as COPD, cessation of use can also be tied to economic benefits. Indeed, in a review of this literature, Contreary and colleagues conclude that in addition to revenues from the tax itself, there are substantial savings in terms of health care costs, with estimates of savings associated with a 20% increase in the price of cigarettes ranging from –$0.13 to $86.72 per person per year (Contreary et al., 2015).

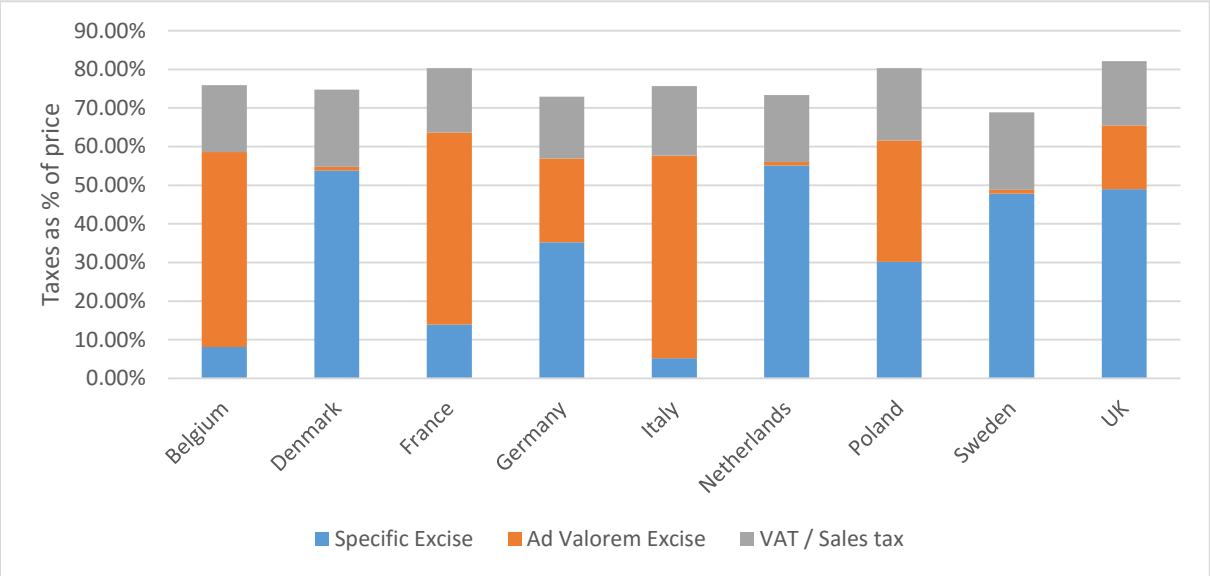
In the short term, a tobacco tax would likely result in increased tax revenue due to unchanged tobacco sale volumes. In the long term, as prices increase, tobacco sales are likely to decrease according to economic theory (i.e. price elasticity, interpreted as the percentage change in demand following a 1% change in price (IARC, 2011)) and result

in declining long-term tax revenues. However, this would be accompanied by improved health, and a consequent decline in treatment costs for smoking-related diseases, due to fewer people smoking.

### 3.4.4. Tobacco taxation today

As can be seen in Figure 62, taxes (in 2014) expressed as a percentage of the total price for a pack of 20 cigarettes of the most commonly sold brand vary between 68.8% (Sweden) and 82.2% (the UK). In the EU, the UK is second only to Bulgaria (at 82.7%) in terms of taxation. Taxes take the form of specific levies based on the number of cigarettes, packs or weight; *ad valorem* excises based on value, for instance the retail price; and finally non-tobacco-specific value added or sales tax. It can be noted that the WHO uses a threshold of 75% as a benchmark value. Germany and the Netherlands fall slightly below this benchmark, while Sweden is well below. (World Health Organization, 2015)

**Figure 62. Taxes (2014) levied on a pack of 20 cigarettes of the most commonly sold brand**




Source: WHO (World Health Organization, 2015).

There is large variation between the use of specific excise and ad valorem excise between the countries. Denmark, the Netherlands and Sweden utilise specific excises almost exclusively, while Belgium and Italy rely mainly on ad valorem excises. From a policy perspective, it has been argued that specific excise is more efficient as a public health intervention since it is insensitive to price changes of the underlying product being taxed (World Health Organization, 2015).

### 3.4.5. Earmarking tax revenue for health care

According to the WHO, 29 countries use different forms of earmarking to channel income from tobacco taxes to health care or other health-promoting activities or actors (World Health Organization, 2015). Typically, only a fraction of the income is earmarked. Most examples can be found in developing countries, but there are also a few cases in Europe: Iceland and Poland allocate income to tobacco control (0.9% and 0.5% respectively); Romania allocates €10 per 1,000 cigarettes to health care and 1% of the excise budget to sports; Switzerland allocates CFR 0.26 per pack of cigarettes to the Tobacco

Prevention Fund, and Macedonia, finally, allocates part of sales tax to fund drugs for rare diseases.

In a few cases, tax revenues are specifically allocated to cancer care. In Algeria, two dinars per pack are allocated to cancer. Costa Rica allocates the entire income from tobacco taxes to diseases linked to tobacco use (including cancer) and to sports. In Panama, 50% of income is allocated to health, including the National Institute for Cancer.

Though there are only a few cases where income from tobacco taxes is earmarked for specific purposes, the WHO notes that this may be a way to make new taxes more acceptable. The effectiveness of this strategy is, however, very dependent on the elasticity of demand for cigarettes (the effect of a price increase on consumption). Health-promotion activities may seek to reduce cigarette consumption, which has clear benefits for the incidence of cancer, but this may conflict with taxation policies which are used to generate income for the health system. It is clearly preferable to use tobacco taxation to reduce smoking prevalence. Increasing the dependence of the health system on revenues from tobacco taxation may reduce the incentive to do this. It is important to note that earmarked taxation should not be the only source of funding for cancer treatment, as it is unlikely to be sustainable.

# CONCLUSION

There have been significant advances in the development of treatments and diagnostics for cancer in the past few decades, accompanied by improvements in the overall provision of cancer care. However, cancer continues to represent a growing burden of disease among the ageing European population, and in parallel, financial pressures and spending constraints face all of our healthcare systems. Together, these factors mean that we need to be as efficient as possible in how we spend our resources within cancer care. We have identified several areas where efficiencies – or the way we allocate resources - can be improved. Some of these have the potential to be cost-saving, for example if we reduced the prevalence of smoking or increased the use of biosimilars and generics. Other practices may also improve overall efficiency by improving patient outcomes, even if they require additional expenditure and are not cost-saving as such. The major challenge for society is to get the balance right: between outcomes for patients, spending and efficiency. This report provides data and analysis to help take this discussion forward.

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# APPENDICES

## *Appendix I – Health and non-health expenditure*

### Table 43. Total general government expenditure – Growth rate versus previous year

| Country | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|
| EU-28 European Union | | 4.53% | 4.15% | 2.05% | 3.76% | 0.03% | 2.80% | 0.03% |
| Belgium | -1.41% | 5.17% | 6.93% | 6.00% | 2.87% | 5.69% | 5.15% | 1.12% |
| Denmark | 3.05% | 2.99% | 5.24% | 7.35% | 5.39% | 1.50% | 5.44% | -2.11% |
| Germany | 0.59% | 0.69% | 3.66% | 4.76% | 4.29% | -1.03% | 1.04% | 2.47% |
| France | 3.83% | 4.45% | 4.08% | 4.07% | 2.49% | 2.09% | 2.94% | 1.87% |
| Italy | 5.01% | 2.11% | 3.66% | 3.07% | -0.52% | 0.55% | 1.91% | -0.34% |
| Netherlands | 7.98% | 4.43% | 6.95% | 6.85% | 2.32% | -0.72% | 0.58% | -1.07% |
| Poland | 12.26% | 10.56% | 19.62% | -11.94% | 16.03% | 0.36% | -0.03% | 0.92% |
| Sweden | 4.19% | 2.92% | 0.21% | -7.28% | 14.85% | 8.39% | 6.86% | 4.30% |
| United Kingdom | 6.44% | 4.87% | -4.24% | -6.93% | 6.84% | -1.28% | 9.92% | -4.20% |
| 9 countries average | 3.97% | 3.35% | 2.84% | 1.36% | 4.07% | 0.63% | 3.61% | 0.31% |

Data source: Author's calculation on Eurostat figures.

### Table 44. General public services expenditure by country and by year – Million euro

| Country | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|
| EU-28 European Union | | € 777,999 | € 825,946 | € 856,607 | € 820,361 | € 856,284 | € 909,396 | € 925,354 | € 919,699 |
| Belgium | € 28,615 | € 27,813 | € 29,658 | € 30,558 | € 31,825 | € 31,106 | € 32,320 | € 33,380 | € 33,606 |
| Denmark | € 14,484 | € 15,345 | € 15,634 | € 17,124 | € 18,186 | € 19,066 | € 20,193 | € 23,327 | € 19,721 |
| Germany | € 144,776 | € 148,140 | € 153,284 | € 163,650 | € 162,258 | € 167,357 | € 177,985 | € 175,961 | € 179,902 |
| France | € 131,072 | € 127,859 | € 138,214 | € 143,675 | € 139,514 | € 136,002 | € 140,080 | € 142,161 | € 143,799 |
| Italy | € 129,727 | € 130,153 | € 138,395 | € 145,354 | € 135,422 | € 133,148 | € 140,986 | € 150,177 | € 143,225 |
| Netherlands | € 32,443 | € 33,240 | € 33,457 | € 36,237 | € 33,951 | € 36,003 | € 34,086 | € 33,284 | € 32,778 |
| Poland | € 14,461 | € 15,578 | € 16,923 | € 19,649 | € 17,627 | € 20,499 | € 21,133 | € 22,391 | € 22,576 |
| Sweden | € 24,427 | € 25,810 | € 27,419 | € 27,500 | € 22,915 | € 27,294 | € 30,806 | € 32,577 | € 33,959 |
| United Kingdom | € 89,146 | € 94,663 | € 99,506 | € 89,632 | € 78,215 | € 100,000 | € 106,246 | € 110,167 | € 115,073 |
| 9 countries average | € 67,683 | € 68,733 | € 72,499 | € 74,820 | € 71,101 | € 74,497 | € 78,204 | € 80,381 | € 80,516 |

### Table 45. Defence expenditure by country and by year – Million euro

| Country | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|
| EU-28 European Union | | € 182,344 | € 180,676 | € 194,683 | € 183,663 | € 191,705 | € 197,695 | € 187,753 | € 189,350 |
| Belgium | € 3,421 | € 3,272 | € 3,449 | € 3,909 | € 3,497 | € 3,660 | € 3,422 | € 3,493 | € 3,558 |
| Denmark | € 2,982 | € 3,385 | € 3,267 | € 3,377 | € 3,223 | € 3,379 | € 3,448 | € 3,512 | € 3,287 |
| Germany | € 22,980 | € 23,894 | € 22,616 | € 25,570 | € 27,043 | € 28,322 | € 29,664 | € 30,243 | € 30,921 |
| France | € 31,882 | € 33,354 | € 33,094 | € 33,923 | € 36,816 | € 38,001 | € 37,080 | € 37,631 | € 38,065 |
| Italy | € 17,893 | € 18,593 | € 19,311 | € 21,231 | € 22,046 | € 20,855 | € 21,312 | € 20,992 | € 19,311 |
| Netherlands | € 7,029 | € 7,450 | € 7,908 | € 8,265 | € 8,642 | € 8,211 | € 8,361 | € 7,681 | € 7,713 |
| Poland | € 3,922 | € 4,373 | € 5,954 | € 6,914 | € 4,721 | € 6,114 | € 6,038 | € 5,791 | € 6,733 |
| Sweden | € 5,324 | € 5,363 | € 5,341 | € 5,289 | € 4,645 | € 5,533 | € 5,675 | € 5,923 | € 6,531 |
| United Kingdom | € 46,511 | € 49,389 | € 49,753 | € 47,677 | € 43,268 | € 47,273 | € 46,599 | € 48,963 | € 46,433 |
| 9 countries average | € 15,772 | € 16,564 | € 16,744 | € 17,350 | € 17,100 | € 17,927 | € 17,955 | € 18,248 | € 18,061 |

## Table 46. Public order and safety expenditure by country and by year – Million euro

| Country | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|
| EU-28 European Union | | € 218,812 | € 232,297 | € 233,620 | € 232,640 | € 242,827 | € 237,234 | € 241,397 | € 243,450 |
| Belgium | € 4,977 | € 5,563 | € 5,518 | € 6,040 | € 6,295 | € 6,587 | € 6,844 | € 6,987 | € 7,117 |
| Denmark | € 1,917 | € 2,031 | € 2,100 | € 2,412 | € 2,532 | € 2,413 | € 2,709 | € 2,508 | € 2,528 |
| Germany | € 36,768 | € 35,840 | € 37,693 | € 38,355 | € 39,335 | € 41,196 | € 43,148 | € 41,241 | € 44,976 |
| France | € 26,569 | € 27,795 | € 29,200 | € 29,932 | € 32,941 | € 34,001 | € 32,960 | € 33,450 | € 33,835 |
| Italy | € 29,822 | € 29,439 | € 30,576 | € 29,397 | € 31,494 | € 32,084 | € 32,787 | € 32,296 | € 32,185 |
| Netherlands | € 9,192 | € 10,316 | € 10,949 | € 12,079 | € 12,346 | € 12,001 | € 12,219 | € 12,161 | € 12,854 |
| Poland | € 5,147 | € 6,013 | € 6,894 | € 8,733 | € 7,554 | € 8,631 | € 8,680 | € 8,879 | € 8,714 |
| Sweden | € 4,071 | € 4,358 | € 4,629 | € 4,583 | € 4,335 | € 5,164 | € 5,269 | € 5,923 | € 6,095 |
| United Kingdom | € 46,511 | € 49,389 | € 51,916 | € 47,677 | € 44,932 | € 45,455 | € 44,735 | € 46,923 | € 44,414 |
| 9 countries average | € 18,330 | € 18,972 | € 19,942 | € 19,912 | € 20,196 | € 20,837 | € 21,039 | € 21,152 | € 21,413 |

## Table 47. Economic affairs expenditure by country and by year – Million euro

| Country | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|
| EU-28 European Union | | € 510,562 | € 516,216 | € 597,029 | € 599,965 | € 651,798 | € 579,905 | € 616,902 | € 581,574 |
| Belgium | € 22,394 | € 17,015 | € 18,622 | € 20,964 | € 22,383 | € 24,153 | € 26,616 | € 29,111 | € 26,094 |
| Denmark | € 7,029 | € 6,996 | € 6,767 | € 6,753 | € 7,597 | € 8,206 | € 8,373 | € 9,281 | € 9,102 |
| Germany | € 80,431 | € 78,849 | € 77,899 | € 89,496 | € 95,879 | € 121,012 | € 91,689 | € 93,479 | € 92,762 |
| France | € 81,477 | € 83,386 | € 83,707 | € 89,797 | € 94,947 | € 102,002 | € 98,880 | € 104,530 | € 103,620 |
| Italy | € 62,627 | € 79,021 | € 67,588 | € 65,328 | € 72,435 | € 65,772 | € 68,854 | € 66,207 | € 67,589 |
| Netherlands | € 22,710 | € 23,497 | € 25,549 | € 27,973 | € 33,334 | € 32,845 | € 30,870 | € 28,803 | € 25,066 |
| Poland | € 9,559 | € 12,299 | € 14,729 | € 19,285 | € 17,941 | € 21,578 | € 21,510 | € 18,531 | € 16,239 |
| Sweden | € 13,153 | € 13,408 | € 13,888 | € 14,808 | € 13,935 | € 16,229 | € 17,430 | € 19,038 | € 18,721 |
| United Kingdom | € 60,076 | € 63,795 | € 64,895 | € 97,260 | € 74,887 | € 60,000 | € 54,055 | € 73,445 | € 62,584 |
| 9 countries average | € 39,940 | € 42,029 | € 41,516 | € 47,963 | € 48,149 | € 50,200 | € 46,475 | € 49,158 | € 46,864 |

## Table 48. Environment protection expenditure by country and by year – Million euro

| Country | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|
| EU-28 European Union | | € 97,250 | € 103,243 | € 103,831 | € 110,198 | € 115,023 | € 105,437 | € 107,287 | € 108,200 |
| Belgium | € 2,177 | € 1,963 | € 2,069 | € 2,132 | € 2,098 | € 2,562 | € 3,422 | € 3,493 | € 3,954 |
| Denmark | € 1,278 | € 1,354 | € 1,167 | € 1,206 | € 921 | € 965 | € 985 | € 1,003 | € 1,011 |
| Germany | € 11,490 | € 14,336 | € 12,564 | € 12,785 | € 17,209 | € 15,448 | € 16,180 | € 16,496 | € 16,866 |
| France | € 15,941 | € 16,677 | € 17,520 | € 17,959 | € 19,377 | € 20,000 | € 20,600 | € 20,906 | € 21,147 |
| Italy | € 13,420 | € 12,395 | € 12,874 | € 14,699 | € 14,172 | € 14,438 | € 14,754 | € 16,148 | € 14,483 |
| Netherlands | € 8,111 | € 9,170 | € 9,733 | € 10,172 | € 10,494 | € 10,106 | € 10,290 | € 10,241 | € 9,641 |
| Poland | € 1,716 | € 1,913 | € 1,880 | € 2,547 | € 2,203 | € 2,517 | € 2,642 | € 2,316 | € 2,773 |
| Sweden | € 1,253 | € 1,341 | € 1,068 | € 1,058 | € 1,239 | € 1,107 | € 1,216 | € 1,269 | € 1,306 |
| United Kingdom | € 11,628 | € 18,521 | € 19,469 | € 17,164 | € 16,642 | € 18,182 | € 16,776 | € 18,361 | € 16,151 |
| 9 countries average | € 7,446 | € 8,630 | € 8,705 | € 8,858 | € 9,373 | € 9,481 | € 9,652 | € 10,026 | € 9,703 |

## Table 49. Housing and community amenities expenditure by country and by year – €million

| Country | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|
| EU-28 European Union | | € 109,406 | € 116,149 | € 116,810 | € 122,442 | € 102,243 | € 92,258 | € 93,876 | € 94,675 |
| Belgium | € 1,244 | € 1,309 | € 1,379 | € 1,066 | € 1,049 | € 1,464 | € 1,521 | € 1,553 | € 1,186 |
| Denmark | € 639 | € 451 | € 700 | € 965 | € 1,151 | € 724 | € 739 | € 752 | € 759 |
| Germany | € 22,980 | € 21,504 | € 20,103 | € 17,899 | € 17,209 | € 15,448 | € 13,484 | € 10,998 | € 11,244 |
| France | € 19,484 | € 20,383 | € 23,360 | € 23,946 | € 29,065 | € 28,000 | € 28,840 | € 29,269 | € 29,606 |
| Italy | € 8,947 | € 10,846 | € 9,655 | € 11,432 | € 12,597 | € 11,229 | € 9,836 | € 12,918 | € 11,265 |
| Netherlands | € 2,163 | € 2,292 | € 2,433 | € 3,179 | € 4,321 | € 3,790 | € 3,216 | € 3,200 | € 3,214 |
| Poland | € 3,431 | € 3,280 | € 3,447 | € 4,003 | € 3,462 | € 2,877 | € 3,019 | € 3,088 | € 2,773 |
| Sweden | € 2,505 | € 2,346 | € 2,493 | € 2,468 | € 2,477 | € 2,582 | € 2,837 | € 2,962 | € 3,048 |
| United Kingdom | € 19,379 | € 20,579 | € 23,795 | € 20,978 | € 21,634 | € 18,182 | € 14,912 | € 16,321 | € 14,132 |
| 9 countries average | € 8,975 | € 9,221 | € 9,707 | € 9,548 | € 10,330 | € 9,366 | € 8,711 | € 9,007 | € 8,581 |

## Table 50. Health expenditure by country and by year – Million euro

| Country | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|
| EU-28 European Union | | € 802,312 | € 838,852 | € 882,565 | € 906,070 | € 932,966 | € 935,755 | € 965,587 | € 973,799 |
| Belgium | € 21,150 | € 21,596 | € 23,106 | € 25,228 | € 26,929 | € 27,813 | € 29,278 | € 30,663 | € 31,234 |
| Denmark | € 15,336 | € 16,474 | € 17,967 | € 19,054 | € 20,488 | € 20,756 | € 20,932 | € 22,073 | € 21,997 |
| Germany | € 149,372 | € 152,919 | € 158,310 | € 163,650 | € 174,550 | € 180,231 | € 183,379 | € 186,959 | € 196,768 |
| France | € 134,615 | € 140,830 | € 144,054 | € 147,666 | € 153,078 | € 158,002 | € 162,740 | € 167,249 | € 171,290 |
| Italy | € 101,396 | € 106,911 | € 107,819 | € 114,323 | € 118,101 | € 118,711 | € 116,396 | € 116,266 | € 115,867 |
| Netherlands | € 29,739 | € 39,544 | € 41,364 | € 43,866 | € 48,149 | € 49,267 | € 50,807 | € 53,766 | € 53,345 |
| Poland | € 10,784 | € 12,572 | € 14,102 | € 18,194 | € 15,738 | € 17,982 | € 17,736 | € 18,145 | € 18,219 |
| Sweden | € 20,356 | € 21,453 | € 22,790 | € 23,270 | € 21,986 | € 25,081 | € 27,563 | € 29,192 | € 30,476 |
| United Kingdom | € 127,905 | € 139,937 | € 147,095 | € 137,309 | € 133,132 | € 141,818 | € 141,661 | € 153,010 | € 153,431 |
| 9 countries average | € 67,850 | € 72,470 | € 75,179 | € 76,951 | € 79,128 | € 82,185 | € 83,388 | € 86,369 | € 88,070 |

## Table 51. Recreation, culture and religion expenditure by country and by year – €million

| Country | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|
| EU-28 European Union | | € 133,719 | € 141,960 | € 142,768 | € 146,930 | € 140,584 | € 144,976 | € 147,520 | € 135,250 |
| Belgium | € 4,043 | € 3,927 | € 4,138 | € 4,264 | € 3,847 | € 4,391 | € 4,563 | € 5,046 | € 5,140 |
| Denmark | € 3,408 | € 3,385 | € 3,967 | € 4,341 | € 4,374 | € 4,344 | € 4,433 | € 4,766 | € 4,551 |
| Germany | € 18,384 | € 19,115 | € 20,103 | € 20,456 | € 19,668 | € 20,598 | € 21,574 | € 21,995 | € 22,488 |
| France | € 23,026 | € 24,089 | € 25,307 | € 25,941 | € 27,128 | € 28,000 | € 28,840 | € 29,269 | € 31,720 |
| Italy | € 13,420 | € 12,395 | € 12,874 | € 13,066 | € 14,172 | € 12,834 | € 8,197 | € 11,304 | € 11,265 |
| Netherlands | € 8,651 | € 9,170 | € 9,125 | € 10,808 | € 11,111 | € 11,369 | € 10,933 | € 10,881 | € 10,283 |
| Poland | € 2,451 | € 3,006 | € 3,447 | € 4,730 | € 4,092 | € 4,675 | € 4,906 | € 4,247 | € 4,357 |
| Sweden | € 3,132 | € 3,352 | € 3,561 | € 3,878 | € 3,406 | € 4,057 | € 4,459 | € 4,654 | € 4,789 |
| United Kingdom | € 19,379 | € 18,521 | € 19,469 | € 19,071 | € 16,642 | € 18,182 | € 16,776 | € 18,361 | € 16,151 |
| 9 countries average | € 10,655 | € 10,773 | € 11,332 | € 11,839 | € 11,604 | € 12,050 | € 11,631 | € 12,280 | € 12,305 |

## Table 52. Education expenditure by country and by year – €million

| Country | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|
| EU-28 European Union | | € 607,812 | € 632,365 | € 648,945 | € 648,942 | € 677,359 | € 672,162 | € 670,546 | € 676,249 |
| Belgium | € 17,729 | € 18,324 | € 18,967 | € 20,253 | € 20,984 | € 22,323 | € 23,954 | € 24,453 | € 25,303 |
| Denmark | € 13,632 | € 13,991 | € 13,767 | € 14,712 | € 16,114 | € 17,377 | € 16,992 | € 17,809 | € 17,699 |
| Germany | € 94,219 | € 95,574 | € 98,001 | € 99,724 | € 105,713 | € 113,288 | € 115,960 | € 118,224 | € 120,872 |
| France | € 97,418 | € 101,916 | € 103,174 | € 107,756 | € 110,448 | € 112,002 | € 113,300 | € 114,983 | € 116,308 |
| Italy | € 67,100 | € 69,725 | € 72,416 | € 71,860 | € 72,435 | € 70,585 | € 67,214 | € 66,207 | € 65,980 |
| Netherlands | € 28,658 | € 30,374 | € 31,632 | € 33,694 | € 35,186 | € 36,003 | € 36,015 | € 35,844 | € 35,349 |
| Poland | € 14,951 | € 16,398 | € 17,863 | € 20,741 | € 16,997 | € 20,140 | € 20,755 | € 20,847 | € 20,992 |
| Sweden | € 20,982 | € 22,123 | € 22,434 | € 22,917 | € 21,057 | € 23,975 | € 26,347 | € 27,500 | € 28,734 |
| United Kingdom | € 112,401 | € 123,473 | € 127,627 | € 118,238 | € 109,834 | € 120,000 | € 111,838 | € 118,328 | € 111,035 |
| 9 countries average | € 51,899 | € 54,655 | € 56,209 | € 56,655 | € 56,530 | € 59,521 | € 59,153 | € 60,466 | € 60,253 |

## Table 53. Social protection expenditure by country and by year – Million euro

| Country | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|
| EU-28 European Union | | € 2,127,341 | € 2,206,825 | € 2,271,306 | € 2,387,617 | € 2,479,388 | € 2,517,314 | € 2,601,719 | € 2,650,896 |
| Belgium | € 52,876 | € 55,299 | € 57,247 | € 61,116 | € 66,448 | € 67,702 | € 70,342 | € 74,523 | € 77,887 |
| Denmark | € 48,352 | € 48,970 | € 50,169 | € 52,096 | € 56,170 | € 60,578 | € 61,319 | € 62,456 | € 63,463 |
| Germany | € 475,691 | € 473,092 | € 472,417 | € 478,165 | € 506,440 | € 512,370 | € 509,685 | € 516,886 | € 531,274 |
| France | € 377,275 | € 398,401 | € 420,483 | € 435,017 | € 459,233 | € 472,007 | € 488,219 | € 503,837 | € 518,101 |
| Italy | € 259,454 | € 269,602 | € 281,618 | € 295,607 | € 311,786 | € 317,631 | € 324,596 | € 331,035 | € 337,947 |
| Netherlands | € 82,188 | € 84,819 | € 88,204 | € 93,454 | € 100,619 | € 104,851 | € 106,116 | € 108,172 | € 110,546 |
| Poland | € 42,401 | € 46,461 | € 49,201 | € 57,492 | € 51,621 | € 60,059 | € 59,625 | € 61,384 | € 64,164 |
| Sweden | € 70,462 | € 72,402 | € 72,999 | € 71,924 | € 68,436 | € 77,826 | € 82,690 | € 89,269 | € 94,040 |
| United Kingdom | € 296,506 | € 306,626 | € 322,312 | € 295,595 | € 287,899 | € 314,546 | € 318,738 | € 354,984 | € 341,182 |
| 9 countries average | € 189,467 | € 195,074 | € 201,628 | € 204,496 | € 212,072 | € 220,841 | € 224,592 | € 233,616 | € 237,622 |

## Table 54. General public service expenditure by year (% of GDP)

| Country | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|
| EU-28 European Union | : | 6.4 | 6.4 | 6.6 | 6.7 | 6.7 | 6.9 | 6.9 | 6.8 |
| Belgium | 9.2 | 8.5 | 8.6 | 8.6 | 9.1 | 8.5 | 8.5 | 8.6 | 8.5 |
| Denmark | 6.8 | 6.8 | 6.7 | 7.1 | 7.9 | 7.9 | 8.2 | 9.3 | 7.8 |
| Germany | 6.3 | 6.2 | 6.1 | 6.4 | 6.6 | 6.5 | 6.6 | 6.4 | 6.4 |
| France | 7.4 | 6.9 | 7.1 | 7.2 | 7.2 | 6.8 | 6.8 | 6.8 | 6.8 |
| Italy | 8.7 | 8.4 | 8.6 | 8.9 | 8.6 | 8.3 | 8.6 | 9.3 | 8.9 |
| Netherlands | 6.0 | 5.8 | 5.5 | 5.7 | 5.5 | 5.7 | 5.3 | 5.2 | 5.1 |
| Poland | 5.9 | 5.7 | 5.4 | 5.4 | 5.6 | 5.7 | 5.6 | 5.8 | 5.7 |
| Sweden | 7.8 | 7.7 | 7.7 | 7.8 | 7.4 | 7.4 | 7.6 | 7.7 | 7.8 |
| United Kingdom | 4.6 | 4.6 | 4.6 | 4.7 | 4.7 | 5.5 | 5.7 | 5.4 | 5.7 |
| Average 9 countries | 7.0 | 6.7 | 6.7 | 6.9 | 7.0 | 6.9 | 7.0 | 7.2 | 7.0 |

## Table 55. Defence expenditure by year (% of GDP)

| Country | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|
| EU-28 European Union | : | 1.5 | 1.4 | 1.5 | 1.5 | 1.5 | 1.5 | 1.4 | 1.4 |
| Belgium | 1.1 | 1.0 | 1.0 | 1.1 | 1.0 | 1.0 | 0.9 | 0.9 | 0.9 |
| Denmark | 1.4 | 1.5 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.3 |
| Germany | 1.0 | 1.0 | 0.9 | 1.0 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| France | 1.8 | 1.8 | 1.7 | 1.7 | 1.9 | 1.9 | 1.8 | 1.8 | 1.8 |
| Italy | 1.2 | 1.2 | 1.2 | 1.3 | 1.4 | 1.3 | 1.3 | 1.3 | 1.2 |
| Netherlands | 1.3 | 1.3 | 1.3 | 1.3 | 1.4 | 1.3 | 1.3 | 1.2 | 1.2 |
| Poland | 1.6 | 1.6 | 1.9 | 1.9 | 1.5 | 1.7 | 1.6 | 1.5 | 1.7 |
| Sweden | 1.7 | 1.6 | 1.5 | 1.5 | 1.5 | 1.5 | 1.4 | 1.4 | 1.5 |
| United Kingdom | 2.4 | 2.4 | 2.3 | 2.5 | 2.6 | 2.6 | 2.5 | 2.4 | 2.3 |
| Average 9 countries | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.4 | 1.4 |

## Table 56. Public order and safety expenditure by year (% of GDP)

| Country | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|
| EU-28 European Union | : | 1.8 | 1.8 | 1.8 | 1.9 | 1.9 | 1.8 | 1.8 | 1.8 |
| Belgium | 1.6 | 1.7 | 1.6 | 1.7 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 |
| Denmark | 0.9 | 0.9 | 0.9 | 1.0 | 1.1 | 1.0 | 1.1 | 1.0 | 1.0 |
| Germany | 1.6 | 1.5 | 1.5 | 1.5 | 1.6 | 1.6 | 1.6 | 1.5 | 1.6 |
| France | 1.5 | 1.5 | 1.5 | 1.5 | 1.7 | 1.7 | 1.6 | 1.6 | 1.6 |
| Italy | 2.0 | 1.9 | 1.9 | 1.8 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Netherlands | 1.7 | 1.8 | 1.8 | 1.9 | 2.0 | 1.9 | 1.9 | 1.9 | 2.0 |
| Poland | 2.1 | 2.2 | 2.2 | 2.4 | 2.4 | 2.4 | 2.3 | 2.3 | 2.2 |
| Sweden | 1.3 | 1.3 | 1.3 | 1.3 | 1.4 | 1.4 | 1.3 | 1.4 | 1.4 |
| United Kingdom | 2.4 | 2.4 | 2.4 | 2.5 | 2.7 | 2.5 | 2.4 | 2.3 | 2.2 |
| Average 9 countries | 1.7 | 1.7 | 1.7 | 1.7 | 1.9 | 1.8 | 1.8 | 1.8 | 1.8 |

## Table 57. Economic affair expenditure by year (% of GDP)

| Country | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|
| EU-28 European Union | : | 4.2 | 4.0 | 4.6 | 4.9 | 5.1 | 4.4 | 4.6 | 4.3 |
| Belgium | 7.2 | 5.2 | 5.4 | 5.9 | 6.4 | 6.6 | 7.0 | 7.5 | 6.6 |
| Denmark | 3.3 | 3.1 | 2.9 | 2.8 | 3.3 | 3.4 | 3.4 | 3.7 | 3.6 |
| Germany | 3.5 | 3.3 | 3.1 | 3.5 | 3.9 | 4.7 | 3.4 | 3.4 | 3.3 |
| France | 4.6 | 4.5 | 4.3 | 4.5 | 4.9 | 5.1 | 4.8 | 5.0 | 4.9 |
| Italy | 4.2 | 5.1 | 4.2 | 4.0 | 4.6 | 4.1 | 4.2 | 4.1 | 4.2 |
| Netherlands | 4.2 | 4.1 | 4.2 | 4.4 | 5.4 | 5.2 | 4.8 | 4.5 | 3.9 |
| Poland | 3.9 | 4.5 | 4.7 | 5.3 | 5.7 | 6.0 | 5.7 | 4.8 | 4.1 |
| Sweden | 4.2 | 4.0 | 3.9 | 4.2 | 4.5 | 4.4 | 4.3 | 4.5 | 4.3 |
| United Kingdom | 3.1 | 3.1 | 3.0 | 5.1 | 4.5 | 3.3 | 2.9 | 3.6 | 3.1 |
| Average 9 countries | 4.2 | 4.1 | 4.0 | 4.4 | 4.8 | 4.8 | 4.5 | 4.6 | 4.2 |

## Table 58. Environment protection expenditure by year (% of GDP)

| Country | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|
| EU-28 European Union | : | 0.8 | 0.8 | 0.8 | 0.9 | 0.9 | 0.8 | 0.8 | 0.8 |
| Belgium | 0.7 | 0.6 | 0.6 | 0.6 | 0.6 | 0.7 | 0.9 | 0.9 | 1.0 |
| Denmark | 0.6 | 0.6 | 0.5 | 0.5 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| Germany | 0.5 | 0.6 | 0.5 | 0.5 | 0.7 | 0.6 | 0.6 | 0.6 | 0.6 |
| France | 0.9 | 0.9 | 0.9 | 0.9 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Italy | 0.9 | 0.8 | 0.8 | 0.9 | 0.9 | 0.9 | 0.9 | 1.0 | 0.9 |
| Netherlands | 1.5 | 1.6 | 1.6 | 1.6 | 1.7 | 1.6 | 1.6 | 1.6 | 1.5 |
| Poland | 0.7 | 0.7 | 0.6 | 0.7 | 0.7 | 0.7 | 0.7 | 0.6 | 0.7 |
| Sweden | 0.4 | 0.4 | 0.3 | 0.3 | 0.4 | 0.3 | 0.3 | 0.3 | 0.3 |
| United Kingdom | 0.6 | 0.9 | 0.9 | 0.9 | 1.0 | 1.0 | 0.9 | 0.9 | 0.8 |
| Average 9 countries | 0.8 | 0.8 | 0.7 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |

## Table 59. Housing and community amenities expenditure by year (% of GDP)

| Country | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|
| EU-28 European Union | : | 0.9 | 0.9 | 0.9 | 1.0 | 0.8 | 0.7 | 0.7 | 0.7 |
| Belgium | 0.4 | 0.4 | 0.4 | 0.3 | 0.3 | 0.4 | 0.4 | 0.4 | 0.3 |
| Denmark | 0.3 | 0.2 | 0.3 | 0.4 | 0.5 | 0.3 | 0.3 | 0.3 | 0.3 |
| Germany | 1.0 | 0.9 | 0.8 | 0.7 | 0.7 | 0.6 | 0.5 | 0.4 | 0.4 |
| France | 1.1 | 1.1 | 1.2 | 1.2 | 1.5 | 1.4 | 1.4 | 1.4 | 1.4 |
| Italy | 0.6 | 0.7 | 0.6 | 0.7 | 0.8 | 0.7 | 0.6 | 0.8 | 0.7 |
| Netherlands | 0.4 | 0.4 | 0.4 | 0.5 | 0.7 | 0.6 | 0.5 | 0.5 | 0.5 |
| Poland | 1.4 | 1.2 | 1.1 | 1.1 | 1.1 | 0.8 | 0.8 | 0.8 | 0.7 |
| Sweden | 0.8 | 0.7 | 0.7 | 0.7 | 0.8 | 0.7 | 0.7 | 0.7 | 0.7 |
| United Kingdom | 1.0 | 1.0 | 1.1 | 1.1 | 1.3 | 1.0 | 0.8 | 0.8 | 0.7 |
| Average 9 countries | 0.8 | 0.7 | 0.7 | 0.7 | 0.9 | 0.7 | 0.7 | 0.7 | 0.6 |

## Table 60. Health expenditure by year (% of GDP)

| Country | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|
| EU-28 European Union | : | 6.6 | 6.5 | 6.8 | 7.4 | 7.3 | 7.1 | 7.2 | 7.2 |
| Belgium | 6.8 | 6.6 | 6.7 | 7.1 | 7.7 | 7.6 | 7.7 | 7.9 | 7.9 |
| Denmark | 7.2 | 7.3 | 7.7 | 7.9 | 8.9 | 8.6 | 8.5 | 8.8 | 8.7 |
| Germany | 6.5 | 6.4 | 6.3 | 6.4 | 7.1 | 7.0 | 6.8 | 6.8 | 7.0 |
| France | 7.6 | 7.6 | 7.4 | 7.4 | 7.9 | 7.9 | 7.9 | 8.0 | 8.1 |
| Italy | 6.8 | 6.9 | 6.7 | 7.0 | 7.5 | 7.4 | 7.1 | 7.2 | 7.2 |
| Netherlands | 5.5 | 6.9 | 6.8 | 6.9 | 7.8 | 7.8 | 7.9 | 8.4 | 8.3 |
| Poland | 4.4 | 4.6 | 4.5 | 5.0 | 5.0 | 5.0 | 4.7 | 4.7 | 4.6 |
| Sweden | 6.5 | 6.4 | 6.4 | 6.6 | 7.1 | 6.8 | 6.8 | 6.9 | 7.0 |
| United Kingdom | 6.6 | 6.8 | 6.8 | 7.2 | 8.0 | 7.8 | 7.6 | 7.5 | 7.6 |
| Average 9 countries | 6.4 | 6.6 | 6.6 | 6.8 | 7.4 | 7.3 | 7.2 | 7.4 | 7.4 |

## Table 61. Recreation, culture and religion expenditure by year (% of GDP)

| Country | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|
| EU-28 European Union | : | 1.1 | 1.1 | 1.1 | 1.2 | 1.1 | 1.1 | 1.1 | 1.0 |
| Belgium | 1.3 | 1.2 | 1.2 | 1.2 | 1.1 | 1.2 | 1.2 | 1.3 | 1.3 |
| Denmark | 1.6 | 1.5 | 1.7 | 1.8 | 1.9 | 1.8 | 1.8 | 1.9 | 1.8 |
| Germany | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| France | 1.3 | 1.3 | 1.3 | 1.3 | 1.4 | 1.4 | 1.4 | 1.4 | 1.5 |
| Italy | 0.9 | 0.8 | 0.8 | 0.8 | 0.9 | 0.8 | 0.5 | 0.7 | 0.7 |
| Netherlands | 1.6 | 1.6 | 1.5 | 1.7 | 1.8 | 1.8 | 1.7 | 1.7 | 1.6 |
| Poland | 1.0 | 1.1 | 1.1 | 1.3 | 1.3 | 1.3 | 1.3 | 1.1 | 1.1 |
| Sweden | 1.0 | 1.0 | 1.0 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| United Kingdom | 1.0 | 0.9 | 0.9 | 1.0 | 1.0 | 1.0 | 0.9 | 0.9 | 0.8 |
| Average 9 countries | 1.2 | 1.1 | 1.1 | 1.2 | 1.3 | 1.2 | 1.2 | 1.2 | 1.2 |

## Table 62. Education expenditure by year (% of GDP)

| Country | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|
| EU-28 European Union | : | 5.0 | 4.9 | 5.0 | 5.3 | 5.3 | 5.1 | 5.0 | 5.0 |
| Belgium | 5.7 | 5.6 | 5.5 | 5.7 | 6.0 | 6.1 | 6.3 | 6.3 | 6.4 |
| Denmark | 6.4 | 6.2 | 5.9 | 6.1 | 7.0 | 7.2 | 6.9 | 7.1 | 7.0 |
| Germany | 4.1 | 4.0 | 3.9 | 3.9 | 4.3 | 4.4 | 4.3 | 4.3 | 4.3 |
| France | 5.5 | 5.5 | 5.3 | 5.4 | 5.7 | 5.6 | 5.5 | 5.5 | 5.5 |
| Italy | 4.5 | 4.5 | 4.5 | 4.4 | 4.6 | 4.4 | 4.1 | 4.1 | 4.1 |
| Netherlands | 5.3 | 5.3 | 5.2 | 5.3 | 5.7 | 5.7 | 5.6 | 5.6 | 5.5 |
| Poland | 6.1 | 6.0 | 5.7 | 5.7 | 5.4 | 5.6 | 5.5 | 5.4 | 5.3 |
| Sweden | 6.7 | 6.6 | 6.3 | 6.5 | 6.8 | 6.5 | 6.5 | 6.5 | 6.6 |
| United Kingdom | 5.8 | 6.0 | 5.9 | 6.2 | 6.6 | 6.6 | 6.0 | 5.8 | 5.5 |
| Average 9 countries | 5.6 | 5.5 | 5.4 | 5.5 | 5.8 | 5.8 | 5.6 | 5.6 | 5.6 |

## Table 63. Social protection expenditure by year (% of GDP)

| Country | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|
| EU-28 European Union | : | 17.5 | 17.1 | 17.5 | 19.5 | 19.4 | 19.1 | 19.4 | 19.6 |
| Belgium | 17.0 | 16.9 | 16.6 | 17.2 | 19.0 | 18.5 | 18.5 | 19.2 | 19.7 |
| Denmark | 22.7 | 21.7 | 21.5 | 21.6 | 24.4 | 25.1 | 24.9 | 24.9 | 25.1 |
| Germany | 20.7 | 19.8 | 18.8 | 18.7 | 20.6 | 19.9 | 18.9 | 18.8 | 18.9 |
| France | 21.3 | 21.5 | 21.6 | 21.8 | 23.7 | 23.6 | 23.7 | 24.1 | 24.5 |
| Italy | 17.4 | 17.4 | 17.5 | 18.1 | 19.8 | 19.8 | 19.8 | 20.5 | 21.0 |
| Netherlands | 15.2 | 14.8 | 14.5 | 14.7 | 16.3 | 16.6 | 16.5 | 16.9 | 17.2 |
| Poland | 17.3 | 17.0 | 15.7 | 15.8 | 16.4 | 16.7 | 15.8 | 15.9 | 16.2 |
| Sweden | 22.5 | 21.6 | 20.5 | 20.4 | 22.1 | 21.1 | 20.4 | 21.1 | 21.6 |
| United Kingdom | 15.3 | 14.9 | 14.9 | 15.5 | 17.3 | 17.3 | 17.1 | 17.4 | 16.9 |
| Average 9 countries | 18.8 | 18.4 | 18.0 | 18.2 | 20.0 | 19.8 | 19.5 | 19.9 | 20.1 |

## Table 64. General public services expenditure by year (% Total general government expenditure)

| Country | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|
| EU-28 European Union | | 14.0 | 14.3 | 14.2 | 13.3 | 13.4 | 14.2 | 14.1 | 14.0 |
| Belgium | 18.1 | 17.8 | 18.1 | 17.4 | 17.1 | 16.3 | 16.0 | 15.7 | 15.6 |
| Denmark | 13.3 | 13.7 | 13.5 | 14.1 | 13.9 | 13.8 | 14.4 | 15.8 | 13.7 |
| Germany | 13.7 | 13.9 | 14.3 | 14.7 | 13.9 | 13.8 | 14.8 | 14.5 | 14.4 |
| France | 14.0 | 13.1 | 13.6 | 13.6 | 12.7 | 12.1 | 12.2 | 12.0 | 11.9 |
| Italy | 18.5 | 17.6 | 18.4 | 18.6 | 16.8 | 16.6 | 17.5 | 18.3 | 17.5 |
| Netherlands | 14.1 | 13.3 | 12.9 | 13.0 | 11.4 | 11.8 | 11.3 | 10.9 | 10.9 |
| Poland | 13.3 | 12.8 | 12.5 | 12.2 | 12.4 | 12.4 | 12.8 | 13.5 | 13.5 |
| Sweden | 14.8 | 15.0 | 15.5 | 15.5 | 13.9 | 14.5 | 15.0 | 14.9 | 14.9 |
| United Kingdom | 10.7 | 10.7 | 10.7 | 10.1 | 9.5 | 11.3 | 12.2 | 11.5 | 12.5 |
| 9 countries average | 14.5 | 14.2 | 14.4 | 14.4 | 13.5 | 13.6 | 14.0 | 14.1 | 13.9 |

## Table 65. Defence expenditure by year (% Total general government expenditure)

| Country | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|
| EU-28 European Union | | 3.3 | 3.1 | 3.2 | 3.0 | 3.0 | 3.1 | 2.9 | 2.9 |
| Belgium | 2.2 | 2.1 | 2.1 | 2.2 | 1.9 | 1.9 | 1.7 | 1.6 | 1.7 |
| Denmark | 2.7 | 3.0 | 2.8 | 2.8 | 2.5 | 2.5 | 2.5 | 2.4 | 2.3 |
| Germany | 2.2 | 2.2 | 2.1 | 2.3 | 2.3 | 2.3 | 2.5 | 2.5 | 2.5 |
| France | 3.4 | 3.4 | 3.3 | 3.2 | 3.3 | 3.4 | 3.2 | 3.2 | 3.2 |
| Italy | 2.5 | 2.5 | 2.6 | 2.7 | 2.7 | 2.6 | 2.6 | 2.6 | 2.4 |
| Netherlands | 3.0 | 3.0 | 3.0 | 3.0 | 2.9 | 2.7 | 2.8 | 2.5 | 2.6 |
| Poland | 3.6 | 3.6 | 4.4 | 4.3 | 3.3 | 3.7 | 3.6 | 3.5 | 4.0 |
| Sweden | 3.2 | 3.1 | 3.0 | 3.0 | 2.8 | 2.9 | 2.8 | 2.7 | 2.9 |
| United Kingdom | 5.6 | 5.6 | 5.4 | 5.4 | 5.2 | 5.3 | 5.3 | 5.1 | 5.1 |
| 9 countries average | 3.2 | 3.2 | 3.2 | 3.2 | 3.0 | 3.0 | 3.0 | 2.9 | 2.9 |

## Table 66. Public order and safety expenditure by year (% Total general government expenditure)

| Country | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|
| EU-28 European Union | | 3.9 | 4.0 | 3.9 | 3.8 | 3.8 | 3.7 | 3.7 | 3.7 |
| Belgium | 3.1 | 3.6 | 3.4 | 3.4 | 3.4 | 3.4 | 3.4 | 3.3 | 3.3 |
| Denmark | 1.8 | 1.8 | 1.8 | 2.0 | 1.9 | 1.8 | 1.9 | 1.7 | 1.8 |
| Germany | 3.5 | 3.4 | 3.5 | 3.4 | 3.4 | 3.4 | 3.6 | 3.4 | 3.6 |
| France | 2.8 | 2.9 | 2.9 | 2.8 | 3.0 | 3.0 | 2.9 | 2.8 | 2.8 |
| Italy | 4.2 | 4.0 | 4.1 | 3.8 | 3.9 | 4.0 | 4.1 | 3.9 | 3.9 |
| Netherlands | 4.0 | 4.1 | 4.2 | 4.3 | 4.1 | 3.9 | 4.0 | 4.0 | 4.3 |
| Poland | 4.7 | 4.9 | 5.1 | 5.4 | 5.3 | 5.2 | 5.2 | 5.4 | 5.2 |
| Sweden | 2.5 | 2.5 | 2.6 | 2.6 | 2.6 | 2.7 | 2.6 | 2.7 | 2.7 |
| United Kingdom | 5.6 | 5.6 | 5.6 | 5.4 | 5.4 | 5.1 | 5.1 | 4.9 | 4.8 |
| 9 countries average | 3.6 | 3.6 | 3.7 | 3.7 | 3.7 | 3.6 | 3.6 | 3.6 | 3.6 |

## Table 67. Economic affairs expenditure by year (% Total general government expenditure)

| Country | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|
| EU-28 European Union | | 9.2 | 8.9 | 9.9 | 9.7 | 10.2 | 9.1 | 9.4 | 8.8 |
| Belgium | 14.1 | 10.9 | 11.3 | 11.9 | 12.0 | 12.6 | 13.2 | 13.7 | 12.1 |
| Denmark | 6.4 | 6.2 | 5.8 | 5.5 | 5.8 | 6.0 | 6.0 | 6.3 | 6.3 |
| Germany | 7.6 | 7.4 | 7.3 | 8.0 | 8.2 | 10.0 | 7.6 | 7.7 | 7.4 |
| France | 8.7 | 8.6 | 8.2 | 8.5 | 8.6 | 9.0 | 8.6 | 8.8 | 8.6 |
| Italy | 8.9 | 10.7 | 9.0 | 8.4 | 9.0 | 8.2 | 8.6 | 8.1 | 8.3 |
| Netherlands | 9.8 | 9.4 | 9.8 | 10.0 | 11.2 | 10.8 | 10.2 | 9.5 | 8.3 |
| Poland | 8.8 | 10.1 | 10.9 | 11.9 | 12.6 | 13.1 | 13.0 | 11.2 | 9.7 |
| Sweden | 8.0 | 7.8 | 7.8 | 8.3 | 8.5 | 8.6 | 8.5 | 8.7 | 8.2 |
| United Kingdom | 7.2 | 7.2 | 7.0 | 10.9 | 9.1 | 6.8 | 6.2 | 7.7 | 6.8 |
| 9 countries average | 8.8 | 8.7 | 8.6 | 9.3 | 9.4 | 9.4 | 9.1 | 9.1 | 8.4 |

## Table 68. Environment protection expenditure by year (% Total general government expenditure)

| Country | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|
| EU-28 European Union | | 1.8 | 1.8 | 1.7 | 1.8 | 1.8 | 1.6 | 1.6 | 1.6 |
| Belgium | 1.4 | 1.3 | 1.3 | 1.2 | 1.1 | 1.3 | 1.7 | 1.6 | 1.8 |
| Denmark | 1.2 | 1.2 | 1.0 | 1.0 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| Germany | 1.1 | 1.3 | 1.2 | 1.1 | 1.5 | 1.3 | 1.3 | 1.4 | 1.4 |
| France | 1.7 | 1.7 | 1.7 | 1.7 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 |
| Italy | 1.9 | 1.7 | 1.7 | 1.9 | 1.8 | 1.8 | 1.8 | 2.0 | 1.8 |
| Netherlands | 3.5 | 3.7 | 3.7 | 3.7 | 3.5 | 3.3 | 3.4 | 3.4 | 3.2 |
| Poland | 1.6 | 1.6 | 1.4 | 1.6 | 1.5 | 1.5 | 1.6 | 1.4 | 1.7 |
| Sweden | 0.8 | 0.8 | 0.6 | 0.6 | 0.8 | 0.6 | 0.6 | 0.6 | 0.6 |
| United Kingdom | 1.4 | 2.1 | 2.1 | 1.9 | 2.0 | 2.1 | 1.9 | 1.9 | 1.8 |
| 9 countries average | 1.6 | 1.7 | 1.6 | 1.6 | 1.6 | 1.6 | 1.7 | 1.6 | 1.6 |

## Table 69. Housing and community amenities expenditure by year (% Total general government expenditure)

| Country | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|
| EU-28 European Union | | 2.0 | 2.0 | 1.9 | 2.0 | 1.6 | 1.4 | 1.4 | 1.4 |
| Belgium | 0.8 | 0.8 | 0.8 | 0.6 | 0.6 | 0.8 | 0.8 | 0.7 | 0.6 |
| Denmark | 0.6 | 0.4 | 0.6 | 0.8 | 0.9 | 0.5 | 0.5 | 0.5 | 0.5 |
| Germany | 2.2 | 2.0 | 1.9 | 1.6 | 1.5 | 1.3 | 1.1 | 0.9 | 0.9 |
| France | 2.1 | 2.1 | 2.3 | 2.3 | 2.6 | 2.5 | 2.5 | 2.5 | 2.5 |
| Italy | 1.3 | 1.5 | 1.3 | 1.5 | 1.6 | 1.4 | 1.2 | 1.6 | 1.4 |
| Netherlands | 0.9 | 0.9 | 0.9 | 1.1 | 1.5 | 1.2 | 1.1 | 1.1 | 1.1 |
| Poland | 3.2 | 2.7 | 2.6 | 2.5 | 2.4 | 1.7 | 1.8 | 1.9 | 1.7 |
| Sweden | 1.5 | 1.4 | 1.4 | 1.4 | 1.5 | 1.4 | 1.4 | 1.4 | 1.3 |
| United Kingdom | 2.3 | 2.3 | 2.6 | 2.4 | 2.6 | 2.1 | 1.7 | 1.7 | 1.5 |
| 9 countries average | 1.6 | 1.6 | 1.6 | 1.6 | 1.7 | 1.4 | 1.3 | 1.4 | 1.3 |

## Table 70. Health expenditure by year (% Total general government expenditure)

| Country | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|
| EU-28 European Union | | 14.5 | 14.5 | 14.6 | 14.7 | 14.6 | 14.6 | 14.7 | 14.8 |
| Belgium | 13.4 | 13.8 | 14.1 | 14.4 | 14.5 | 14.5 | 14.5 | 14.4 | 14.5 |
| Denmark | 14.1 | 14.7 | 15.5 | 15.6 | 15.7 | 15.1 | 15.0 | 15.0 | 15.2 |
| Germany | 14.1 | 14.3 | 14.8 | 14.7 | 15.0 | 14.8 | 15.2 | 15.4 | 15.8 |
| France | 14.4 | 14.5 | 14.2 | 14.0 | 13.9 | 14.0 | 14.1 | 14.1 | 14.2 |
| Italy | 14.4 | 14.5 | 14.3 | 14.6 | 14.7 | 14.8 | 14.5 | 14.2 | 14.2 |
| Netherlands | 12.9 | 15.9 | 15.9 | 15.8 | 16.2 | 16.2 | 16.8 | 17.7 | 17.7 |
| Poland | 9.9 | 10.3 | 10.4 | 11.3 | 11.1 | 10.9 | 10.7 | 11.0 | 10.9 |
| Sweden | 12.3 | 12.5 | 12.9 | 13.1 | 13.4 | 13.3 | 13.5 | 13.3 | 13.4 |
| United Kingdom | 15.4 | 15.8 | 15.9 | 15.5 | 16.1 | 16.0 | 16.2 | 16.0 | 16.7 |
| 9 countries average | 13.4 | 14.0 | 14.2 | 14.3 | 14.5 | 14.4 | 14.5 | 14.6 | 14.7 |

## Table 71. Recreation, culture and religion expenditure by year (% Total general government expenditure)

| Country | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|
| EU-28 European Union | | 2.4 | 2.4 | 2.4 | 2.4 | 2.2 | 2.3 | 2.2 | 2.1 |
| Belgium | 2.6 | 2.5 | 2.5 | 2.4 | 2.1 | 2.3 | 2.3 | 2.4 | 2.4 |
| Denmark | 3.1 | 3.0 | 3.4 | 3.6 | 3.3 | 3.2 | 3.2 | 3.2 | 3.2 |
| Germany | 1.7 | 1.8 | 1.9 | 1.8 | 1.7 | 1.7 | 1.8 | 1.8 | 1.8 |
| France | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.6 |
| Italy | 1.9 | 1.7 | 1.7 | 1.7 | 1.8 | 1.6 | 1.0 | 1.4 | 1.4 |
| Netherlands | 3.7 | 3.7 | 3.5 | 3.9 | 3.7 | 3.7 | 3.6 | 3.6 | 3.4 |
| Poland | 2.3 | 2.5 | 2.6 | 2.9 | 2.9 | 2.8 | 3.0 | 2.6 | 2.6 |
| Sweden | 1.9 | 1.9 | 2.0 | 2.2 | 2.1 | 2.1 | 2.2 | 2.1 | 2.1 |
| United Kingdom | 2.3 | 2.1 | 2.1 | 2.1 | 2.0 | 2.1 | 1.9 | 1.9 | 1.8 |
| 9 countries average | 2.4 | 2.4 | 2.5 | 2.6 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 |

## Table 72. Education expenditure by year (% Total general government expenditure)

| Country | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|
| EU-28 European Union | | 11.0 | 10.9 | 10.8 | 10.5 | 10.6 | 10.5 | 10.2 | 10.3 |
| Belgium | 11.2 | 11.7 | 11.6 | 11.5 | 11.3 | 11.7 | 11.8 | 11.5 | 11.8 |
| Denmark | 12.5 | 12.4 | 11.9 | 12.1 | 12.3 | 12.6 | 12.1 | 12.1 | 12.3 |
| Germany | 8.9 | 9.0 | 9.1 | 9.0 | 9.1 | 9.3 | 9.6 | 9.7 | 9.7 |
| France | 10.4 | 10.5 | 10.2 | 10.2 | 10.0 | 9.9 | 9.8 | 9.7 | 9.6 |
| Italy | 9.6 | 9.5 | 9.6 | 9.2 | 9.0 | 8.8 | 8.4 | 8.1 | 8.1 |
| Netherlands | 12.4 | 12.2 | 12.1 | 12.1 | 11.8 | 11.8 | 11.9 | 11.8 | 11.8 |
| Poland | 13.7 | 13.4 | 13.2 | 12.8 | 11.9 | 12.2 | 12.5 | 12.6 | 12.6 |
| Sweden | 12.7 | 12.9 | 12.7 | 12.9 | 12.8 | 12.7 | 12.9 | 12.6 | 12.6 |
| United Kingdom | 13.5 | 14.0 | 13.8 | 13.3 | 13.3 | 13.6 | 12.8 | 12.3 | 12.1 |
| 9 countries average | 11.7 | 11.7 | 11.6 | 11.5 | 11.3 | 11.4 | 11.3 | 11.2 | 11.2 |

## Table 73. Social protection expenditure by year (% Total general government expenditure)

| Country | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|
| **EU-28 European Union** | | 38.4 | 38.1 | 37.6 | 38.8 | 38.8 | 39.4 | 39.6 | 40.3 |
| **Belgium** | 33.4 | 35.4 | 34.9 | 34.8 | 35.7 | 35.4 | 34.8 | 35.0 | 36.2 |
| **Denmark** | 44.3 | 43.6 | 43.3 | 42.8 | 43.0 | 44.0 | 43.8 | 42.3 | 44.0 |
| **Germany** | 44.9 | 44.4 | 44.0 | 43.0 | 43.5 | 42.2 | 42.4 | 42.5 | 42.7 |
| **France** | 40.3 | 41.0 | 41.4 | 41.1 | 41.7 | 41.8 | 42.4 | 42.5 | 42.9 |
| **Italy** | 36.9 | 36.6 | 37.4 | 37.9 | 38.7 | 39.7 | 40.3 | 40.4 | 41.3 |
| **Netherlands** | 35.6 | 34.0 | 33.9 | 33.6 | 33.8 | 34.4 | 35.1 | 35.6 | 36.8 |
| **Poland** | 39.0 | 38.0 | 36.4 | 35.6 | 36.3 | 36.4 | 36.0 | 37.1 | 38.4 |
| **Sweden** | 42.7 | 42.1 | 41.2 | 40.6 | 41.6 | 41.2 | 40.4 | 40.8 | 41.2 |
| **United Kingdom** | 35.7 | 34.7 | 34.7 | 33.3 | 34.8 | 35.6 | 36.5 | 37.0 | 37.1 |
| **9 countries average** | 39.2 | 38.9 | 38.6 | 38.1 | 38.8 | 39.0 | 39.1 | 39.3 | 40.1 |

## Appendix II – Relative spending on cancer care

**Table 74. Sources for disease burden and health care expenditures, both disease specific and total, by country**

| Country | Disease Burden (DALYs) | Health Care Expenditure | | |
|---|---|---|---|---|
| | | Cancer, IHD, Stroke [a] | Dementia | Country total |
| Belgium | (Murray et al., 2015a; Murray et al., 2015b) | (Luengo-Fernandez et al., 2011) | (Luengo-Fernandez et al., 2011) | (Eurostat, 2015e) |
| Denmark | (Murray et al., 2015a; Murray et al., 2015b) | (Luengo-Fernandez et al., 2011) | (Luengo-Fernandez et al., 2011) | (Eurostat, 2015e) |
| France | (Murray et al., 2015a; Murray et al., 2015b) | (Luengo-Fernandez et al., 2011) | (Luengo-Fernandez et al., 2011) | (Eurostat, 2015e) |
| Germany | (Murray et al., 2015a; Murray et al., 2015b) | (Luengo-Fernandez et al., 2011) | (Luengo-Fernandez et al., 2011) | (Eurostat, 2015e) |
| Italy | (Murray et al., 2015a; Murray et al., 2015b) | (Luengo-Fernandez et al., 2011) | (Luengo-Fernandez et al., 2011) | (OECD) |
| Netherlands | (Murray et al., 2015a; Murray et al., 2015b) | (Luengo-Fernandez et al., 2011) | (Luengo-Fernandez et al., 2011) | (Eurostat, 2015e) |
| Poland | (Murray et al., 2015a; Murray et al., 2015b) | (Luengo-Fernandez et al., 2011) | (Luengo-Fernandez et al., 2011) | (Eurostat, 2015e) |
| Sweden | (Murray et al., 2015a; Murray et al., 2015b) | (Luengo-Fernandez et al., 2011) | (Luengo-Fernandez et al., 2011) | (Eurostat, 2015e) |
| UK | (Murray et al., 2015a; Murray et al., 2015b) | (Luengo-Fernandez et al., 2011) | (Luengo-Fernandez et al., 2011) | (OECD) |
| EU27 | (Murray et al., 2015a; Murray et al., 2015b) | (Luengo-Fernandez et al., 2011) | (Luengo-Fernandez et al., 2011; Alzheimer Europe) | (OECD; Eurostat, 2015e) |

[a] Cost of long term care was added to the disease specific health care expenditures for cancer, IHD and stroke.

**Table 75. ICD codes in data sources**

| Disease | Disease burden (Murray et al., 2015a) | Health care expenditures (Luengo-Fernandez et al., 2013; Leal et al., 2012; Luengo-Fernandez et al., 2011; Wimo et al., 2009) |
|---|---|---|
| All cancers | C00-C13, C15-C159, C16-C25, C30-C34, C37-C41, C43-C45, C47-C54, C56-C75 (except C57.9, C63.9, and C75.9), C77-C79, C81-C85, C88-C90, C91-C97<br><br>D00-D24[a], D26-D44.9[a], D44.6-D48.9[b] | C00-C97 |
| Lung cancer | C33-C34, D02.1-D02.2 [a], D38.1 [a] | C33-C34 |
| Breast cancer | C50, D0.5-D05.9 [a], D48.6 [a] | C50 |
| Prostate cancer | C61, D07.5 [a], D40.0 [a] | C61 |
| Colorectal cancer | C18-C21, D01.0-D01.3 [a], D37.3-D37.5 [a] | C18-C21 |
| IHD | I20-I25 | I20-I25 |
| Stroke | I60-I63, I65-I67, 169.0-169.3 | I60-I69 |
| Dementia | F00-F03, G30-G31 | F00-F03, G30 |

[a] These codes have been used just for calculation of mortality (YLL)

[b] These codes have been used just for calculation of non-fatal outcomes (YLD)

**Table 76. Disease burden in 1000 DALYs, by country in 2013**

| Country | Cancer | | | | | Comparator diseases | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | All | Lung | Breast | Prostate | Colorectal | IHD | Stroke | Dementia | |
| Belgium | 554 | 138 | 57 | 33 | 60 | 231 | 123 | 122 | 3 161 |
| Denmark | 265 | 61 | 23 | 17 | 38 | 113 | 67 | 59 | 1 549 |
| France | 3 239 | 739 | 286 | 187 | 335 | 960 | 543 | 485 | 16 573 |
| Germany | 4 320 | 901 | 381 | 260 | 509 | 2 335 | 1 032 | 904 | 25 036 |
| Italy | 3 050 | 607 | 259 | 140 | 352 | 1 208 | 710 | 824 | 17 016 |
| Netherlands | 933 | 227 | 91 | 52 | 119 | 308 | 146 | 119 | 4 492 |
| Poland | 2 089 | 530 | 140 | 71 | 220 | 1 164 | 870 | 276 | 11 949 |
| Sweden | 398 | 68 | 33 | 39 | 56 | 253 | 104 | 77 | 2 555 |
| UK | 2 873 | 637 | 286 | 166 | 323 | 1 293 | 663 | 559 | 16 651 |
| EU27 | 25 036 | 5 473 | 2 121 | 1 299 | 2 889 | 12 536 | 7 216 | 4 882 | 143 705 |

**Table 77. Health care expenditures, in million Euro, by country in 2009**

| Country | Cancer | | | | | Comparator diseases | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | All | Lung | Breast | Prostate | Colorectal | IHD | Stroke | Dementia | |
| Belgium | 1 152 | 122 | 145 | 123 | 146 | 524 | 575 | 1 372 | 30 204 |
| Denmark | 845 | 96 | 86 | 79 | 87 | 308 | 633 | 1 303 | 27 487 |
| France | 7 781 | 616 | 1 021 | 997 | 744 | 1 828 | 3 137 | 10 515 | 197 392 |
| Germany | 15 507 | 1 463 | 2 388 | 1 777 | 1 803 | 5 536 | 7 313 | 15 852 | 232 004 |
| Italy | 7 378 | 658 | 676 | 616 | 840 | 2 677 | 3 860 | 4 536 | 133 603 |
| Netherlands | 2 454 | 312 | 339 | 171 | 336 | 1 673 | 2 271 | 1 588 | 66 756 |
| Poland | 1 438 | 201 | 161 | 95 | 173 | 932 | 638 | 1 627 | 17 843 |
| Sweden | 1 182 | 111 | 119 | 143 | 89 | 643 | 1 029 | 3 150 | 35 180 |
| UK | 5 812 | 590 | 624 | 451 | 654 | 2 112 | 3 240 | 15 365 | 152 918 |
| EU27 | 54 913 | 5 054 | 7 017 | 5 674 | 6 018 | 20 652 | 27 727 | 66 107 | 1 096 387 |

**Table 78. Spend relative to disease burden, in thousand euros per DALY lost**

| Country | Cancer | | | | | Comparator disease | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | All cancer | Lung | Breast | Prostate | Colorectal | IHD | Stroke | Dementia | |
| Belgium | 2.08 | 0.88 | 2.57 | 3.72 | 2.43 | 2.27 | 4.69 | 11.22 | 9.55 |
| Denmark | 3.19 | 1.58 | 3.74 | 4.76 | 2.31 | 2.72 | 9.48 | 21.97 | 17.74 |
| France | 2.40 | 0.83 | 3.57 | 5.32 | 2.22 | 1.90 | 5.77 | 21.70 | 11.91 |
| Germany | 3.59 | 1.62 | 6.26 | 6.83 | 3.54 | 2.37 | 7.09 | 17.55 | 9.27 |
| Italy | 2.42 | 1.08 | 2.61 | 4.39 | 2.39 | 2.22 | 5.44 | 5.51 | 7.85 |
| Netherlands | 2.63 | 1.38 | 3.73 | 3.27 | 2.82 | 5.44 | 15.57 | 13.37 | 14.86 |
| Poland | 0.69 | 0.38 | 1.15 | 1.34 | 0.79 | 0.80 | 0.73 | 5.90 | 1.49 |
| Sweden | 2.97 | 1.63 | 3.65 | 3.64 | 1.59 | 2.54 | 9.93 | 41.07 | 13.77 |
| UK | 2.02 | 0.93 | 2.18 | 2.71 | 2.02 | 1.63 | 4.89 | 27.48 | 9.18 |
| EU27 | 2.19 | 0.92 | 3.31 | 4.37 | 2.08 | 1.65 | 3.84 | 13.54 | 7.63 |

**Table 79. Relative share of total disease burden, by country in 2013**

| Country | Cancer | | | | | Comparator diseases | | |
|---|---|---|---|---|---|---|---|---|
| | All | Lung | Breast | Prostate | Colorectal | IHD | Stroke | Dementia |
| Belgium | 17.5% | 4.4% | 1.8% | 1.0% | 1.9% | 7.3% | 3.9% | 3.9% |
| Denmark | 17.1% | 3.9% | 1.5% | 1.1% | 2.4% | 7.3% | 4.3% | 3.8% |
| France | 19.5% | 4.5% | 1.7% | 1.1% | 2.0% | 5.8% | 3.3% | 2.9% |
| Germany | 17.3% | 3.6% | 1.5% | 1.0% | 2.0% | 9.3% | 4.1% | 3.6% |
| Italy | 17.9% | 3.6% | 1.5% | 0.8% | 2.1% | 7.1% | 4.2% | 4.8% |
| Netherlands | 20.8% | 5.0% | 2.0% | 1.2% | 2.6% | 6.8% | 3.2% | 2.6% |
| Poland | 17.5% | 4.4% | 1.2% | 0.6% | 1.8% | 9.7% | 7.3% | 2.3% |
| Sweden | 15.6% | 2.7% | 1.3% | 1.5% | 2.2% | 9.9% | 4.1% | 3.0% |
| UK | 17.3% | 3.8% | 1.7% | 1.0% | 1.9% | 7.8% | 4.0% | 3.4% |
| EU27 | 17.4% | 3.8% | 1.5% | 0.9% | 2.0% | 8.7% | 5.0% | 3.4% |

**Table 80. Relative share of total health care budget spent on each individual disease, by country in 2009**

| Country | Cancer | | | | | Comparator diseases | | |
|---|---|---|---|---|---|---|---|---|
| | All | Lung | Breast | Prostate | Colorectal | IHD | Stroke | Dementia |
| Belgium | 3.8% | 0.4% | 0.5% | 0.4% | 0.5% | 1.7% | 1.9% | 4.5% |
| Denmark | 3.1% | 0.3% | 0.3% | 0.3% | 0.3% | 1.1% | 2.3% | 4.7% |
| France | 3.9% | 0.3% | 0.5% | 0.5% | 0.4% | 0.9% | 1.6% | 5.3% |
| Germany | 6.7% | 0.6% | 1.0% | 0.8% | 0.8% | 2.4% | 3.2% | 6.8% |
| Italy | 5.5% | 0.5% | 0.5% | 0.5% | 0.6% | 2.0% | 2.9% | 3.4% |
| Netherlands | 3.7% | 0.5% | 0.5% | 0.3% | 0.5% | 2.5% | 3.4% | 2.4% |
| Poland | 8.1% | 1.1% | 0.9% | 0.5% | 1.0% | 5.2% | 3.6% | 9.1% |
| Sweden | 3.4% | 0.3% | 0.3% | 0.4% | 0.3% | 1.8% | 2.9% | 9.0% |
| UK | 3.8% | 0.4% | 0.4% | 0.3% | 0.4% | 1.4% | 2.1% | 10.0% |
| EU27 | 5.0% | 0.5% | 0.6% | 0.5% | 0.5% | 1.9% | 2.5% | 6.0% |

**Table 81. Ratio between relative health care expenditure (2009) and relative disease burden (2013), by country. A ratio of 1 indicates an equal share of total disease burden and health care expenditure.**

| Country | Cancer | | | | | Comparator diseases | | |
|---|---|---|---|---|---|---|---|---|
| | All | Lung | Breast | Prostate | Colorectal | IHD | Stroke | Dementia |
| Belgium | 0.22 | 0.09 | 0.27 | 0.39 | 0.25 | 0.24 | 0.49 | 1.17 |
| Denmark | 0.18 | 0.09 | 0.21 | 0.27 | 0.13 | 0.15 | 0.53 | 1.24 |
| France | 0.20 | 0.07 | 0.30 | 0.45 | 0.19 | 0.16 | 0.48 | 1.82 |
| Germany | 0.39 | 0.18 | 0.68 | 0.74 | 0.38 | 0.26 | 0.76 | 1.89 |
| Italy | 0.31 | 0.14 | 0.33 | 0.56 | 0.30 | 0.28 | 0.69 | 0.70 |
| Netherlands | 0.18 | 0.09 | 0.25 | 0.22 | 0.19 | 0.37 | 1.05 | 0.90 |
| Poland | 0.46 | 0.25 | 0.77 | 0.89 | 0.53 | 0.54 | 0.49 | 3.95 |
| Sweden | 0.22 | 0.12 | 0.27 | 0.26 | 0.12 | 0.18 | 0.72 | 2.98 |
| UK | 0.22 | 0.10 | 0.24 | 0.30 | 0.22 | 0.18 | 0.53 | 2.99 |
| EU27 | 0.29 | 0.12 | 0.43 | 0.57 | 0.27 | 0.22 | 0.50 | 1.78 |

**Table 82. Ratio-of-ratios; the ratio between relative health care expenditure (2009) over relative disease burden (2013) between various diagnoses, by country**

| Country | All cancers versus IHD | All cancers versus stroke | All cancers versus dementia | Lung cancer versus all cancers | Breast cancer versus all cancers | Prostate cancer versus all cancers | Colorectal cancer versus all cancers |
|---|---|---|---|---|---|---|---|
| Belgium | 0.92 | 0.44 | 0.19 | 0.42 | 1.23 | 1.79 | 1.17 |
| Denmark | 1.17 | 0.34 | 0.15 | 0.50 | 1.17 | 1.49 | 0.72 |
| France | 1.26 | 0.42 | 0.11 | 0.35 | 1.49 | 2.22 | 0.92 |
| Germany | 1.51 | 0.51 | 0.20 | 0.45 | 1.75 | 1.90 | 0.99 |
| Italy | 1.09 | 0.45 | 0.44 | 0.45 | 1.08 | 1.81 | 0.99 |
| Netherlands | 0.48 | 0.17 | 0.20 | 0.52 | 1.42 | 1.24 | 1.07 |
| Poland | 0.86 | 0.94 | 0.12 | 0.55 | 1.67 | 1.94 | 1.14 |
| Sweden | 1.17 | 0.30 | 0.07 | 0.55 | 1.23 | 1.22 | 0.53 |
| UK | 1.24 | 0.41 | 0.07 | 0.46 | 1.08 | 1.34 | 1.00 |
| EU27 | 1.33 | 0.57 | 0.16 | 0.42 | 1.51 | 1.99 | 0.95 |

## *Appendix III – Economic burden of cancer*

**Table 83. COST OF ALL CANCERS BY COUNTRY, IN 2015. PRESENTED IN MILLION €.**

| Country | Cancer-related health care costs | | | | | | | Informal care costs | Productivity losses | | | Total costs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Primary | Outpatient | Emergency | Inpatient | Drugs | Long-term | Total | | Market production (mortality) | Market production (morbidity) | Unpaid work | |
| **Belgium** | 38 | 78 | 10 | 612 | 385 | 159 | 1 283 | 616 | 1 166 | 672 | 294 | 4 030 |
| **Denmark** | 4 | 60 | 12 | 324 | 222 | 196 | 818 | 300 | 1 094 | 412 | 391 | 3 015 |
| **France** | 123 | 190 | 21 | 4 017 | 3 270 | 790 | 8 411 | 2 749 | 5 394 | 2 485 | 1 711 | 20 751 |
| **Germany** | 772 | 1 836 | 32 | 10 608 | 2 940 | 667 | 16 853 | 6 971 | 12 615 | 2 405 | 3 495 | 42 339 |
| **Italy** | 536 | 497 | 126 | 4 549 | 1 830 | 577 | 8 115 | 6 039 | 4 362 | 157 | 241 | 18 914 |
| **Netherlands** | 190 | 276 | 14 | 1 489 | 392 | 454 | 2 814 | 1 083 | 2 776 | 778 | 994 | 8 446 |
| **Poland** | 142 | 405 | 17 | 681 | 294 | 44 | 1 583 | 605 | 1 438 | 425 | 301 | 4 352 |
| **Sweden** | 50 | 257 | 42 | 431 | 246 | 221 | 1 247 | 419 | 974 | 504 | 375 | 3 520 |
| **UK** | 176 | 1 233 | 51 | 3 353 | 1 212 | 659 | 6 683 | 2 684 | 7 113 | 784 | 1 838 | 19 101 |
| **Target countries** | 2 030 | 4 831 | 324 | 26 063 | 10 791 | 3 766 | 47 807 | 21 466 | 36 932 | 8 624 | 9 639 | 124 467 |

**Table 84. COST OF LUNG CANCER BY COUNTRY, IN 2015. PRESENTED IN MILLION €.**

| Country | Cancer-related health care costs | | | | | | | Informal care costs | Productivity losses | | | Total costs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Primary | Outpatient | Emergency | Inpatient | Drugs | Long-term | Total | | Market production (mortality) | Market production (morbidity) | Unpaid work | |
| **Belgium** | 4 | 9 | 1 | 70 | 13 | 38 | 136 | 127 | 318 | 76 | 80 | 657 |
| **Denmark** | 1 | 9 | 1 | 38 | 8 | 48 | 104 | 62 | 256 | 50 | 96 | 471 |
| **France** | 9 | 14 | 1 | 364 | 117 | 161 | 665 | 431 | 1 399 | 173 | 444 | 2 669 |
| **Germany** | 82 | 196 | 4 | 1 041 | 135 | 133 | 1 591 | 956 | 2 965 | 151 | 831 | 5 663 |
| **Italy** | 47 | 44 | 11 | 442 | 66 | 114 | 724 | 1 116 | 906 | 12 | 47 | 2 759 |
| **Netherlands** | 19 | 28 | 1 | 173 | 10 | 113 | 343 | 201 | 682 | 93 | 259 | 1 319 |
| **Poland** | 23 | 67 | 2 | 107 | 11 | 11 | 221 | 119 | 394 | 65 | 78 | 799 |
| **Sweden** | 4 | 21 | 3 | 43 | 8 | 37 | 117 | 51 | 151 | 51 | 67 | 369 |
| **UK** | 11 | 121 | 5 | 350 | 44 | 149 | 679 | 488 | 1 423 | 64 | 387 | 2 654 |
| **Target countries** | 201 | 508 | 30 | 2 628 | 412 | 803 | 4 581 | 3 550 | 8 495 | 734 | 2 289 | 17 360 |

**Table 85. COST OF BREAST CANCER BY COUNTRY, IN 2015. PRESENTED IN MILLION €.**

| Country | Cancer-related health care costs | | | | | | | Informal care costs | Productivity losses | | | Total costs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Primary | Outpatient | Emergency | Inpatient | Drugs | Long-term | Total | | Market production (mortality) | Market production (morbidity) | Unpaid work | |
| **Belgium** | 4 | 10 | 1 | 51 | 81 | 13 | 162 | 82 | 111 | 66 | 29 | 421 |
| **Denmark** | 1 | 8 | 1 | 22 | 47 | 15 | 93 | 38 | 85 | 27 | 29 | 243 |
| **France** | 16 | 26 | 3 | 312 | 685 | 61 | 1 104 | 363 | 472 | 822 | 154 | 2 761 |
| **Germany** | 111 | 264 | 2 | 1 323 | 844 | 52 | 2 596 | 1 166 | 992 | 672 | 309 | 5 426 |
| **Italy** | 48 | 45 | 11 | 212 | 384 | 43 | 744 | 670 | 321 | 10 | 21 | 1 745 |
| **Netherlands** | 20 | 29 | 1 | 238 | 52 | 34 | 373 | 154 | 227 | 56 | 95 | 811 |
| **Poland** | 12 | 36 | 1 | 64 | 62 | 2 | 178 | 77 | 70 | 44 | 20 | 369 |
| **Sweden** | 5 | 25 | 4 | 24 | 52 | 15 | 125 | 62 | 95 | 28 | 30 | 311 |
| **UK** | 13 | 130 | 5 | 268 | 254 | 49 | 718 | 355 | 560 | 68 | 189 | 1 701 |
| **Target countries** | 231 | 573 | 30 | 2 514 | 2 461 | 284 | 6 093 | 2 968 | 2 934 | 1 792 | 877 | 13 788 |

**Table 86. COST OF PROSTATE CANCER BY COUNTRY, IN 2015. PRESENTED IN MILLION €.**

| Country | Cancer-related health care costs | | | | | | | Informal care costs | Productivity losses | | | Total costs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Primary | Outpatient | Emergency | Inpatient | Drugs | Long-term | Total | | Market production (mortality) | Market production (morbidity) | Unpaid work | |
| **Belgium** | 2 | 6 | 1 | 35 | 84 | 10 | 137 | 48 | 18 | 29 | 6 | 232 |
| **Denmark** | 0 | 4 | 1 | 15 | 49 | 16 | 86 | 28 | 26 | 20 | 15 | 160 |
| **France** | 10 | 15 | 2 | 295 | 711 | 44 | 1 077 | 224 | 50 | 66 | 34 | 1 417 |
| **Germany** | 59 | 141 | 1 | 883 | 810 | 38 | 1 932 | 627 | 236 | 165 | 104 | 2 960 |
| **Italy** | 27 | 26 | 7 | 192 | 398 | 27 | 678 | 378 | 49 | 5 | 4 | 1 111 |
| **Netherlands** | 10 | 14 | 1 | 72 | 63 | 28 | 188 | 93 | 53 | 17 | 29 | 350 |
| **Poland** | 4 | 11 | 0 | 23 | 64 | 2 | 105 | 44 | 24 | 8 | 6 | 181 |
| **Sweden** | 5 | 26 | 4 | 37 | 54 | 25 | 151 | 51 | 28 | 43 | 18 | 274 |
| **UK** | 6 | 59 | 2 | 145 | 263 | 44 | 519 | 233 | 176 | 15 | 53 | 943 |
| **Target countries** | 124 | 303 | 20 | 1 696 | 2 495 | 235 | 4 873 | 1 726 | 660 | 368 | 270 | 7 627 |

**Table 87. COST OF COLORECTAL CANCER BY COUNTRY, IN 2015. PRESENTED IN MILLION €.**

| Country | Cancer-related health care costs | | | | | | | Informal care costs | Productivity losses | | | Total costs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Primary | Outpatient | Emergency | Inpatient | Drugs | Long-term | Total | | Market production (mortality) | Market production (morbidity) | Unpaid work | |
| **Belgium** | 4 | 9 | 1 | 114 | 16 | 19 | 162 | 73 | 75 | 59 | 25 | 369 |
| **Denmark** | 1 | 9 | 1 | 50 | 9 | 25 | 94 | 39 | 115 | 64 | 41 | 312 |
| **France** | 12 | 18 | 2 | 549 | 135 | 88 | 804 | 325 | 333 | 204 | 135 | 1 667 |
| **Germany** | 77 | 185 | 4 | 1 491 | 124 | 78 | 1 959 | 871 | 1 103 | 238 | 324 | 4 171 |
| **Italy** | 57 | 53 | 13 | 660 | 76 | 65 | 924 | 705 | 379 | 18 | 22 | 2 026 |
| **Netherlands** | 21 | 31 | 2 | 234 | 15 | 56 | 359 | 133 | 260 | 95 | 104 | 847 |
| **Poland** | 19 | 63 | 2 | 89 | 12 | 5 | 190 | 73 | 111 | 42 | 27 | 416 |
| **Sweden** | 3 | 16 | 2 | 35 | 11 | 27 | 94 | 82 | 243 | 41 | 42 | 460 |
| **UK** | 5 | 139 | 5 | 485 | 51 | 68 | 752 | 294 | 653 | 83 | 169 | 1 782 |
| **Target countries** | 199 | 522 | 33 | 3 706 | 448 | 431 | 5 340 | 2 596 | 3 272 | 843 | 889 | 12 051 |

**Table 88. COST OF IHD BY COUNTRY, IN 2015. PRESENTED IN MILLION €.**

| Country | Cancer-related health care costs | | | | | | | Informal care costs | Productivity losses | | | Total costs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Primary | Outpatient | Emergency | Inpatient | Drugs | Long-term | Total | | Market production (mortality) | Market production (morbidity) | Unpaid work | |
| **Belgium** | 60 | 19 | 3 | 337 | 133 | 32 | 584 | 542 | 285 | 225 | 52 | 1 636 |
| **Denmark** | 17 | 19 | 9 | 214 | 36 | 39 | 334 | 136 | 207 | 111 | 64 | 789 |
| **France** | 57 | 88 | 10 | 1 154 | 509 | 158 | 1 976 | 2 379 | 746 | 977 | 199 | 6 079 |
| **Germany** | 339 | 807 | 38 | 3 988 | 711 | 133 | 6 017 | 8 142 | 3 622 | 1 501 | 963 | 19 282 |
| **Italy** | 309 | 284 | 73 | 1 411 | 752 | 115 | 2 945 | 3 815 | 948 | 48 | 43 | 7 755 |
| **Netherlands** | 130 | 187 | 8 | 1 019 | 409 | 91 | 1 844 | 834 | 486 | 849 | 142 | 4 014 |
| **Poland** | 80 | 273 | 11 | 456 | 197 | 9 | 1 026 | 1 454 | 467 | 200 | 88 | 3 147 |
| **Sweden** | 104 | 178 | 42 | 264 | 47 | 44 | 678 | 395 | 294 | 126 | 118 | 1 493 |
| **UK** | 138 | 460 | 67 | 1 290 | 341 | 132 | 2 428 | 2 202 | 2 844 | 1 175 | 543 | 8 649 |
| **Target countries** | 1 235 | 2 315 | 261 | 10 134 | 3 135 | 753 | 17 832 | 19 900 | 9 899 | 5 212 | 2 211 | 52 844 |

**Table 89. COST OF STROKE BY COUNTRY, IN 2015. PRESENTED IN MILLION €.**

| Country | Cancer-related health care costs | | | | | | | Informal care costs | Productivity losses | | | Total costs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Primary | Outpatient | Emergency | Inpatient | Drugs | Long-term | Total | | Market production (mortality) | Market production (morbidity) | Unpaid work | |
| **Belgium** | 26 | 8 | 1 | 211 | 43 | 350 | 640 | 208 | 130 | 168 | 28 | 1 146 |
| **Denmark** | 9 | 10 | 6 | 218 | 12 | 431 | 686 | 89 | 138 | 117 | 54 | 1 030 |
| **France** | 47 | 72 | 8 | 1 341 | 187 | 1 738 | 3 392 | 928 | 452 | 493 | 130 | 5 265 |
| **Germany** | 534 | 1 272 | 22 | 4 365 | 288 | 1 468 | 7 948 | 4 479 | 1 222 | 754 | 336 | 14 403 |
| **Italy** | 240 | 221 | 57 | 2 215 | 243 | 1 269 | 4 245 | 1 707 | 431 | 51 | 23 | 6 433 |
| **Netherlands** | 74 | 106 | 5 | 1 270 | 50 | 998 | 2 502 | 402 | 232 | 449 | 76 | 3 585 |
| **Poland** | 38 | 130 | 5 | 367 | 64 | 97 | 702 | 648 | 308 | 147 | 57 | 1 805 |
| **Sweden** | 62 | 105 | 25 | 392 | 15 | 487 | 1 086 | 177 | 106 | 191 | 40 | 1 560 |
| **UK** | 51 | 207 | 41 | 1 867 | 110 | 1 450 | 3 725 | 1 286 | 808 | 406 | 181 | 6 225 |
| **Target countries** | 1 081 | 2 132 | 169 | 12 247 | 1 010 | 8 286 | 24 926 | 9 922 | 3 828 | 2 776 | 924 | 41 452 |

**Table 90. COST OF DEMENTIA BY COUNTRY, IN 2015. PRESENTED IN MILLION €.**

| Country | Cancer-related health care costs | | | | | | | Informal care costs | Productivity losses | | | Total costs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Primary | Outpatient | Emergency | Inpatient | Drugs | Long-term | Total | | Market production (mortality) | Market production (morbidity) | Unpaid work | |
| **Belgium** | 59 | 7 | 10 | 93 | 54 | 1 304 | 1 527 | 3 339 | 8 | 58 | 3 | 4 932 |
| **Denmark** | 14 | 14 | 8 | 18 | 23 | 1 336 | 1 412 | 4 342 | 9 | 57 | 5 | 5 820 |
| **France** | 313 | 96 | 60 | 310 | 388 | 10 200 | 11 368 | 15 111 | 30 | 257 | 9 | 26 765 |
| **Germany** | 1 756 | 497 | 84 | 347 | 436 | 14 109 | 17 229 | 26 090 | 34 | 481 | 31 | 43 833 |
| **Italy** | 280 | 324 | 29 | 138 | 109 | 4 108 | 4 988 | 32 880 | 22 | 241 | 1 | 38 131 |
| **Netherlands** | 81 | 17 | 7 | 75 | 14 | 1 556 | 1 751 | 4 189 | 14 | 102 | 12 | 6 056 |
| **Poland** | 0 | 0 | 0 | 0 | 0 | 0 | 1 791 | 1 130 | 0 | 0 | 0 | 2 921 |
| **Sweden** | 128 | 48 | 7 | 43 | 41 | 3 058 | 3 324 | 5 400 | 12 | 56 | 5 | 8 792 |
| **UK** | 462 | 118 | 55 | 1 736 | 164 | 15 130 | 17 666 | 29 329 | 71 | 450 | 32 | 47 516 |
| **Target countries** | 3 092 | 1 120 | 260 | 2 761 | 1 229 | 50 802 | 61 056 | 121 809 | 199 | 1 702 | 98 | 184 766 |

**Table 91. POPULATION ESTIMATES BY COUNTRY FROM 2014, USED TO CALCULATE COST PER 100,000 POPULATION FOR EACH DISEASE**

| Country | Total population | Population / 100 000 |
|---|---|---|
| **Belgium** | 11 203 992 | 112 |
| **Denmark** | 5 627 235 | 56 |
| **France** | 65 835 579 | 658 |
| **Germany** | 80 767 463 | 808 |
| **Italy** | 60 782 668 | 608 |
| **Netherlands** | 16 829 289 | 168 |
| **Poland** | 38 017 856 | 380 |
| **Sweden** | 9 644 864 | 96 |
| **UK** | 64 308 261 | 643 |
| **Target countries** | 353 017 207 | 3 530 |

**Table 92. CHANGE IN HOURS OF UNPAID WORK BY COUNTRY. PRESENTED IN MILLION HOURS**

| Country | All Cancer | Lung | Breast | Prostate | Colorectal | IHD | Stroke | Dementia |
|---|---|---|---|---|---|---|---|---|
| **Belgium** | 31.02 | 8.46 | 3.06 | 0.62 | 2.62 | 5.52 | 3.00 | 0.35 |
| **Denmark** | 26.05 | 6.37 | 1.95 | 1.01 | 2.70 | 4.28 | 3.58 | 0.30 |
| **France** | 186.14 | 48.26 | 16.71 | 3.69 | 14.71 | 21.62 | 14.10 | 0.97 |
| **Germany** | 411.13 | 97.76 | 36.41 | 12.29 | 38.07 | 113.24 | 39.56 | 3.70 |
| **Italy** | 38.32 | 7.39 | 3.33 | 0.58 | 3.53 | 6.79 | 3.59 | 0.18 |
| **Netherlands** | 104.92 | 27.40 | 10.04 | 3.08 | 11.03 | 15.00 | 8.04 | 1.27 |
| **Poland** | 116.65 | 30.37 | 7.87 | 2.48 | 10.64 | 34.06 | 21.98 | 0.03 |
| **Sweden** | 30.93 | 5.55 | 2.50 | 1.48 | 3.45 | 9.72 | 3.26 | 0.43 |
| **UK** | 211.33 | 44.50 | 21.74 | 6.09 | 19.46 | 62.40 | 20.82 | 3.64 |

**Table 93. AVERAGE ANNUAL UNPAID WORK BY COUNTRY AND SEX. PRESENTED IN HOURS PER PERSON (AGES 15-79).**

| Country | Voluntary work | | Informal care | |
|---|---|---|---|---|
| | Male | Female | Male | Female |
| **Belgium** | 71.0 | 48.8 | 42.4 | 153.3 |
| **Denmark** | 125.6 | 73.5 | 92.0 | 163.9 |
| **France** | 71.0 | 48.8 | 42.4 | 153.3 |
| **Germany** | 181.4 | 162.0 | 70.0 | 169.5 |
| **Italy** | 16.1 | 9.4 | 50.2 | 125.7 |
| **Netherlands** | 142.1 | 133.1 | 65.5 | 179.2 |
| **Poland** | 67.9 | 35.3 | 60.7 | 145.1 |
| **Sweden** | 125.6 | 73.5 | 92.0 | 163.9 |
| **UK** | 59.6 | 59.3 | 97.7 | 216.1 |
| **Target countries** | 95.6 | 71.5 | 68.1 | 163.3 |

**Table 94. PURCHASING POWER PARITY (PPP) INDICES IN 2014, BY COUNTRY, RELATIVE TO EU27**

| Country | Index value (=country index/index of EU27) |
|---|---|
| **Target countries** | 1.000 |
| **Belgium** | 1.102 |
| **Denmark** | 1.347 |
| **France** | 1.098 |
| **Germany** | 1.041 |
| **Italy** | 1.004 |
| **Netherlands** | 1.092 |
| **Poland** | 0.574 |
| **Sweden** | 1.315 |
| **UK** | 1.164 |

## *Appendix IV – Country Summaries*

These short country summaries include an overview of country-relevant data on the burden of cancer and cancer care to patients and society, as well as a description of the highlights in the efficient or inefficient provision of cancer care and patient access.

# Belgium

### Health care spending: Government expenditure (1.1)

Government expenditure on health in Belgium in 2013 was €31.2 billion, which represents 7.9% of GDP. This is higher than the European average of 7.2% (for EU28 countries). Health represents 14.5% of total government expenditure (this slightly lower than the EU28 average which is 14.8%), and is the third highest spend for Government after social protection (36.2%) and general public services (15.6%). These data do not include private expenditure on health, either through private insurance (which represents 4.2% of health care expenditure in Belgium) or out-of-pocket expenditure (accounting for 20.4% of spending, which was the second highest among countries studied).

### Cancer expenditure and disease burden (1.2)

Total expenditure on health care in Belgium in 2013 was €40.46 billion.[26] Belgium spent 3.8% of total health care expenditure on cancer in 2009.[27] This is lower than the EU average of 5.0%. Spending should be considered in relation to the disease burden of cancer in Belgium, which shows us how big a problem cancer is in the country. We measure disease burden in disability adjusted life years (DALYs) lost which is a measure of ill health (both from early death and poor quality of life) across the whole population, caused by disease. This measure therefore incorporates prevalence. Total burden of disease in Belgium in 2013 in terms of DALYs lost is 3.161 million DALYs. 17.5% of this total disease burden is due to cancer (0.554 million DALYs). This is close to the EU average, where cancer represents on average 17.4% of total disease burden.

[26] Source: OECD health expenditure statistics. Includes all health care expenditure by all financing agents.

[27] This includes: primary care, outpatient care, inpatient care, emergency care and drugs [source: Luengo-Fernandez et al (2013)], as well as long-term care costs [source: Lipszyc et al. (2012)]. These estimates cover all expenditures irrespective of who bears the cost (i.e. public, private, social care etc.). The year 2009 is used as this is the latest available data covering the necessary information available across all countries studied. This should be considered in the interpretation of results, particularly in assessing the spend between tumour types, the balance between which may have altered with the availability of new therapies.

This graph shows the ratio of health care spending to disease burden, and how this differs by tumour type and compared with the European average. Overall, Belgium spends slightly less on cancer relative to burden than the European average. The lower spend on lung cancer relative to burden means that, compared with the high impact of lung cancer on the population (from lives lost and poor quality of life), less money is spent at the moment on lung cancer than the other major cancers. It is apparent in Figure 64 that spend on lung, breast and prostate cancer relative to burden is lower in Belgium than the European average, but spend relative to burden is higher than average for colorectal cancer.

**Figure 63. Ratio of spend to burden in Belgium**

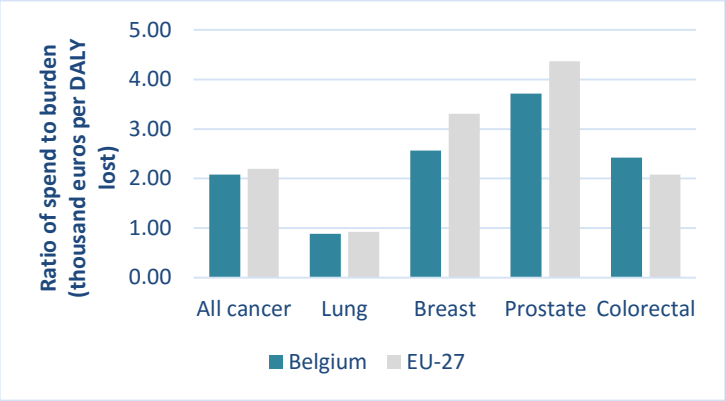
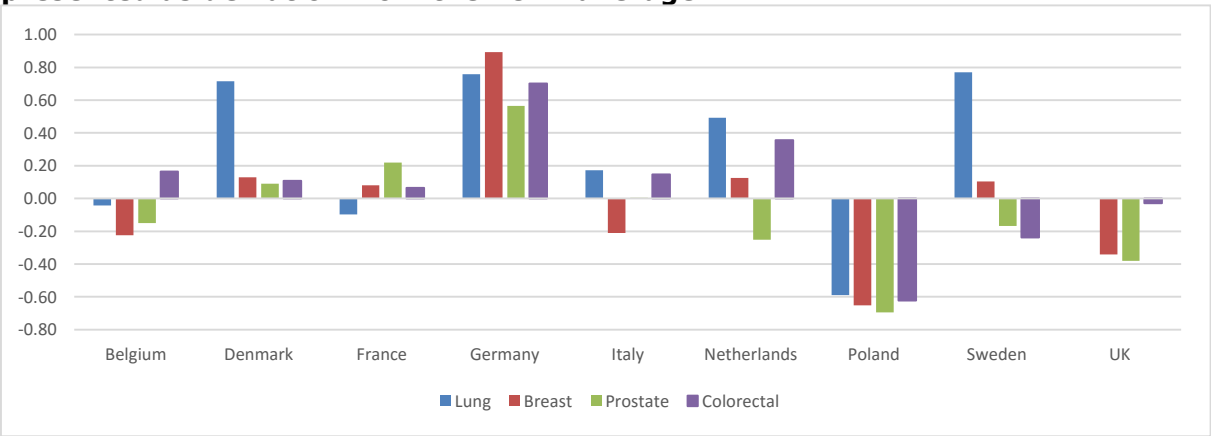


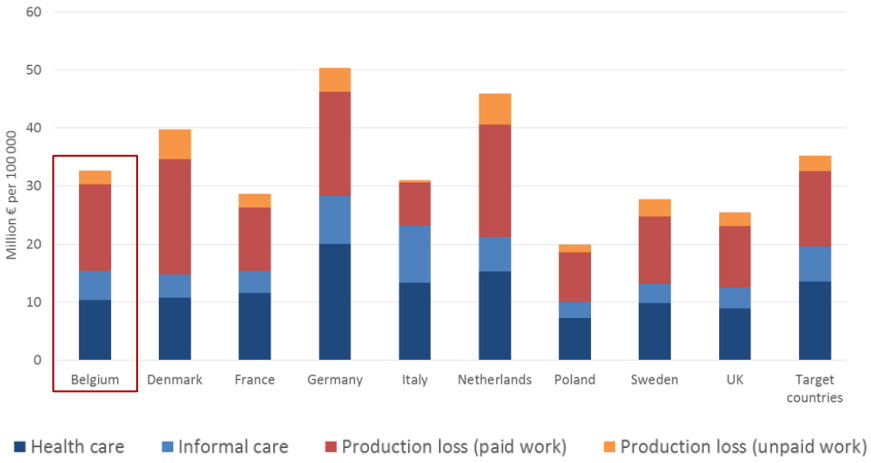

**Figure 64. Ratios between health care expenditures and disease burden, presented as deviation from the EU27 average**




## Economic burden of cancer (1.3)

Whereas most countries consider only direct health care costs in decision-making, there are many other costs that pose a high economic burden to patients and to society, that are often left unconsidered. We quantify those costs, and by doing so demonstrate the high cost to society of cancer resulting from: the time given up by friends and family to care for patients, production losses from cancer patients no longer being able to go to work, and the time cancer patients can no longer spend volunteering and caregiving for others.

**Figure 65. PPP-adjusted economic burden of all cancer, 2015 (million € per 100,000 population)**




Sources of data: Luengo-Fernandez et al (2013), Lipszyc et al. (2012) and Multinational Time Use Study (MTUS)

Direct health care expenditure represents on average only 31.8% of total economic burden of cancer in Belgium. Production losses of paid work is the major cost driver (45.6%), followed by informal care (e.g. by family and friends) (15.3%) and unpaid work (resulting in 31 million hours of unpaid work e.g. from caregiving and volunteering lost per year) (7.3%).

Across all countries studied, lung cancer has a higher total economic burden than breast (1.3 times), prostate (2.3 times) and colorectal cancer (1.4 times). Cancer also had a higher total economic burden than IHD (2.4 times) and stroke (3 times) but lower than dementia (0.7 times).

**Table 95. Cost distribution for cancer in Belgium, all cancer types combined**

| | Costs included | Total costs per year | % of total economic burden of cancer |
|---|---|---|---|
| Direct health care costs | primary care, outpatient and inpatient care, emergency care, long-term care and drug costs | €1.28 billion | 32% |
| Informal care | costs of caregivers providing support to cancer patients | €0.62 billion | 15% |
| Production losses | loss of paid work for patients because of their condition (due to morbidity and mortality) | €1.84 billion | 46% |
| Unpaid work | Loss of unpaid work (e.g. caregiving and volunteer work) for patients (due to mortality only) | €0.29 billion<br>31 million hours (38% of which are in the voluntary sector) | 7% |
| Total costs | All of the above | €4.03 billion | 100% |

**Clinical pathways and care delivery (2.3) and reimbursement and regulation mechanisms (2.4)**

More than one third of cancers are preventable by changing lifestyle factors. Prevention strategies therefore provide a major focus for policy-makers at both the national and European level. Early diagnosis is critical, and the Council of the European Union recommends population screening programmes for breast, cervical and colorectal cancer. Belgium has implemented screening programmes for all three.

In Belgium, 'care programmes' have been implemented since 1999 to offer an organisational framework and to implement clinical trajectories (clinical guidelines). The oncological care programmes were published in Royal Decrees in 2002/2003 for basic oncology care (diagnosis and less complex treatments) and oncology care (more advanced diagnostic options and therapeutic possibilities). Further, specialised care programmes exist for extremely specialised and/or rare cancers. The national cancer plan which was first introduced in 2008 have further modified the organisation of cancer services in Belgium. The 'Cancer Centre' was created in 2008 to monitor, evaluate and develop recommendations for the cancer plan.

In Belgium, maximum prices are set by the Minister of Economics Affairs, based on recommendations by the Medicines Pricing Commission. Manufacturers are required to submit a pricing application to the Price Department of the Federal Public Service for Economic Affairs. A reimbursement dossier must be submitted simultaneously to the National Institute for Health and Disability Insurance (INAMI). The maximum price decision is then forwarded to the Medicines Reimbursement Commission.

Reimbursement price and conditions are determined by a drug's therapeutic value. Pharmacoeconomic data are required to justify higher prices than existing treatments.

**Table 96. Belgium: Summary of policies and practices that may be leading to the efficient / inefficient delivery of cancer care**

| Practices contributing to the **inefficient** delivery of cancer care | Practices contributing to the **efficient** delivery of cancer care |
|---|---|
| • Belgium has implemented cancer screening programmes for cervical, breast and colorectal cancer, but uptake is relatively low (63.2% for cervical cancer, and of the eligible population for colorectal cancer screening 83.2% had never undergone the test).<br>• Fragmentation in the Belgian laboratories sector inhibits an efficient system of diagnosis.<br>• Whilst clinical guidelines exist, implementation may be problematic.<br>• Highly cost-effective treatments such as radiotherapy are currently under-utilised.<br>• Variability in care is a concern, particularly for highly complex interventions in rare cancers.<br>• Time from marketing approval to patient access is very long in Belgium.<br>• Disparity in authorisation and reimbursement processes for specialised medicines and their companion diagnostics causes market access delays.<br>• There could be potential for greater savings from the use of generics.<br>• Whilst there is strong collection of real world data in Belgium, it's utilisation for research is inhibited. | • Belgium has in place a comprehensive National Cancer Plan, which is regularly monitored, evaluated and updated.<br>• Various measures have been introduced to ensure excellence in cancer care, e.g. health care facility "authorisation", minimum thresholds and striving for geographic accessibility.<br>• Coordination of multidisciplinary patient-centred care is facilitated through a personalised patient pathway and recovery plan. This is supported by measures such as extra financing for multidisciplinary team meetings, the introduction of oncological care coordinator nurses, and the continued development of clinical trajectories.<br>• The medical need programme permits access to drugs licensed for different indications when there is severe unmet need. However, this programme is not currently funded.<br>• There is a strong emphasis on data collection. Coverage of the Belgian Cancer Registry is high, and supported through financing data managers. |

# Denmark

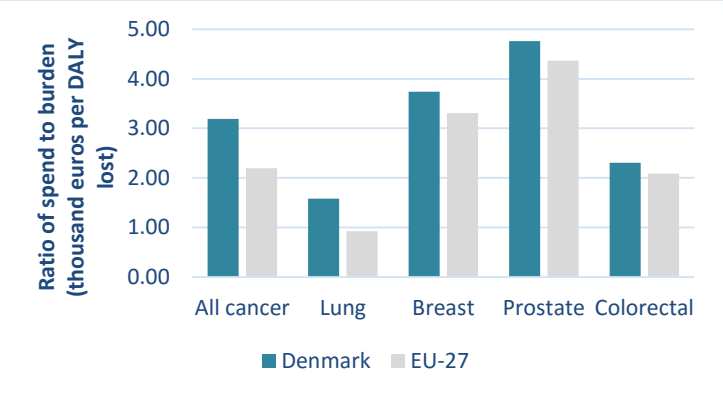
### Health care spending: Government expenditure (1.1)

Government expenditure on health in Denmark in 2013 was €22 billion, which represents 8.7% of GDP. This is higher than the European average of 7.2% (for EU28 countries). Health represents 15.2% of total government expenditure (this is higher than the EU28 average which is 14.8%), and is the second highest spend for Government after social protection (44%). These data do not include private expenditure on health, either through private insurance (which represents 1.8% of health care expenditure in Denmark) or out-of-pocket expenditure (accounting for 12.9% of spending).

### Cancer expenditure and disease burden (1.2)

Total expenditure on health care in Denmark in 2013 was 196.19 billion Danish Krone.[28] Denmark spent 3.1% of total health care expenditure on cancer in 2009.[29] This is lower than the EU average of 5.0%. Spending should be considered in relation to the disease burden of cancer in Denmark, which shows us how big a problem cancer is in the country. We measure disease burden in disability adjusted life years (DALYs) lost which is a measure of ill health (both from early death and poor quality of life) across the whole population, caused by disease. This measure therefore incorporates prevalence. Total burden of disease in Denmark in 2013 in terms of DALYs lost is 1.549 million DALYs. 17.1% of this total disease burden is due to cancer (0.265 million DALYs). This is slightly lower than the EU average, where cancer represents on average 17.4% of total disease burden.

**Figure 66. Ratio of spend to burden in Denmark**

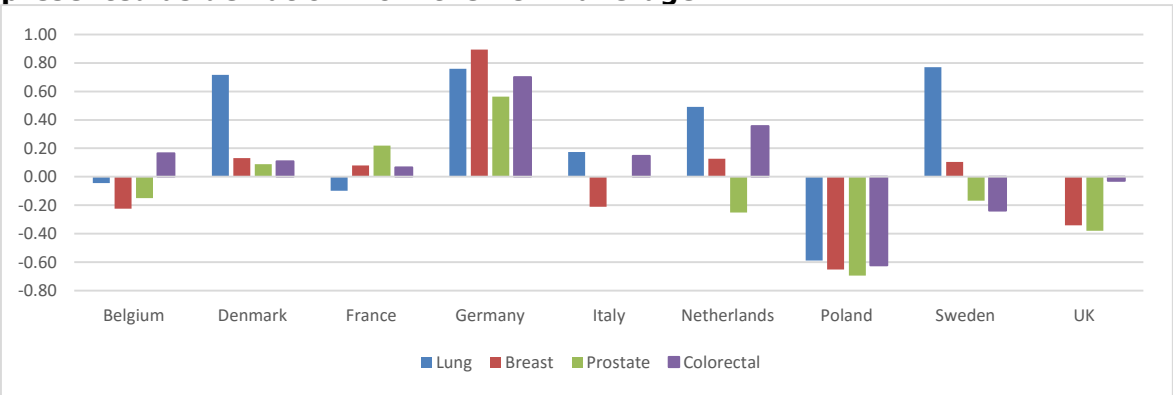



This graph shows the ratio of health care spending to disease burden, and how this differs by tumour type and compared with the European average. Overall, Denmark spends more on cancer relative to burden than the European average. The lower spend on lung (and to some extent colorectal) cancer relative to burden means that, compared with the high impact of lung (and colorectal) cancer on the population (from lives lost and poor quality of life), less money is spent at the moment on those than the other major cancers. However, it is apparent in Figure 67 that, compared with other European countries, spend on lung cancer relative to burden is particularly high in Denmark; all expenditure-to-disease ratios are above the European average.

[28] Source: OECD health expenditure statistics. Includes all health care expenditure by all financing agents.

[29] This includes: primary care, outpatient care, inpatient care, emergency care and drugs [source: Luengo-Fernandez et al (2013)], as well as long-term care costs [source: Lipszyc et al. (2012)]. These estimates cover all expenditures irrespective of who bears the cost (i.e. public, private, social care etc.). The year 2009 is used as this is the latest available data covering the necessary information available across all countries studied. This should be considered in the interpretation of results, particularly in assessing the spend between tumour types, the balance between which may have altered with the availability of new therapies.

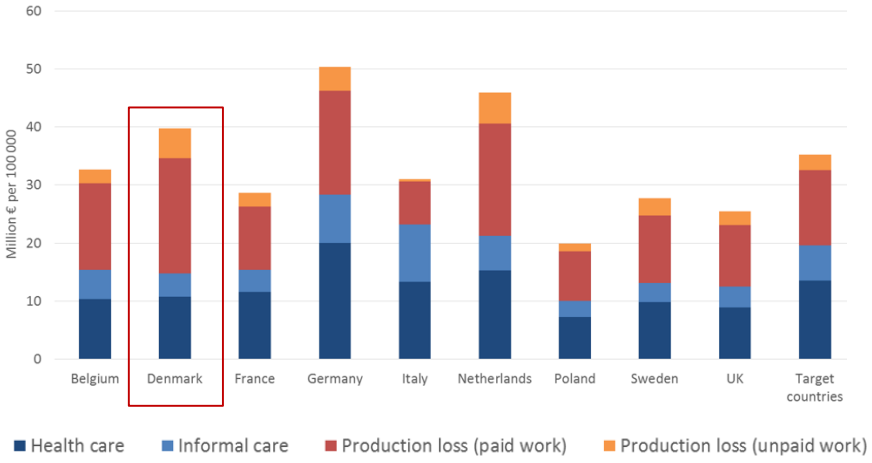
**Figure 67. Ratios between health care expenditures and disease burden, presented as deviation from the EU27 average**




## Economic burden of cancer (1.3)

Whereas most countries consider only direct health care costs in decision-making, there are many other costs that pose a high economic burden to patients and to society, that are often left unconsidered. We quantify those costs, and by doing so demonstrate the high cost to society of cancer resulting from: the time given up by friends and family to care for patients, production losses from cancer patients no longer being able to go to work, and the time cancer patients can no longer spend volunteering and caregiving for others.

**Figure 68. PPP-adjusted economic burden of all cancer, 2015 (million € per 100,000 population)**




Sources of data: Luengo-Fernandez et al (2013), Lipszyc et al. (2012) and Multinational Time Use Study (MTUS)

Direct health care expenditure represents on average only 27% of total economic burden of cancer in Denmark. Production losses of paid work is the major cost driver (50%), followed by unpaid work (resulting in 26 million hours of unpaid work e.g. from caregiving and volunteering lost per year) (13%) and informal care (e.g. by family and friends) (10%).

Across all countries studied, lung cancer has a higher total economic burden than breast (1.3 times), prostate (2.3 times) and colorectal cancer (1.4 times). Cancer also had a higher total economic burden than IHD (2.4 times) and stroke (3 times) but lower than dementia (0.7 times).

**Table 97. Cost distribution for cancer in Denmark, all cancer types combined**

| | Costs included | Total costs per year | % of total economic burden of cancer |
|---|---|---|---|
| Direct health care costs | primary care, outpatient and inpatient care, emergency care, long-term care and drug costs | €0.82 billion | 27% |
| Informal care | costs of caregivers providing support to cancer patients | €0.30 billion | 10% |
| Production losses | loss of paid work for patients because of their condition (due to morbidity and mortality) | €1.51 billion | 50% |
| Unpaid work | Loss of unpaid work (e.g. caregiving and volunteer work) for patients (due to mortality only) | €0.39 billion<br>26 million hours (44% of which are in the voluntary sector) | 13% |
| Total costs | All of the above | €3.02 billion | 100% |

**Clinical pathways and care delivery (2.3) and reimbursement and regulation mechanisms (2.4)**

More than one third of cancers are preventable by changing lifestyle factors. Prevention strategies therefore provide a major focus for policy-makers at both the national and European level. Early diagnosis is critical, and the Council of the European Union recommends population screening programmes for breast, cervical and colorectal cancer. Denmark has implemented programmes for all three.

In Denmark the diagnostic process for cancer generally starts with the GP. Hospital services are delivered through the general function level (tasks with limited complexity) or the specialised function level (highly specialised – together, all speciality guidelines constitute the speciality plan). Municipalities are responsible for an interconnected patient pathway, as well as prevention and the promotion of healthy lifestyles.

Drugs are assessed differently depending on whether they are prescribed in the primary care or hospital setting. For primary care drugs (and any drug that is available on prescription) the Danish Medicines Agency (DMA) decides on the reimbursement status. For drugs in the hospital setting assessment is undertaken by the a Coordination Council for Placing in Service Hospital Medicines (KRIS) which assesses benefits and risks (but not financial consequences) and the Danish Council for use of Expensive Hospital Medicines (RADS) when there is expected to be a high cost impact; whilst RADS looks at price, cost-effectiveness assessments are not undertaken. However, this is likely to change in 2017 when KRIS and RADS will be replaced by a 'Medicine Council'. Whilst the details remain unclear, the Medicine Council will probably negotiate discounts on hospital drugs based on an assessment of drug

benefit in relation to price. This may impose barrier to the uptake of new cancer medicines.

**Table 98. Denmark: Summary of policies and practices that may be leading to the efficient / inefficient delivery of cancer care**

| Practices contributing to the **inefficient** delivery of cancer care | Practices contributing to the **efficient** delivery of cancer care |
|---|---|
| • Late diagnosis is a major driver of poor outcomes in cancer. Uptake of cervical cancer screening is relatively low (64.2% in 2012). As colorectal cancer screening was implemented in 2014, it is too early to observe uptake. Early diagnosis is critical in realising the best outcomes for patients.<br>• Whilst spending relative to burden is higher than the EU average, outcomes are worse. This may be due to lifestyle factors and the late identification of cancer.<br>• There are regional inequalities in waiting times to access cancer treatment.<br>• Cost-effectiveness is currently not taken into consideration in the reimbursement of pharmaceuticals. This may be changing with new Medicine Council that will be introduced next year.<br>• A recent agreement has been implemented to ensure that costs of all hospital medicines will decrease by 10% over three years. Explicit caps on pharmaceutical expenditure can create perverse incentives for decision-makers and encourage a narrow perspective of value. | • Various public health initiatives to promote healthy living and cancer prevention have been implemented.<br>• Implementation of cervical, breast and colorectal cancer screening. Uptake is relatively high for breast (81.5% in 2012).<br>• Whilst highly cost-effective treatments such as radiotherapy are under-utilised in Europe, Denmark has a high availability of radiotherapy treatment machines.<br>• Standardised clinical pathways (pakkeforløb) have been implemented to improve care quality and reduce variation.<br>• Multidisciplinary cancer groups encourage cooperative research and knowledge sharing.<br>• A Centre for Cancer Immuno-Therapy (CCIT) was established to bridge the gap between discovery and implementation.<br>• The collection of RWD in Denmark is strong, and access is well facilitated.<br>• Time from medicine approval to access in Denmark is short. However, imminent changes to the reimbursement system may affect this. |

# France

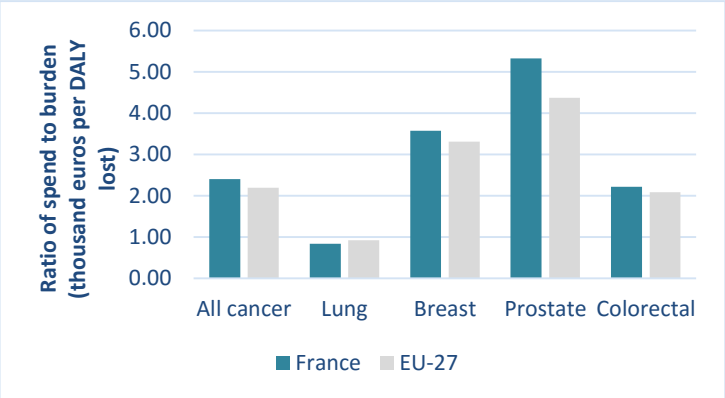
### Health care spending: Government expenditure (1.1)

Government expenditure on health in France in 2013 was €171.3 billion, which represents 8.1% of GDP. This is higher than the European average of 7.2% (for EU28 countries). Health represents 14.2% of total government expenditure (this slightly lower than the EU28 average which is 14.8%), and is the second highest spend for Government after social protection (42.9%). These data do not include private expenditure on health, either through private insurance (which represents 13.8% of health care expenditure in France) or out-of-pocket expenditure (accounting for 7.8% of spending).

### Cancer expenditure and disease burden (1.2)

Total expenditure on health care in France in 2013 was €231.38 billion.[30] France spent 3.9% of total health care expenditure on cancer in 2009.[31] This is lower than the EU average of 5.0%. Spending should be considered in relation to the disease burden of cancer in France, which shows us how big a problem cancer is in the country. We measure disease burden in disability adjusted life years (DALYs) lost which is a measure of ill health (both from early death and poor quality of life) across the whole population, caused by disease. This measure therefore incorporates prevalence. Total burden of disease in France in 2013 in terms of DALYs lost is 16.573 million DALYs. 19.5% of this total disease burden is due to cancer (3.239 million DALYs). This is higher than the EU average, where cancer represents on average 17.4% of total disease burden.

**Figure 69. Ratio of spend to burden in France**

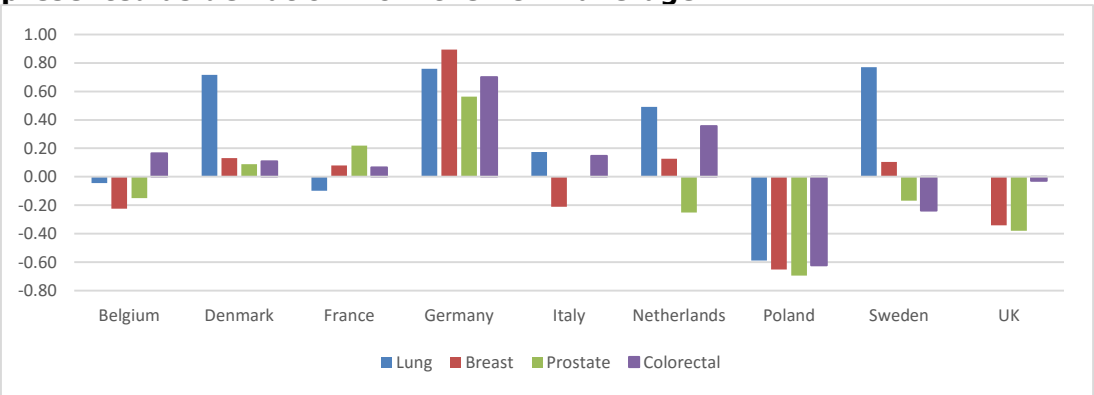



This graph shows the ratio of health care spending to disease burden, and how this differs by tumour type and compared with the European average. Overall, France spends more on cancer relative to burden than the European average. The lower spend on lung cancer (and to some extent colorectal cancer) relative to burden means that, compared with the high impact of lung (and colorectal) cancer on the population (from lives lost and poor quality of life), less money is spent at the moment on these than the other major cancers. It is apparent in Figure 70 that spend on lung cancer relative to burden is lower in France than the European average but spend is higher on the three other major cancers: breast, prostate and colorectal cancer.

[30] Source: OECD health expenditure statistics. Includes all health care expenditure by all financing agents.

[31] This includes: primary care, outpatient care, inpatient care, emergency care and drugs [source: Luengo-Fernandez et al (2013)], as well as long-term care costs [source: Lipszyc et al. (2012)]. These estimates cover all expenditures irrespective of who bears the cost (i.e. public, private, social care etc.). The year 2009 is used as this is the latest available data covering the necessary information available across all countries studied. This should be considered in the interpretation of results, particularly in assessing the spend between tumour types, the balance between which may have altered with the availability of new therapies.

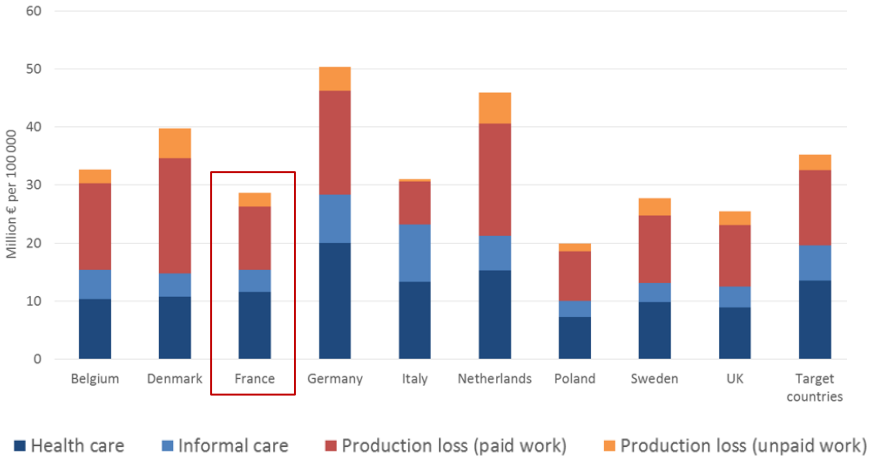
**Figure 70. Ratios between health care expenditures and disease burden, presented as deviation from the EU27 average**




## Economic burden of cancer (1.3)

Whereas most countries consider only direct health care costs in decision-making, there are many other costs that pose a high economic burden to patients and to society, that are often left unconsidered. We quantify those costs, and by doing so demonstrate the high cost to society of cancer resulting from: the time given up by friends and family to care for patients, production losses from cancer patients no longer being able to go to work, and the time cancer patients can no longer spend volunteering and caregiving for others.

**Figure 71. PPP-adjusted economic burden of all cancer, 2015 (million € per 100,000 population)**




Sources of data: Luengo-Fernandez et al (2013), Lipszyc et al. (2012) and Multinational Time Use Study (MTUS)

Direct health care expenditure represents on average only 40.5% of total economic burden of cancer in France. Production losses of paid work is a major cost driver (38%), followed by informal care (e.g. by family and friends) (13.2%) and unpaid work (resulting in 186 million hours of unpaid work e.g. from caregiving and volunteering lost per year) (8.2%).

Across all countries studied, lung cancer has a higher total economic burden than breast (1.3 times), prostate (2.3 times) and colorectal cancer (1.4 times). Cancer also had a higher total economic burden than IHD (2.4 times) and stroke (3 times) but lower than dementia (0.7 times).

**Table 99. Cost distribution for cancer in France, all cancer types combined**

| | Costs included | Total costs per year | % of total economic burden of cancer |
|---|---|---|---|
| Direct health care costs | primary care, outpatient and inpatient care, emergency care, long-term care and drug costs | €8.41 billion | 41% |
| Informal care | costs of caregivers providing support to cancer patients | €2.75 billion | 13% |
| Production losses | loss of paid work for patients because of their condition (due to morbidity and mortality) | €7.88 billion | 38% |
| Unpaid work | Loss of unpaid work (e.g. caregiving and volunteer work) for patients (due to mortality only) | €1.71 billion<br>186 million hours (38% of which are in the voluntary sector) | 8% |
| Total costs | All of the above | €20.75 billion | 100% |

**Clinical pathways and care delivery (2.3) and reimbursement and regulation mechanisms (2.4)**

More than one third of cancers are preventable by changing lifestyle factors. Prevention strategies therefore provide a major focus for policy-makers at both the national and European level. Early diagnosis is critical, and the Council of the European Union recommends population screening programmes for breast, cervical and colorectal cancer. France has implemented programmes for breast and colorectal cancer screening, but not yet for cervical cancer (although a national programme is in the process of being organised).

In France, the cancer plan is a major focus among health care providers and patients. As well as committing to health care delivery changes and targets, there is also a major focus on research. All aspects of the national cancer plan have been allocated specific additional funds for their delivery. To ensure excellence in cancer care, France have introduced three important initiatives: 'oncology authorisation' whereby health care facilities must have specific permission by their regional agency to treat patients suffering from cancer; 'minimum thresholds' which refers to the minimum annual activity in order to be able to provide safe and high quality treatments, and; 'cancer networks' which support regional cancer facilities.

In France, pricing and reimbursement decisions are undertaken at a national level. Each year in France there is social security funding law to control the social and health budget. As part of this, various measures to control costs can be implemented. Notable for pharmaceutical products is that there is a post-hoc retrospective cap called 'pharmaco-therapeutic class rebate', i.e., for each therapeutic class, the Economic Committee of Health Care Products (CEPS) attributes an annual sales growth target.

Manufacturers are 'taxed' if two criteria are met: manufacturers' sales exceed the target, and total pharmaceuticals market exceeds the target.

**Table 100. France: Summary of policies and practices that may be leading to the efficient / inefficient delivery of cancer care**

| Practices contributing to the **inefficient** delivery of cancer care | Practices contributing to the **efficient** delivery of cancer care |
|---|---|
| • The uptake of screening programmes in France is low: only 52.1% of the eligible population undergo breast cancer screening and for breast cancer and 70.7% of the eligible population had never undergone colorectal cancer screening.<br>• Highly cost-effective treatments such as radiotherapy are currently under-utilised.<br>• There are inequities in access to care, for example in access to imaging and variability in waiting times to access cancer treatments.<br>• The time delay between marketing approval and patient access can be substantial.<br>• Governance arrangements for the utilisation of real world data (particularly for research) are restrictive; this may change as the new 'General Data Protection Regulation' (GDPR) is implemented in France<br>• There is potential for greater savings from the use of generics. | • The national cancer plan is fully funded in France.<br>• Various measures have been introduced to ensure excellence in cancer care, e.g. health care facility "authorisation", minimum thresholds and cancer networks.<br>• There is a strong emphasis on multi-disciplinary care and personalised care plans, including for patients recovering from cancer (after-cancer personalised programme).<br>• Cancer is recognised to be a 'long-standing disease' which means it is exempt from patient co-payments (100% reimbursed)<br>• The new Loi de Modernisation introduces new measure to strengthen prevention, re-organise community care and develop patient rights<br>• Coordination of cancer services is supported through the implementation of cancer coordination centres and the cancer communication file.<br>• Earlier access to medicines is facilitated through various regulatory schemes (ATU, RTU, AcSé). The ATU scheme has had a very important impact (advancing patient access by around three years), which several other countries are looking to replicate. |

# Germany

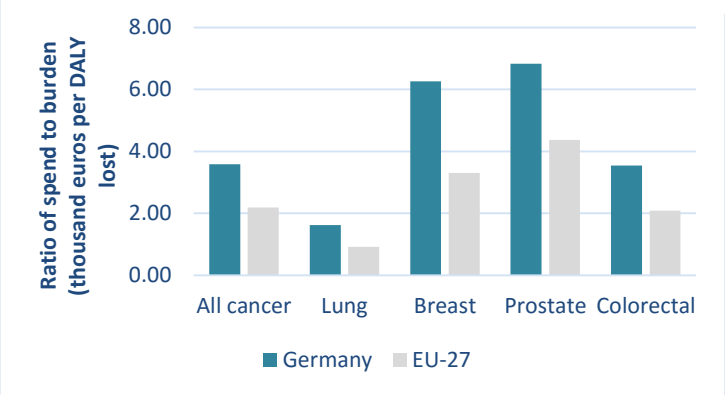
### Health care spending: Government expenditure (1.1)

Government expenditure on health in Germany (including the statutory health insurance) in 2013 was is €196.8 billion, which represents 7.0% of GDP. This is slightly lower than the European average of 7.2% (for EU28 countries). Health represents 15.8% of total government expenditure (this is higher than the EU28 average which is 14.8%), and is the second highest spend for Government after social protection (42.9%). These data do not include private expenditure on health, either through private insurance (which represents 9.6% of health care expenditure in Germany) or out-of-pocket expenditure (accounting for 12.2% of spending).

### Cancer expenditure and disease burden (1.2)

Total expenditure on health care in Germany in 2014 was €322.8 billion.[32] Germany spent 6.7% of total health care expenditure on cancer in 2009.[33] This is higher than the EU average of 5.0%. Spending should be considered in relation to the disease burden of cancer in Germany, which shows us how big a problem cancer is in the country. We measure disease burden in disability adjusted life years (DALYs) lost which is a measure of ill health (both from early death and poor quality of life) across the whole population, caused by disease. This measure therefore incorporates prevalence. Total burden of disease in Germany in 2013 in terms of DALYs lost is 25.036 million DALYs. 17.4% of this total disease burden is due to cancer (4.320 million DALYs). This is in line with the EU average, where cancer represents on average 17.4% of total disease burden.

**Figure 72. Ratio of spend to burden in Germany**

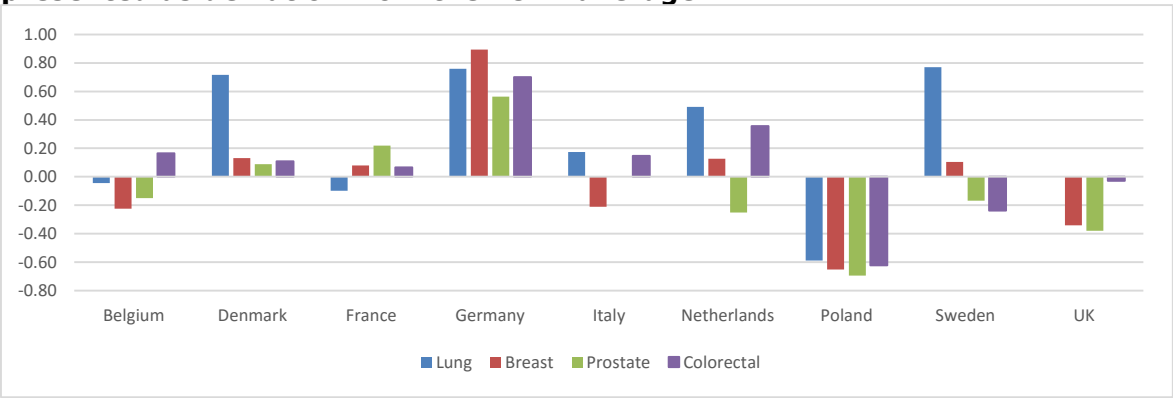



This graph shows the ratio of health care spending to disease burden, and how this differs by tumour type and compared with the European average. Overall, Germany spends much more on cancer relative to burden than the European average. The lower spend on lung cancer relative to burden means that, compared with the high impact of lung cancer on the population (from lives lost and poor quality of life), less money is spent at the moment on lung cancer than the other major cancers. However, it is apparent in Figure 73, that spend on lung cancer relative to burden is higher than the European average in Germany, as is spend on the three other major cancers: breast, prostate and colorectal cancer.

[32] Source: OECD health expenditure statistics. Includes all health care expenditure by all financing agents.

[33] This includes: primary care, outpatient care, inpatient care, emergency care and drugs [source: Luengo-Fernandez et al (2013)], as well as long-term care costs [source: Lipszyc et al. (2012)]. These estimates cover all expenditures irrespective of who bears the cost (i.e. public, private, social care etc.). The year 2009 is used as this is the latest available data covering the necessary information available across all countries studied. This should be considered in the interpretation of results, particularly in assessing the spend between tumour types, the balance between which may have altered with the availability of new therapies.

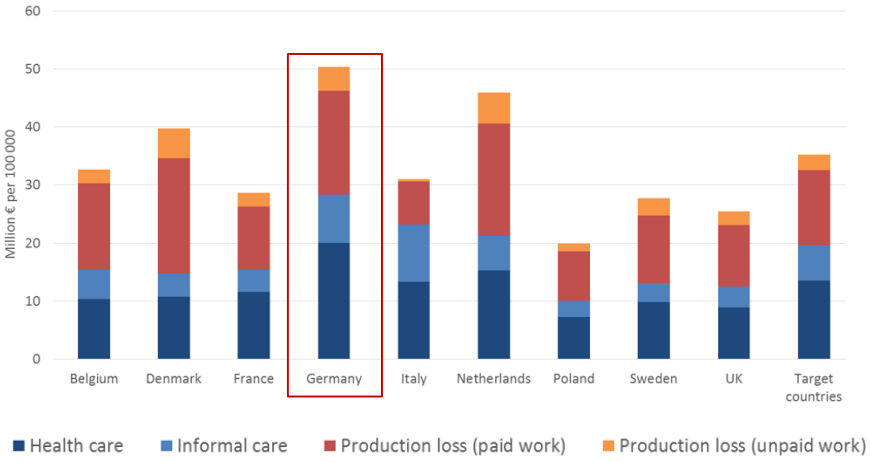
**Figure 73. Ratios between health care expenditures and disease burden, presented as deviation from the EU27 average**




## Economic burden of cancer (1.3)

Whereas most countries consider only direct health care costs in decision-making, there are many other costs that pose a high economic burden to patients and to society, that are often left unconsidered. We quantify those costs, and by doing so demonstrate the high cost to society of cancer resulting from: the time given up by friends and family to care for patients, production losses from cancer patients no longer being able to go to work, and the time cancer patients can no longer spend volunteering and caregiving for others.

**Figure 74. PPP-adjusted economic burden of all cancer, 2015 (million € per 100,000 population)**




Sources of data: Luengo-Fernandez et al (2013), Lipszyc et al. (2012) and Multinational Time Use Study (MTUS)

Direct health care expenditure represents on average only 39.8% of total economic burden of cancer in Germany. Production losses of paid work is a major cost driver (35.5%), followed by informal care (e.g. by family and friends) (16.5%) and unpaid work (resulting in 411 million hours of unpaid work e.g. from caregiving and volunteering lost per year) (8.3%).

Across all countries studied, lung cancer has a higher total economic burden than breast (1.3 times), prostate (2.3 times) and colorectal cancer (1.4 times). Cancer also had a higher total economic burden than IHD (2.4 times) and stroke (3 times) but lower than dementia (0.7 times).

**Table 101. Cost distribution for cancer in Germany, all cancer types combined**

| | Costs included | Total costs per year | % of total economic burden of cancer |
|---|---|---|---|
| Direct health care costs | primary care, outpatient and inpatient care, emergency care, long-term care and drug costs | €16.85 billion | 40% |
| Informal care | costs of caregivers providing support to cancer patients | €6.97 billion | 16% |
| Production losses | loss of paid work for patients because of their condition (due to morbidity and mortality) | €15.02 billion | 35% |
| Unpaid work | Loss of unpaid work (e.g. caregiving and volunteer work) for patients (due to mortality only) | €3.50 billion<br>411 million hours (59% of which are in the voluntary sector) | 8% |
| Total costs | All of the above | €42.34 billion | 100% |

**Clinical pathways and care delivery (2.3) and reimbursement and regulation mechanisms (2.4)**

More than one third of cancers are preventable by changing lifestyle factors. Prevention strategies therefore provide a major focus for policy-makers at both the national and European level. Early diagnosis is critical, and the Council of the European Union recommends population screening programmes for breast, cervical and colorectal cancer. Germany has implemented programmes for all three, as well as screening programmes for prostate and skin cancer.

Cancer care in Germany is organised according to a specialisation hierarchy, at the top of which are 'organ centres' which provide state-of-the-art, specialised care and are mainly located in academic hospitals. Next, 'Oncologic Centres' represent cooperation programmes which bundle competence and equipment at dedicated centres; they coordinate overlapping functions such as palliative care, supportive care, management of pain and rehabilitative care. Finally, 'Comprehensive Cancer Centres' combine all aspects of cancer care such as patient treatment, research and training. There are currently 13 of these in Germany. German Tumour Centres function as regional networks of hospitals, coordinating cancer treatment across the continuum of care.

Drugs are assessed differently depending on whether they are prescribed in an inpatient or outpatient setting. In an outpatient setting (ambulatory care), drugs are automatically reimbursed upon marketing authorization, unless they have been pro-actively disapproved by the Joint Federal Committee (G-BA). For the inpatient sector, payment is included in the relevant diagnosis-related group (DRG). Where medicine costs are high, the hospital may apply to for additional funding via the New

Examination and Treatment Methods process or the DRG supplement list. The introduction of AMNOG changed the assessment of new drugs. Immediate access is still guaranteed, but free pricing of non reference-priced pharmaceuticals is now limited to 12 months. A rapid benefit assessment is conducted and an assessment by the Institute for Quality and Efficiency in Health Care (IQWiG) might be undertaken. Pricing arrangements depend on the additional benefit of the drug compared to existing therapies.

**Table 102. Germany: Summary of policies and practices that may be leading to the efficient / inefficient delivery of cancer care**

| Practices contributing to the **inefficient** delivery of cancer care | Practices contributing to the **efficient** delivery of cancer care |
|---|---|
| • There is substantial inequality in the uptake of cancer screening, which differs greatly by gender and education.<br>• Uptake for breast cancer screening is low (only 53% of the eligible population).<br>• Highly cost-effective treatments such as radiotherapy are currently under-utilised.<br>• Data collection and transparency is limited compared with some other European countries. Governance arrangements (particularly for research) are restrictive.<br>• Dichotomisation between care providers is inefficient, particularly between ambulatory (outpatient) and hospital care. Since the introduction of regulations to improve this (integration of outpatient speciality treatment), there has been little evidence of impact, and some suggest this could be creating silos of sub-disciplines.<br>• Physician payment incentives may perversely affect appropriate treatment decisions<br>• Case-related negotiations introduce substantial delays in reimbursement of treatments for hospitals.<br>• There is regional inequality in access to treatments across Germany; these seem to be explained by demand-side factors.<br>• The collection and utilisation of real world data are fairly restrictive in Germany<br>• The social health insurance risk equalisation mechanism may disadvantage expensive forms of treatment (such as cancer treatments) | • Germany has implemented cancer screening programmes for cervical, breast and colorectal cancer (as well as prostate and skin cancer).<br>• There are new opportunities for the integration of outpatient speciality treatments for rare diseases.<br>• The implementation of Comprehensive Cancer Centres has improved the cooperation of medical disciplines.<br>• Clinical guidelines support a coordinated approach to cancer care.<br>• Cancer registries which have been introduced offer the opportunity to improve the collection of real world data in cancer. |

# Italy

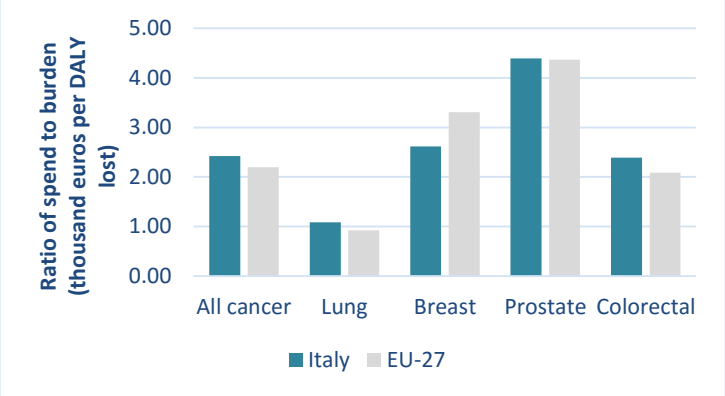
### Health care spending: Government expenditure (1.1)

Government expenditure on health in Italy in 2013 was €115.9 billion, which represents 7.2% of GDP. This is higher than the European average of 7.2% (for EU28 countries). Health represents 14.2% of total government expenditure (this is under the EU28 average which is 14.8%), and is the third highest spend for Government after social protection (41.3%) and general public services (17.5%). These data do not include private expenditure on health.

### Cancer expenditure and disease burden (1.2)

Total expenditure on health care in Italy in 2014 was €143.18 billion.[34] Italy spent 5.5% of total health care expenditure on cancer in 2009.[35] This is higher than the EU average of 5.0%. Spending should be considered in relation to the disease burden of cancer in Italy, which shows us how big a problem cancer is in the country. We measure disease burden in disability adjusted life years (DALYs) lost which is a measure of ill health (both from early death and poor quality of life) across the whole population, caused by disease. This measure therefore incorporates prevalence. Total burden of disease in Italy in 2013 in terms of DALYs lost is 17.016 million DALYs. 17.9% of this total disease burden is due to cancer (3.050 million DALYs). This is slightly higher than the EU average, where cancer represents on average 17.4% of total disease burden.

**Figure 75. Ratio of spend to burden in Italy**

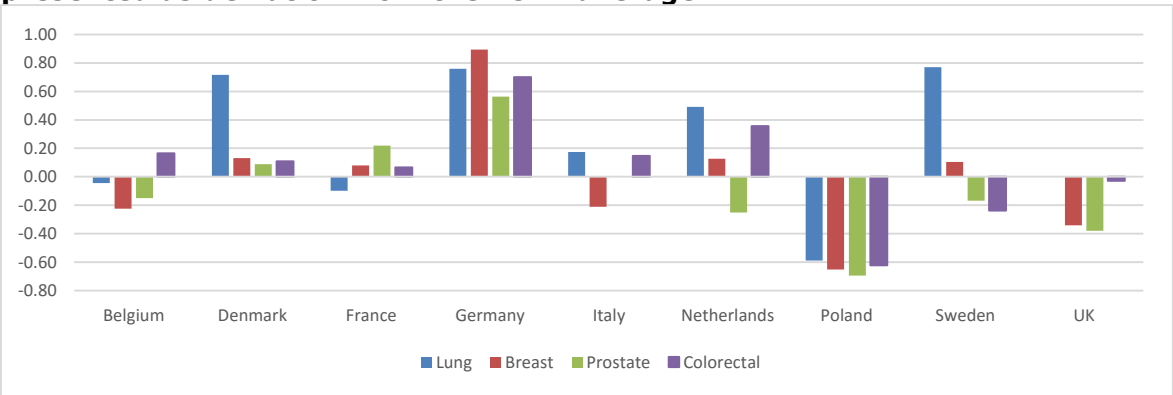



This graph shows the ratio of health care spending to disease burden, and how this differs by tumour type and compared with the European average. Overall, Italy spends slightly more on cancer relative to burden than the European average. The lower spend on lung cancer relative to burden means that, compared with the high impact of lung cancer on the population (from lives lost and poor quality of life), less money is spent at the moment on lung cancer than the other major cancers. However, it is apparent in Figure 76 that, spend on lung cancer relative to burden is higher than the European average, as is spend on colorectal cancer. Compared with other European countries, spend on prostate cancer relative to burden is in line with the European average, but spend on breast cancer is lower.

[34] Source: OECD health expenditure statistics. Includes all health care expenditure by all financing agents.

[35] This includes: primary care, outpatient care, inpatient care, emergency care and drugs [source: Luengo-Fernandez et al (2013)], as well as long-term care costs [source: Lipszyc et al. (2012)]. These estimates cover all expenditures irrespective of who bears the cost (i.e. public, private, social care etc.). The year 2009 is used as this is the latest available data covering the necessary information available across all countries studied. This should be considered in the interpretation of results, particularly in assessing the spend between tumour types, the balance between which may have altered with the availability of new therapies.

**Figure 76. Ratios between health care expenditures and disease burden, presented as deviation from the EU27 average**




## Economic burden of cancer (1.3)

Whereas most countries consider only direct health care costs in decision-making, there are many other costs that pose a high economic burden to patients and to society, that are often left unconsidered. We quantify those costs, and by doing so demonstrate the high cost to society of cancer resulting from: the time given up by friends and family to care for patients, production losses from cancer patients no longer being able to go to work, and the time cancer patients can no longer spend volunteering and caregiving for others.

**Figure 77. PPP-adjusted economic burden of all cancer, 2015 (million € per 100,000 population)**


Sources of data: Luengo-Fernandez et al (2013), Lipszyc et al. (2012) and Multinational Time Use Study (MTUS)

Direct health care expenditure represents on average only 42.9% of total economic burden of cancer in Italy. Informal care (e.g. by family and friends) was a major cost driver (31.9%), which was the highest among countries studies. This was followed by production losses of paid work (23.9%) and unpaid work (resulting in 38 million hours of unpaid work e.g. from caregiving and volunteering lost per year) (1.3%).

Across all countries studied, lung cancer has a higher total economic burden than breast (1.3 times), prostate (2.3 times) and colorectal cancer (1.4 times). Cancer also had a higher total economic burden than IHD (2.4 times) and stroke (3 times) but lower than dementia (0.7 times).

**Table 103. Cost distribution for cancer in Italy, all cancer types combined**

| | Costs included | Total costs per year | % of total economic burden of cancer |
|---|---|---|---|
| Direct health care costs | primary care, outpatient and inpatient care, emergency care, long-term care and drug costs | €8.12 billion | 43% |
| Informal care | costs of caregivers providing support to cancer patients | €6.04 billion | 32% |
| Production losses | loss of paid work for patients because of their condition (due to morbidity and mortality) | €4.52 billion | 24% |
| Unpaid work | Loss of unpaid work (e.g. caregiving and volunteer work) for patients (due to mortality only) | €0.24 billion<br>38 million hours (13% of which are in the voluntary sector) | 1% |
| Total costs | All of the above | €18.91 billion | 100% |

**Clinical pathways and care delivery (2.3) and reimbursement and regulation mechanisms (2.4)**

More than one third of cancers are preventable by changing lifestyle factors. Prevention strategies therefore provide a major focus for policy-makers at both the national and European level. Early diagnosis is critical, and the Council of the European Union recommends population screening programmes for breast, cervical and colorectal cancer. Italy has implemented programmes for all three.

In Italy each region is responsible for the identification of which health care activities should be carried out where. Basic activities (diagnosis and treatment) are carried out at a large number of hospitals, and each region has a limited number of highly specialised centres where experience is concentrated. Regional autonomy in Italy extends to the publication of disease-specific therapeutic guidelines, for which there are regional differences.

In Italy, prices for pharmaceuticals reimbursed by the Italian NHS are set through a negotiation between the Italian Medicines Agency (AIFA) and pharmaceutical companies. Criteria for evaluation include cost-effectiveness (though there is no explicit threshold), benefit/risk ratio, the economic impact, potential market share, and a comparison with prices and consumption in other European countries. Drugs that represent "therapeutic innovations" can have more favourable negotiation terms. Problems arising from the fragmentation of the Italian NHS extend to market access for pharmaceuticals, as each region must be worked with in a different way, and there is duplication of effort in drug assessments at the regional level on top of the national level. In order to prescribe a "high-cost drug" clinicians must complete an online

register entry. These registries represent huge potential in the collection and use of RWD, but this is currently un-realised as access is very poor.

**Table 104. Italy: Summary of policies and practices that may be leading to the efficient / inefficient delivery of cancer care**

| Practices contributing to the **inefficient** delivery of cancer care | Practices contributing to the **efficient** delivery of cancer care |
|---|---|
| • The fragmentation of the Italian NHS creates inefficiencies.<br>• Uptake of screening in Italy is low for breast (62.2%), cervical (41.5%) and colorectal cancer (47.1%), for which there is significant regional variation in participation.<br>• Radiotherapy is currently under-utilised.<br>• Whilst there is a strong infrastructure to support the collection of real world data, governance arrangements and access to the data (particularly for research) are restrictive.<br>• The high variation between regions leads to substantial inequalities in access to health care.<br>• The explicit cap on pharmaceutical expenditure in Italy (3.5% of budget for hospital care and 11.35% for community expenditure), paired with the presence of silo budgets (different offices responsible for pharmaceutical versus hospital budgets) has negative implications for allocative efficiency.<br>• Lengthy pricing negotiations, and well as discussions at Region-level, lead to long delays in access.<br>• There may be significant potential for greater savings from the use of generics. | • The cancer plan contains provision for a multidisciplinary approach to creating personalised intervention plans for patients.<br>• Italy has implemented cancer screening programmes for cervical, breast and colorectal cancer.<br>• Evidence-based recommendations of treatment adoption that are tailored to local populations are becoming more common, as are guidelines for comprehensive clinical pathways in some regions.<br>• The establishment of oncologic networks should lead to better integration of services and reduce inequality between regions.<br>• Data collection alongside clinical practice is strong in Italy.<br>• Risk-sharing arrangements could lead to earlier access to treatments. |

# The Netherlands

### Health care spending: Government expenditure (1.1)

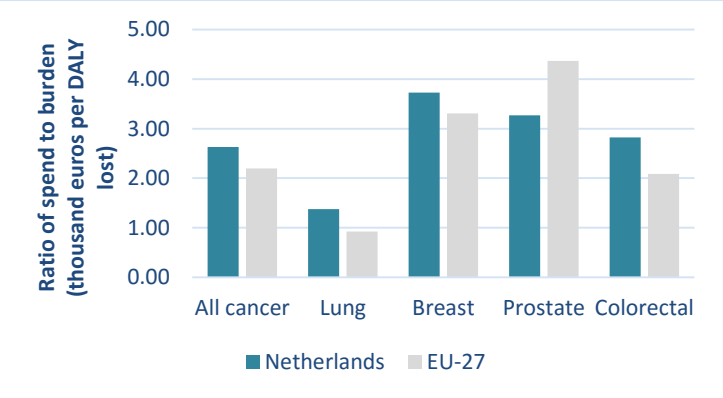
Government expenditure on health in the Netherlands in 2013 was €53.3 billion, which represents 8.3% of GDP. This is higher than the European average of 7.2% (for EU28 countries). Health represents 17.7% of total government expenditure (this is higher than the EU28 average which is 14.8%), and is the second highest spend for Government after social protection (36.8%). These data do not include private expenditure on health, either through private insurance (which represents 5.5% of health care expenditure in the Netherlands) or out-of-pocket expenditure (accounting for 6% of spending – which was the lowest among countries studied).

### Cancer expenditure and disease burden (1.2)

Total expenditure on health care in the Netherlands in 2014 was 72.48 billion euros.[36]The Netherlands spent 3.7% of total health care expenditure on cancer in 2009.[37] This is lower than the EU average of 5.0%. Spending should be considered in relation to the disease burden of cancer in the Netherlands, which shows us how big a problem cancer is in the country. We measure disease burden in disability adjusted life years (DALYs) lost which is a measure of ill health (both from early death and poor quality of life) across the whole population, caused by disease. This measure therefore incorporates prevalence. Total burden of disease in the Netherlands in 2013 in terms of DALYs lost is 4.492 million DALYs. 20.8% of this total disease burden is due to cancer (0.933 million DALYs). This is slightly higher than the EU average, where cancer represents on average 17.4% of total disease burden.

This graph shows the ratio of health care spending to disease burden, and how this differs by tumour type and compared with the European average. Overall, the Netherlands spends more on cancer relative to burden than the European average. The lower spend on lung cancer relative to burden means that, compared with the high impact of lung cancer on the population (from lives lost and poor quality of life), less money is spent at the moment on lung cancer than the other major cancers. However, it is apparent in Figure 79 that, compared with the EU average, spend on lung cancer relative to burden is significantly higher, as is spending on colorectal and breast cancer. Spend on prostate cancer relative to burden is lower than average.

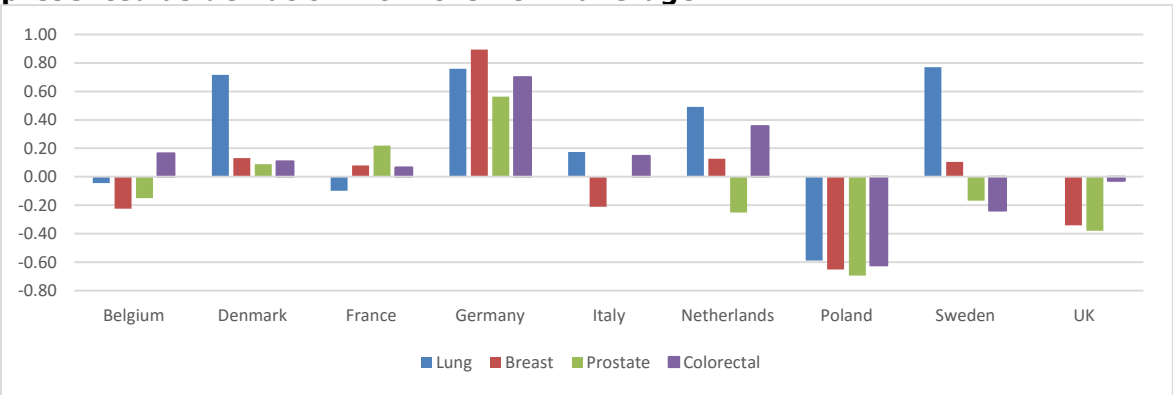
**Figure 78. Ratio of spend to burden in The Netherlands**




[36] Source: OECD health expenditure statistics. Includes all health care expenditure by all financing agents.

[37] This includes: primary care, outpatient care, inpatient care, emergency care and drugs [source: Luengo-Fernandez et al (2013)], as well as long-term care costs [source: Lipszyc et al. (2012)]. These estimates cover all expenditures irrespective of who bears the cost (i.e. public, private, social care etc.). The year 2009 is used as this is the latest available data covering the necessary information available across all countries studied. This should be considered in the interpretation of results, particularly in assessing the spend between tumour types, the balance between which may have altered with the availability of new therapies

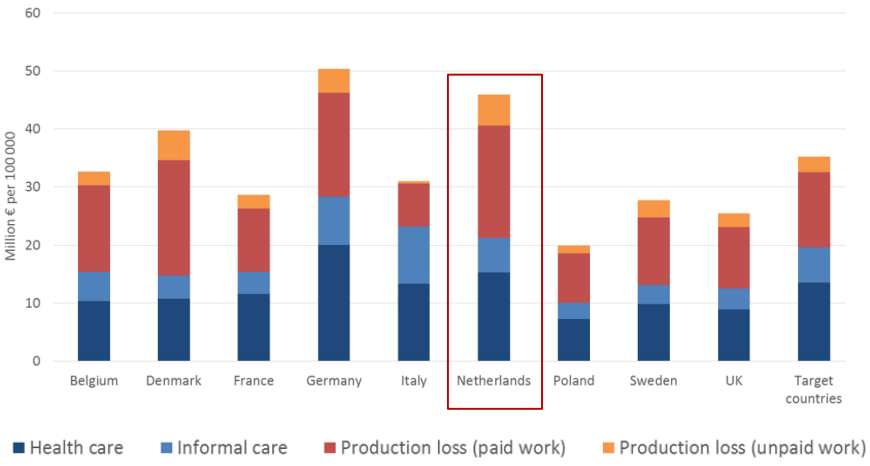
**Figure 79. Ratios between health care expenditures and disease burden, presented as deviation from the EU27 average**




## Economic burden of cancer (1.3)

Whereas most countries consider only direct health care costs in decision-making (the Netherlands being an exception), there are many other costs that pose a high economic burden to patients and to society, that are often left unconsidered. We quantify those costs, and by doing so demonstrate the high cost to society of cancer resulting from: the time given up by friends and family to care for patients, production losses from cancer patients no longer being able to go to work, and the time cancer patients can no longer spend volunteering and caregiving for others.

**Figure 80. PPP-adjusted economic burden of all cancer, 2015 (million € per 100,000 population)**




Sources of data: Luengo-Fernandez et al (2013), Lipszyc et al. (2012) and Multinational Time Use Study (MTUS)

Direct health care expenditure represents on average only 33.3% of total economic burden of cancer in the Netherlands. Production losses of paid work are a major cost driver (42.1%), followed by informal care (e.g. by family and friends) (12.8%) and unpaid work (resulting in 105 million hours of unpaid work e.g. from caregiving and volunteering lost per year) (11.8%).

Across all countries studied, lung cancer has a higher total economic burden than breast (1.3 times), prostate (2.3 times) and colorectal cancer (1.4 times). Cancer also had a higher total economic burden than IHD (2.4 times) and stroke (3 times) but lower than dementia (0.7 times).

**Table 105. Cost distribution for cancer in the Netherlands, all cancer types combined**

| | Costs included | Total costs per year | % of total economic burden of cancer |
|---|---|---|---|
| Direct health care costs | primary care, outpatient and inpatient care, emergency care, long-term care and drug costs | €2.81 billion | 33% |
| Informal care | costs of caregivers providing support to cancer patients | €1.08 billion | 13% |
| Production losses | loss of paid work for patients because of their condition (due to morbidity and mortality) | €3.55 billion | 42% |
| Unpaid work | Loss of unpaid work (e.g. caregiving and volunteer work) for patients (due to mortality only) | €0.99 billion<br>105 million hours (53% of which are in the voluntary sector) | 12% |
| Total costs | All of the above | €8.45 billion | 100% |

**Clinical pathways and care delivery (2.3) and reimbursement and regulation mechanisms (2.4)**

More than one third of cancers are preventable by changing lifestyle factors. Prevention strategies therefore provide a major focus for policy-makers at both the national and European level. Early diagnosis is critical, and the Council of the European Union recommends population screening programmes for breast, cervical and colorectal cancer. The Netherlands has implemented programmes for all three.

The Dutch health care system is based on social health insurance (a Bismarck model). All residents are obliged to enrol in a universal basic health insurance which is provided by competing health insurers. Supplementary health insurance is privately offered on a voluntary basis. Decisions around what type of care is included in the basic package is made at a national level and centrally mandated. Managed competition between health insurers incentivises efficiency whilst ensuring universal access to quality care. A cornerstone of this system it to prohibit risk selection, which is managed through a risk equalisation fund.

Drugs are assessed differently depending on whether they are outpatient or medical specialist drugs. Outpatient drugs are assessed by ZIN before being placed on a positive reimbursement list; reimbursement of therapeutically interchangeable drugs are limited to an average price for that class, and those with added therapeutic value must prove this with pharmacoeconomic evidence and are fully reimbursed. Medical specialist drugs that have a budget impact under €2.5 million are funded within

diagnostic related groups (DRG); where they exceed this budget they are funded as "add-ons" and must be evaluated by ZIN. Whilst there is no formal cost-effectiveness threshold, ZIN described a step-wise approach varying between €20,000 / QALY for diseases with low severity to €80,000 / QALY for diseases with high severity, although they are careful to state that cost-effectiveness is only one criteria. Higher costs / QALY may lead to price negotiations. A societal perspective is taken in economic evaluations which includes, for example, productivity losses and informal care. In practice this perspective is not always adopted and some drugs are exempt from submitting economic evidence (e.g. drugs with a low budget impact). Coverage with evidence development (CED) was introduced to facilitate earlier access and collect outcomes data to reduce uncertainty; in practice there have been challenges in addressing the uncertainty with the evidence collected through CED, and the programme may be reformed.

**Table 106. The Netherlands: Summary of policies and practices that may be leading to the efficient / inefficient delivery of cancer care**

| Practices contributing to the **inefficient** delivery of cancer care | Practices contributing to the **efficient** delivery of cancer care |
|---|---|
| • Uptake of cervical cancer screening is relatively low (64.7% in 2013). As population colorectal cancer screening was only implemented in 2014, it is too early to observe uptake.<br>• Highly cost-effective treatments such as radiotherapy are currently under-utilised.<br>• Performance indicators in the Netherlands are not transparent to the general public.<br>• Whilst there are normally no delays in patient access, recent policy tools have been introduced to delay reimbursement due to budget impact uncertainty. This could limit access to cost-effective interventions.<br>• Data collection through schemes such as coverage with evidence development has been insufficient to resolve uncertainty in many cases, and delisting drugs that have already been available to patients is problematic.<br>• Data governance for RWD protects confidentiality but can limit the utility of data for economic evaluation.<br>• There is regional inequality of access to cancer care. | • Managed competition between health insurers incentivises efficiency whilst ensuring universal access to quality care.<br>• Various public health initiatives to promote healthy living and cancer prevention have been implemented.<br>• Implementation of cervical, breast and colorectal cancer screening. Uptake is relatively high for breast (78.6% in 2012).<br>• National collaboration and coordination in oncology practice is supported through the Dutch association for medical oncology.<br>• Centralisation of care in designated hospitals appears to increase the quality and efficiency of care, and can be made a requirement of reimbursement. The set-up of a patient registry can also be a requirement of reimbursement; these are contributing to better data on treatments and outcomes.<br>• Health insurers have been efficient in limiting expenditure on therapeutically interchangeable drugs.<br>• A societal perspective is adopted for health economic evaluations, though in practice not all applications adopt this perspective and some do not submit economic evidence. |

# Poland

### Health care spending: Government expenditure (1.1)

Government expenditure on health in Poland in 2013 was €18.2 billion, which represents 4.6% of GDP. This is well below the European average of 7.2% (for EU28 countries). Health represents 10.9% of total government expenditure (this is under the EU28 average which is 14.8%), and is the fourth highest spend for Government after social protection (38.4%), general public services (13.5%) and education (12.6%). These data do not include private expenditure on health, either through private insurance (which represents 0.8% of health care expenditure in Poland) or out-of-pocket expenditure (accounting for 24.3% of spending: out of pocket expenditure was the highest among countries studied).

### Cancer expenditure and disease burden (1.2)

Total expenditure on health care in Poland in 2013 was 106.04 billion złoty.[38] Poland spent 8.1% of total health care expenditure on cancer in 2009.[39] This is higher than the EU average of 5.0%. However, actual spend on cancer is very low, even though – within Poland's limited health care budget – proportionally more is spent on cancer compared with other countries. Absolute spending on cancer is very low, because the health budget is very small. For example, in Sweden (which has one of the lowest proportions of health spend allocated to cancer), absolute spending on cancer was €1,182 million in 2009, compared with €1,438 million in Poland, which has a population of roughly four times that of Sweden. This means that, per capita, spend on cancer in Poland is only roughly 30% of that in Sweden. Spending should be considered in relation to the disease burden of cancer in Poland, which shows us how big a problem cancer is in the country. We measure disease burden in disability adjusted life years (DALYs) lost which is a measure of ill health (both from early death and poor quality of life) across the whole population, caused by disease. This measure therefore incorporates prevalence. Total burden of disease in Poland in 2013 in terms of DALYs lost is 11.949 million DALYs. 17.5% of this total disease burden is due to cancer (2.089 million DALYs). This is slightly higher than the EU average, where cancer represents on average 17.4% of total disease burden.

[38] Source: OECD health expenditure statistics. Includes all health care expenditure by all financing agents.

[39] This includes: primary care, outpatient care, inpatient care, emergency care and drugs [source: Luengo-Fernandez et al (2013)], as well as long-term care costs [source: Lipszyc et al. (2012)]. These estimates cover all expenditures irrespective of who bears the cost (i.e. public, private, social care etc.). The year 2009 is used as this is the latest available data covering the necessary information available across all countries studied. This should be considered in the interpretation of results, particularly in assessing the spend between tumour types, the balance between which may have altered with the availability of new therapies.

This graph shows the ratio of health care spending to disease burden, and how this differs by tumour type and compared with the European average. Overall, Poland spends far less on cancer relative to burden than the European average. The lower spend on lung cancer relative to burden in particular means that, compared with the high impact of lung cancer on the population (from lives lost and poor quality of life), less money is spent at the moment on lung cancer than the other major cancers. It is apparent in **Figure 82** that spend on all major cancers in Poland, relative to their burden, is well below the European average.

**Figure 81. Ratio of spend to burden in Poland**

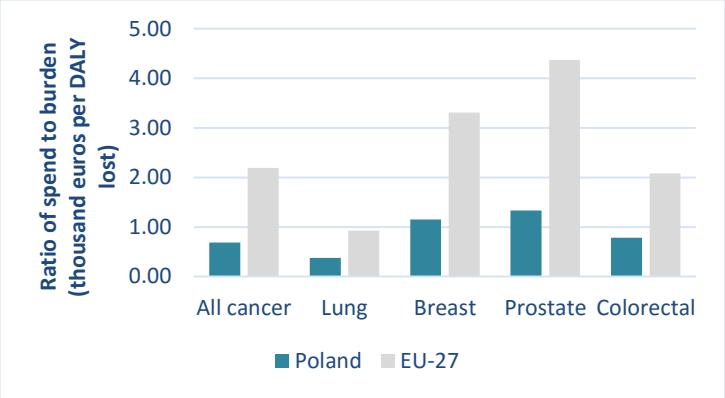
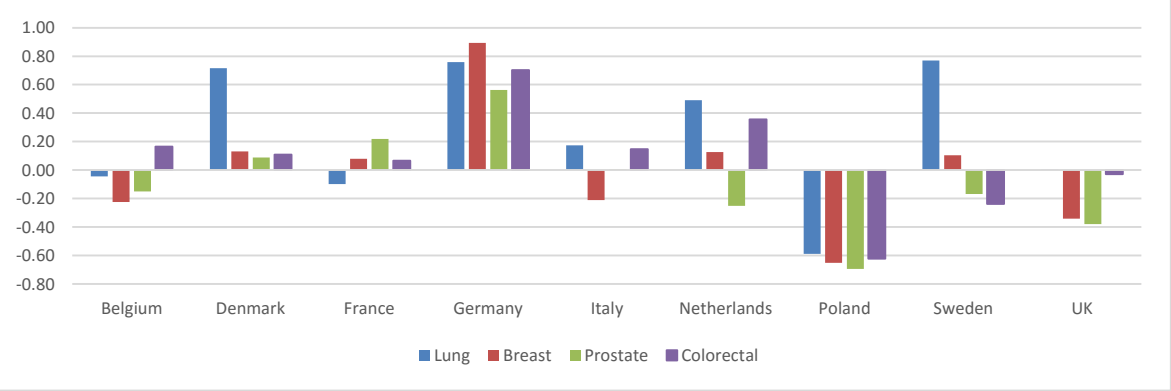


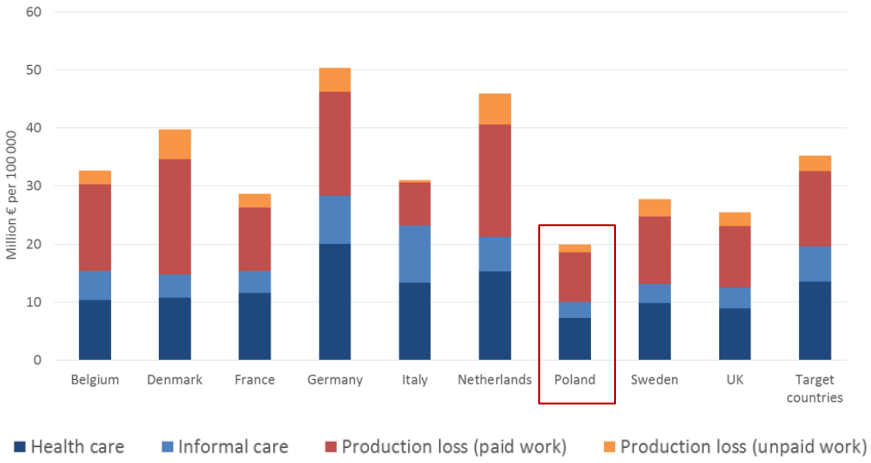

**Figure 82. Ratios between health care expenditures and disease burden, presented as deviation from the EU27 average**




## Economic burden of cancer (1.3)

Whereas most countries consider only direct health care costs in decision-making, there are many other costs that pose a high economic burden to patients and to society, that are often left unconsidered. We quantify those costs, and by doing so demonstrate the high cost to society of cancer resulting from: the time given up by friends and family to care for patients, production losses from cancer patients no longer being able to go to work, and the time cancer patients can no longer spend volunteering and caregiving for others.

**Figure 83. PPP-adjusted economic burden of all cancer, 2015 (million € per 100,000 population)**




Sources of data: Luengo-Fernandez et al (2013), Lipszyc et al. (2012) and Multinational Time Use Study (MTUS)

Direct health care expenditure represents on average only 36.4% of total economic burden of cancer in Poland. Production losses of paid work are a major cost driver (42.8%), followed by informal care (e.g. by family and friends) (13.9%) and unpaid work (resulting in 117 million hours of unpaid work e.g. from caregiving and volunteering lost per year) (6.9%).

Across all countries studied, lung cancer has a higher total economic burden than breast (1.3 times), prostate (2.3 times) and colorectal cancer (1.4 times). Cancer also had a higher total economic burden than IHD (2.4 times) and stroke (3 times) but lower than dementia (0.7 times).

**Table 107. Cost distribution for cancer in Poland, all cancer types combined**

| | Costs included | Total costs per year | % of total economic burden of cancer |
|---|---|---|---|
| Direct health care costs | primary care, outpatient and inpatient care, emergency care, long-term care and drug costs | €1.58 billion | 36% |
| Informal care | costs of caregivers providing support to cancer patients | €0.61 billion | 14% |
| Production losses | loss of paid work for patients because of their condition (due to morbidity and mortality) | €1.86 billion | 43% |
| Unpaid work | Loss of unpaid work (e.g. caregiving and volunteer work) for patients (due to mortality only) | €0.30 billion<br>117 million hours (33% of which are in the voluntary sector) | 7% |
| Total costs | All of the above | €4.35 billion | 100% |

**Clinical pathways and care delivery (2.3) and reimbursement and regulation mechanisms (2.4)**

More than one third of cancers are preventable by changing lifestyle factors. Prevention strategies therefore provide a major focus for policy-makers at both the national and European level. Early diagnosis is critical, and the Council of the European Union recommends population screening programmes for breast, cervical and colorectal cancer. Poland has implemented programmes for all three. However, uptake is extremely low.

In Poland, the provision of care is based on a three-tier system of specialisation, with the Maria Sklodowska-Curie Institute of Oncology at the top, followed by 16 regional comprehensive cancer centres and then cancer wards and units within local hospitals. Cancer care is primarily financed through a national system of guaranteed health benefits.

In Poland, requests for reimbursement are made by the marketing authorisation holder to the Ministry of Health. HTA reports are reviewed by AOTMiT (The Agency for Health Technology Assessment and Tariff System); AOTMiT's recommendations then play an important role in price negotiations between the pharmaceutical companies and the Economic Council. A cost-effectiveness threshold of three times GDP per capita/QALY is applied. Given Poland's low GDP, and constraints in price discrimination due to international reference pricing, this poses a significant barrier to access in Poland, which as a country has among the lowest uptake rates of innovative cancer medicines in Europe. There are also long delays in patient access to innovative therapies, with significant utilisation taking over three years to achieve.

**Table 108. Poland: Summary of policies and practices that may be leading to the efficient / inefficient delivery of cancer care**

| Practices contributing to the **inefficient** delivery of cancer care | Practices contributing to the **efficient** delivery of cancer care |
|---|---|
| • Uptake of cancer screening in Poland is very low for breast (43.3%), cervical (21.2%) and colorectal cancer (90.6% of the eligible population had never undergone screening). This is due to poor awareness.<br>• Availability of complex cancer treatment is poor.<br>• Poland has very long waiting times for cancer treatment (among the highest in Europe).<br>• Access to cancer care varies significantly across regions.<br>• Pricing negotiations lead to long delays in securing access for patients; one study found that it takes three years in Poland to achieve "significant utilisation".<br>• Uptake of innovative therapies is among the lowest in Europe.<br>• Transparency in decision-making is low; whilst processes are clear, criteria for decision-making are unclear; cost-effectiveness and budget impact appear unrelated to reimbursement outcomes.<br>• Poland's low GDP means that the GDP-anchored cost-effectiveness threshold, combined with international reference pricing, is a significant barrier for innovative therapies. This leads to inequity of access to drugs for the Polish population.<br>• There is an explicit cap on pharmaceutical expenditure of 16% of the health budget in 2016. These caps, combined with silo budgets, can have negative implications for allocative efficiency.<br>• Since 2012 the provision of funding treatment on an individual patient basis (compassionate use) has been removed. | • A more multidisciplinary approach to cancer care is being introduced in Poland.<br>• Various public health initiatives to promote healthy living and cancer prevention have been implemented.<br>• Poland has implemented cancer screening programmes for cervical, breast and colorectal cancer.<br>• The "oncology treatment package" has been introduced to shorten waiting times by improving diagnostic procedures, introducing limits, and abolishing health insurance quotas. |

# Sweden

### Health care spending: Government expenditure (1.1)

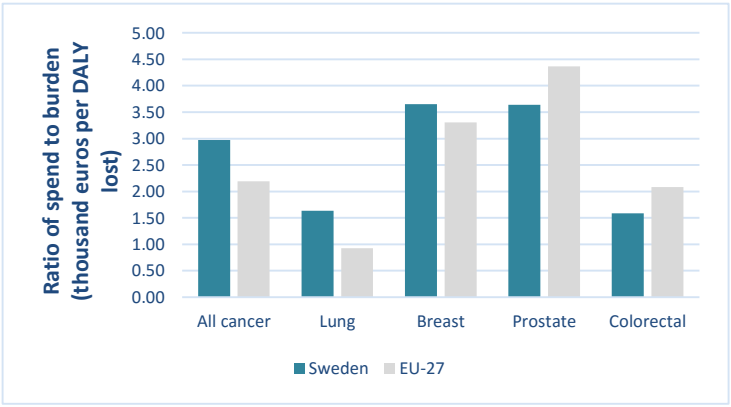
Government expenditure on health in Sweden in 2013 was €30.5 billion, which represents 7.0% of GDP. This is lower than the European average of 7.2% (for EU28 countries). Health represents 13.4% of total government expenditure (this is under the EU28 average which is 14.8%), and is the third highest spend for Government after social protection (41.2%) and general public services (14.9%).

These data do not include private expenditure on health, either through private insurance (which represents 0.3% of health care expenditure in Sweden) or out-of-pocket expenditure (accounting for 17.5% of spending).

### Cancer expenditure and disease burden (1.2)

Total expenditure on health care in Sweden in 2013 was 414.66 billion SEK.[40] Sweden spent 3.4% of total health care expenditure on cancer in 2009.[41] This is lower than the EU average of 5.0%. Spending should be considered in relation to the disease burden of cancer in Sweden, which shows us how big a problem cancer is in the country. We measure disease burden in disability adjusted life years (DALYs) lost which is a measure of ill health (both from early death and poor quality of life) across the whole population, caused by disease. This measure therefore incorporates prevalence. Total burden of disease in Sweden in 2013 in terms of DALYs lost is 2.555 million DALYs. 15.6% of this total disease burden is due to cancer (0.398 million DALYs). This is lower higher than the EU average, where cancer represents on average 17.4% of total disease burden.

**Figure 84. Ratio of spend to burden in Sweden**

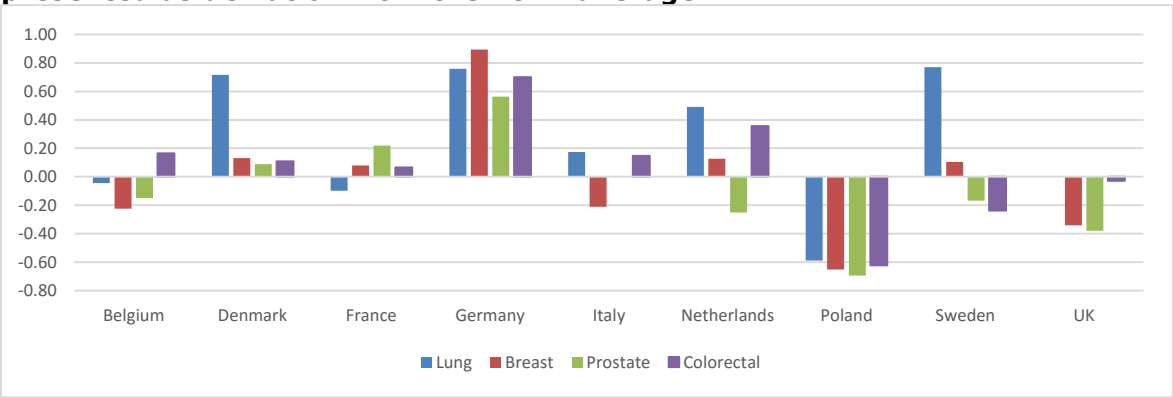



This graph shows the ratio of health care spending to disease burden, and how this differs by tumour type and compared with the European average. Overall, Sweden spends more on cancer relative to burden than the European average. The lower spend on colorectal and lung cancer relative to burden means that, compared with the high impact of colorectal and lung cancer on the population (from lives lost and poor quality of life), less money is spent at the moment on those than the other major cancers. However, it is apparent in Figure 85 that, compared with other European countries, spend on lung cancer relative to burden is high in Sweden; this may be attributable to relatively low incidence (and therefore burden) of lung cancer in Sweden.

[40] Source: OECD health expenditure statistics. Includes all health care expenditure by all financing agents.

[41] This includes: primary care, outpatient care, inpatient care, emergency care and drugs [source: Luengo-Fernandez et al (2013)], as well as long-term care costs [source: Lipszyc et al. (2012)]. These estimates cover all expenditures irrespective of who bears the cost (i.e. public, private, social care etc.). The year 2009 is used as this is the latest available data covering the necessary information available across all countries studied. This should be considered in the interpretation of results, particularly in assessing the spend between tumour types, the balance between which may have altered with the availability of new therapies.

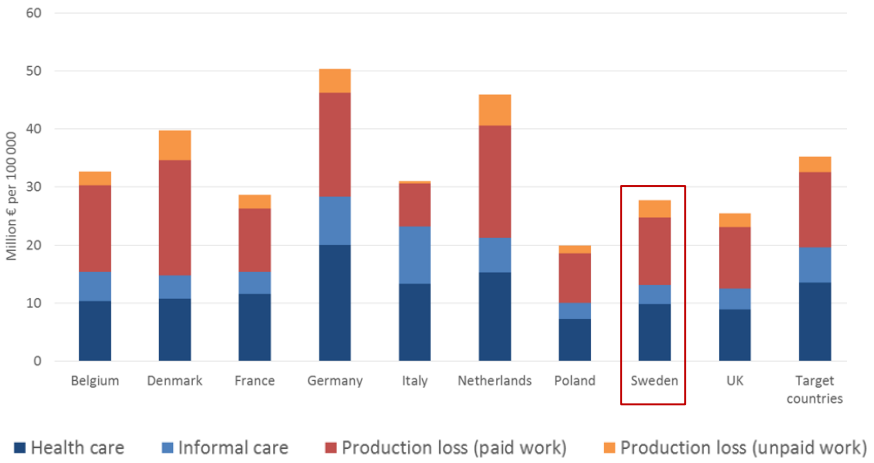
**Figure 85. Ratios between health care expenditures and disease burden, presented as deviation from the EU27 average**




## Economic burden of cancer (1.3)

Whereas most countries consider only direct health care costs in decision-making (Sweden being an exception), there are many other costs that pose a high economic burden to patients and to society, that are often left unconsidered. We quantify those costs, and by doing so demonstrate the high cost to society of cancer resulting from: the time given up by friends and family to care for patients, production losses from cancer patients no longer being able to go to work, and the time cancer patients can no longer spend volunteering and caregiving for others. In Sweden, a societal perspective is taken for the evaluation of health treatments so the production losses should be taken into account, though in practice the acceptance by TLV of these costs can be ambiguous.

**Figure 86. PPP-adjusted economic burden of all cancer, 2015 (million € per 100,000 population)**




Sources of data: Luengo-Fernandez et al (2013), Lipszyc et al. (2012) and Multinational Time Use Study (MTUS)

Direct health care expenditure represents on average only 35.4% of total economic burden of cancer in Sweden. Production losses of paid work are a major cost driver (42.0%), followed by informal care (e.g. by family and friends) (11.9%) and unpaid work (resulting in 31 million hours of unpaid work e.g. from caregiving and volunteering lost per year) (10.7%). Across all countries studied, lung cancer has a higher total economic burden than breast (1.3 times), prostate (2.3 times) and colorectal cancer (1.4 times). Cancer also had a higher total economic burden than IHD (2.4 times) and stroke (3 times) but lower than dementia (0.7 times).

**Table 109. Cost distribution for cancer in Sweden, all cancer types combined**

| | Costs included | Total costs per year | % of total economic burden of cancer |
|---|---|---|---|
| Direct health care costs | primary care, outpatient and inpatient care, emergency care, long-term care and drug costs | €1.25 billion | 35% |
| Informal care | costs of caregivers providing support to cancer patients | €0.42 billion | 12% |
| Production losses | loss of paid work for patients because of their condition (due to morbidity and mortality) | €1.48 billion | 42% |
| Unpaid work | Loss of unpaid work (e.g. caregiving and volunteer work) for patients (due to mortality only) | €0.38 billion<br>31 million hours (44% of which are in the voluntary sector) | 11% |
| Total costs | All of the above | €3.52 billion | 100% |

**Clinical pathways and care delivery (2.3) and reimbursement and regulation mechanisms (2.4)**

More than one third of cancers are preventable by changing lifestyle factors. Prevention strategies therefore provide a major focus for policy-makers at both the national and European level. Early diagnosis is critical, and the Council of the European Union recommends population screening programmes for breast, cervical and colorectal cancer. Sweden has implemented programmes for breast and cervical cancer but not colorectal cancer.

In Sweden there are six Health Care Regions (HCR) which are geographically organised. The majority of care is delivered at a patient's local hospital, which has an affiliation to a council. Each HCR has a Regional Cancer Centre (RCC) which has an important role in implementing the Swedish cancer strategy (introduced in 2009). RCCs along with the National Board of Health and Welfare support the production of clinical guidelines, and also manage the organisation of care, clinical research and strategic planning.

In Sweden the Board of Pharmaceutical benefits (TLV) evaluates drugs for reimbursement and inclusion in the Pharmaceutical Benefit Scheme. The New Treatment Council (NT- Council) was introduced in 2009 to make access to hospital drugs more equal across Sweden. The assessment of drugs is based on cost-effectiveness (among other considerations) using a willingness to pay of approximately SEK 700,000 – SEK 1 million per QALY, and this can vary according to disease severity. Unlike most other countries, a societal perspective is adopted which takes into account productivity costs, although in practice there is some ambiguity for the pharmaceutical industry on what evidence the TLV will accept.

**Table 110. Sweden: Summary of policies and practices that may be leading to the efficient / inefficient delivery of cancer care**

| Practices contributing to the **inefficient** delivery of cancer care | Practices contributing to the **efficient** delivery of cancer care |
|---|---|
| • Until recently, no national programme for colorectal cancer screening was offered (a recommendation has now been made to offer one).<br>• Highly cost-effective treatments such as radiotherapy are currently under-utilised.<br>• Local adaptation of clinical guidelines leads to differences in care provision and access to treatments between regions. This is partly because recommendations are on a national basis but funding is on a local basis.<br>• Waiting times across health care regions vary.<br>• The NT-council process may delay access to drugs that are not covered by the process. | • Various public health initiatives to promote healthy living and cancer prevention have been implemented; Sweden has one of the lowest proportion of smokers.<br>• Sweden has implemented national screening programmes for cervical and breast cancer; cervical cancer screening uptake is relatively high compared with other countries (80% in 2012).<br>• Standardisation of diagnostic procedures and treatment for several cancers has been initiated by Regional Cancer Centres.<br>• Managed entry agreements are widely implemented in Sweden.<br>• Real world data – critical to understanding treatment effects and supporting managed entry agreements – is collected comprehensively in Sweden.<br>• The implementation of the National Introduction Process for New Drugs has prioritized access to innovative drugs |

# The United Kingdom

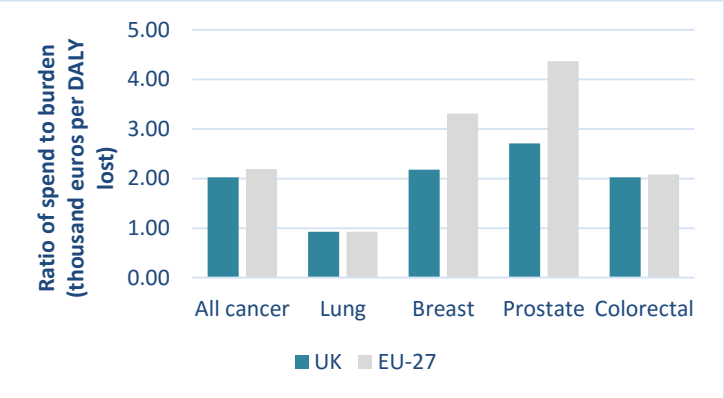
### Health care spending: Government expenditure (1.1)

Government expenditure on health in the UK in 2013 was €153.4 billion, which represents 7.6% of GDP. This is slightly higher than the European average of 7.2% (for EU28 countries). Health represents 16.7% of total government expenditure (this is over the EU28 average which is 14.8%), and is the second highest spend for Government after social protection (37.1%). These data do not include private expenditure on health.

### Cancer expenditure and disease burden (1.2)

Total expenditure on health care in the UK in 2013 was £144.86 billion.[42] The UK spent 3.8% of total health care expenditure on cancer in 2009.[43] This is lower than the EU average of 5.0%. Spending should be considered in relation to the disease burden of cancer in the UK, which shows us how big a problem cancer is in the country. We measure disease burden in disability adjusted life years (DALYs) lost which is a measure of ill health (both from early death and poor quality of life) across the whole population, caused by disease. This measure therefore incorporates prevalence. Total burden of disease in the UK in 2013 in terms of DALYs lost is 16.651 million DALYs. 17.3% of this total disease burden is due to cancer (2.873 million DALYs). This is slightly lower than the EU average, where cancer represents on average 17.4% of total disease burden.

**Figure 87. Ratio of spend to burden in the UK**

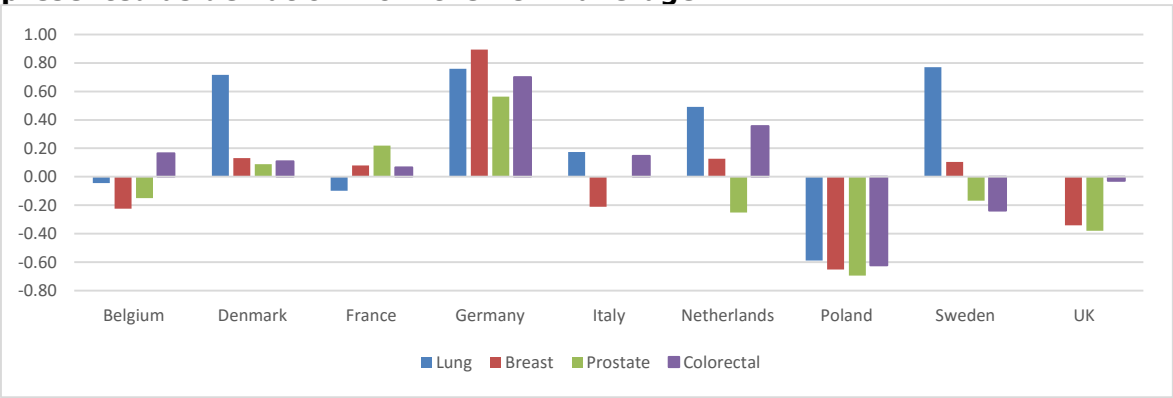



This graph shows the ratio of health care spending to disease burden, and how this differs by tumour type and compared with the European average. Overall, the UK spends slightly less on cancer relative to burden than the European average. The lower spend on lung cancer relative to burden means that, compared with the high impact of lung cancer on the population (from lives lost and poor quality of life), less money is spent at the moment on lung cancer than the other major cancers. However, it is apparent in Figure 88 that, spend on lung cancer relative to burden is in line with the European average. Compared with other European countries, spend on breast, prostate and colorectal cancer relative to burden is lower, particularly for breast and colorectal cancer.

[42] Source: OECD health expenditure statistics. Includes all health care expenditure by all financing agents.

[43] This includes: primary care, outpatient care, inpatient care, emergency care and drugs [source: Luengo-Fernandez et al (2013)], as well as long-term care costs [source: Lipszyc et al. (2012)]. These estimates cover all expenditures irrespective of who bears the cost (i.e. public, private, social care etc.). The year 2009 is used as this is the latest available data covering the necessary information available across all countries studied. This should be considered in the interpretation of results, particularly in assessing the spend between tumour types, the balance between which may have altered with the availability of new therapies.

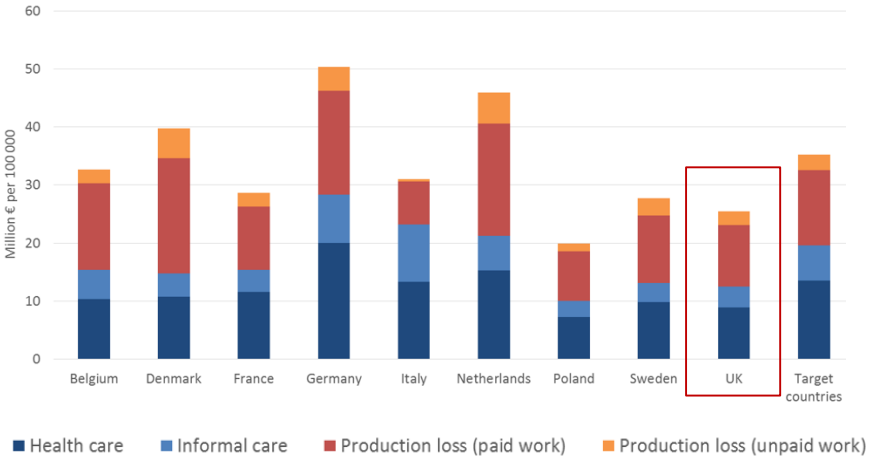
**Figure 88. Ratios between health care expenditures and disease burden, presented as deviation from the EU27 average**




## Economic burden of cancer (1.3)

Whereas most countries consider only direct health care costs in decision-making, there are many other costs that pose a high economic burden to patients and to society, that are often left unconsidered. We quantify those costs, and by doing so demonstrate the high cost to society of cancer resulting from: the time given up by friends and family to care for patients, production losses from cancer patients no longer being able to go to work, and the time cancer patients can no longer spend volunteering and caregiving for others.

**Figure 89. PPP-adjusted economic burden of all cancer, 2015 (million € per 100,000 population)**




Sources of data: Luengo-Fernandez et al (2013), Lipszyc et al. (2012) and Multinational Time Use Study (MTUS)

Direct health care expenditure represents on average only 35% of total economic burden of cancer in the UK. Production losses of paid work is the major cost driver (41.3%), followed by informal care (e.g. by family and friends) (14.1%) and unpaid work (resulting in 211 million hours of unpaid work e.g. from caregiving and volunteering lost per year) (9.6%).

Across all countries studied, lung cancer has a higher total economic burden than breast (1.3 times), prostate (2.3 times) and colorectal cancer (1.4 times). Cancer also had a higher total economic burden than IHD (2.4 times) and stroke (3 times) but lower than dementia (0.7 times).

**Table 111. Cost distribution for cancer in the UK, all cancer types combined**

| | Costs included | Total costs per year | % of total economic burden of cancer |
|---|---|---|---|
| Direct health care costs | primary care, outpatient and inpatient care, emergency care, long-term care and drug costs | €6.68 billion | 35% |
| Informal care | costs of caregivers providing support to cancer patients | €2.68 billion | 14% |
| Production losses | loss of paid work for patients because of their condition (due to morbidity and mortality) | €7.90 billion | 41% |
| Unpaid work | Loss of unpaid work (e.g. caregiving and volunteer work) for patients (due to mortality only) | €211 billion<br>31 million hours (27% of which are in the voluntary sector) | 10% |
| Total costs | All of the above | €19.10 billion | 100% |

**Clinical pathways and care delivery (2.3) and reimbursement and regulation mechanisms (2.4) – related to England only**

More than one third of cancers are preventable by changing lifestyle factors. Prevention strategies therefore provide a major focus for policy-makers at both the national and European level. Early diagnosis is critical, and the Council of the European Union recommends population screening programmes for breast, cervical and colorectal cancer. England has implemented programmes for all three.

In England, the commissioning and organisation of cancer services is centralised. The Department of Health is accountable for cancer services delivered and securing value for money, whilst commissioning is undertaken by NHS England, which is accountable for outcomes achieved by the NHS. Public Health England is accountable for achieving public health outcomes. Clinical reference groups and strategic clinical networks are also involved in the organisation of cancer care in England. Strategic priorities in cancer care are set out in the cancer strategy.

In England, the principal means of assessing drugs for reimbursement at a national level is through the NICE Technology Appraisal (TA) programme. NICE apply an incremental cost-effectiveness ratio (ICER) threshold range of £20,000-£30,000 per QALY. Whist the decision-criteria and methods that NICE apply is theoretically the same for all drugs, there are some specific criteria that may been relevant to cancer drugs specifically. The end-of-life criteria whereby a higher threshold may be applied for drugs that extend life. Highly specialised drugs are evaluated through a different NICE evaluation pathway which does not use an ICER threshold. In addition, the Cancer Drugs Fund (CDF) has until now funded cancer drugs not recommended by NICE; this fund is changing to a 'managed access fund', where real world evidence will

be collected for up to two years for 'promising' new medicines; data collection will inform NICE's subsequent appraisal.

**Table 112. England: Summary of policies and practices that may be leading to the efficient / inefficient delivery of cancer care**

| Practices contributing to the **inefficient** delivery of cancer care | Practices contributing to the **efficient** delivery of cancer care |
|---|---|
| • Health inequalities are substantial, with cancer outcomes being strongly related with socio-economic status. This is both unethical and inefficient.<br>• There is evidence in England of late diagnosis, which contributes to lower survival rates in England compared with Europe.<br>• Highly cost-effective treatments such as radiotherapy are currently under-utilised.<br>• Greater awareness of co-morbidities in the management of cancer survivors could improve outcomes and reduce emergency hospital admissions.<br>• Governance arrangements and access to real world data (particularly for research) are restrictive, and public trust is low. There is a need to collect better evidence on outcomes and expand analytical capacity.<br>• Fragmentation between care providers.<br>• Shortage of oncologists, radiologists and cancer nurses.<br>• Inflexibilities in multi-indication pricing.<br>• There is potential for greater savings from the use of generics. | • Various public health initiatives to promote healthy living and cancer prevention have been implemented.<br>• England has implemented cancer screening programmes for cervical, breast and colorectal cancer, and uptake is relatively high compared with other countries (but there is still room for improvement).<br>• Detailed evidence-based clinical guidelines produced by NICE support clinical practice and improve the coordination of cancer services.<br>• Introduction of national waiting time standards<br>• There are some differences in the relevant cost-effectiveness / funding criteria for some cancer drugs, e.g.: end of life criteria and the cancer drugs fund. It can be argued whether or not these criteria are efficient or inefficient. Reform of the cancer drug fund means that it will become a managed access fund.<br>• Time between marketing approval and launch is relatively short.<br>• Early Access to Medicines Scheme supports pre-license access, but its impact so far has been low. |

## Appendix VIII – Colorectal cancer screening

**Table 113. TOTAL POPULATION, I.E. INDIVIDUALS POTENTIALLY SUBJECT TO SCREENING OF COLORECTAL CANCER, PER COUNTRY AND AGE GROUP**

| | 40-44 | 45-49 | 50-54 | 55-59 | 60-64 | 65-69 | 70-74 | 75-79 | 80-84 | 85+ |
|---|---|---|---|---|---|---|---|---|---|---|
| **Belgium** | 777 650 | 810 543 | 808 781 | 739 760 | 655 234 | 578 277 | 422 267 | 395 900 | 320 768 | 277 155 |
| **Denmark** | 387 330 | 422 425 | 383 496 | 354 046 | 337 982 | 356 312 | 255 367 | 180 164 | 119 026 | 115 865 |
| **France** | 4 580 561 | 4 522 289 | 4 420 221 | 4 196 198 | 4 080 169 | 3 469 560 | 2 397 111 | 2 223 241 | 1 868 336 | 1 887 633 |
| **Germany** | 5 493 441 | 6 899 690 | 6 717 785 | 5 690 453 | 5 078 700 | 3 908 954 | 4 658 479 | 3 897 223 | 2 297 441 | 2 062 140 |
| **Italy** | 4 864 999 | 4 992 748 | 4 491 569 | 3 943 819 | 3 631 039 | 3 447 791 | 3 044 129 | 2 645 596 | 2 013 904 | 1 863 522 |
| **Netherlands** | 1 232 315 | 1 285 478 | 1 253 267 | 1 131 309 | 1 044 204 | 985 760 | 688 947 | 527 228 | 383 047 | 334 042 |
| **Poland** | 2 502 674 | 2 299 127 | 2 569 838 | 2 913 850 | 2 607 714 | 1 784 722 | 1 249 824 | 1 145 040 | 857 640 | 622 814 |
| **Sweden** | 641 199 | 681 129 | 600 575 | 576 035 | 571 895 | 603 356 | 448 830 | 322 304 | 242 688 | 255 029 |
| **UK** | 4 434 728 | 4 673 641 | 4 396 123 | 3 794 166 | 3 521 834 | 3 522 966 | 2 584 744 | 2 114 851 | 1 559 367 | 1 484 145 |

**Table 114. MORTALITY REDUCTION OF COLORECTAL CANCER WITH THE BASELINE SCREENING PROGRAMME**

| | 40-44 | 45-49 | 50-54 | 55-59 | 60-64 | 65-69 | 70-74 | 75-79 | 80-84 | 85+ |
|---|---|---|---|---|---|---|---|---|---|---|
| **Belgium** | 0 | 0 | 0 | 1 | 1 | 1 | 2 | 0 | 0 | 0 |
| **Denmark** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **France** | 0 | 0 | 36 | 65 | 106 | 118 | 129 | 0 | 0 | 0 |
| **Germany** | 0 | 0 | 22 | 246 | 365 | 472 | 845 | 756 | 777 | 0 |
| **Italy** | 0 | 17 | 31 | 47 | 73 | 102 | 145 | 0 | 0 | 0 |
| **Netherlands** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Poland** | 0 | 0 | 0 | 111 | 159 | 159 | 208 | 0 | 0 | 0 |
| **Sweden** | 0 | 0 | 0 | 0 | 7 | 11 | 0 | 0 | 0 | 0 |
| **UK** | 0 | 0 | 0 | 0 | 114 | 148 | 181 | 0 | 0 | 0 |

**Table 115. MORTALITY REDUCTION OF COLORECTAL CANCER OF THE EXTENDED SCREENING PROGRAMME**

| | 40-44 | 45-49 | 50-54 | 55-59 | 60-64 | 65-69 | 70-74 | 75-79 | 80-84 | 85+ |
|---|---|---|---|---|---|---|---|---|---|---|
| **Belgium** | 0 | 0 | 12 | 23 | 34 | 40 | 50 | 0 | 0 | 0 |
| **Denmark** | 0 | 0 | 7 | 13 | 21 | 40 | 42 | 0 | 0 | 0 |
| **France** | 0 | 0 | 68 | 124 | 202 | 223 | 245 | 0 | 0 | 0 |
| **Germany** | 0 | 0 | 79 | 537 | 795 | 1 028 | 1 840 | 1 965 | 2 019 | 0 |
| **Italy** | 0 | 44 | 78 | 119 | 187 | 261 | 372 | 0 | 0 | 0 |
| **Netherlands** | 0 | 0 | 0 | 44 | 71 | 105 | 101 | 0 | 0 | 0 |
| **Poland** | 0 | 0 | 0 | 400 | 574 | 576 | 752 | 0 | 0 | 0 |
| **Sweden** | 0 | 0 | 0 | 0 | 30 | 44 | 47 | 0 | 0 | 0 |
| **UK** | 0 | 0 | 0 | 152 | 239 | 166 | 203 | 0 | 0 | 0 |

**Table 116. INCREMENTAL MORTALITY REDUCTION OF COLORECTAL CANCER OF THE EXTENDED SCREENING PROGRAMME COMPARED TO THE BASELINE SCREENING PROGRAMME**

| | 40-44 | 45-49 | 50-54 | 55-59 | 60-64 | 65-69 | 70-74 | 75-79 | 80-84 | 85+ |
|---|---|---|---|---|---|---|---|---|---|---|
| **Belgium** | 0 | 0 | 12 | 22 | 33 | 39 | 49 | 0 | 0 | 0 |
| **Denmark** | 0 | 0 | 7 | 13 | 21 | 40 | 42 | 0 | 0 | 0 |
| **France** | 0 | 0 | 32 | 59 | 95 | 105 | 116 | 0 | 0 | 0 |
| **Germany** | 0 | 0 | 57 | 290 | 430 | 556 | 995 | 1 209 | 1 242 | 0 |
| **Italy** | 0 | 27 | 48 | 72 | 114 | 159 | 226 | 0 | 0 | 0 |
| **Netherlands** | 0 | 0 | 0 | 44 | 71 | 105 | 101 | 0 | 0 | 0 |
| **Poland** | 0 | 0 | 0 | 289 | 415 | 416 | 544 | 0 | 0 | 0 |
| **Sweden** | 0 | 0 | 0 | 0 | 23 | 33 | 47 | 0 | 0 | 0 |
| **UK** | 0 | 0 | 0 | 152 | 125 | 18 | 22 | 0 | 0 | 0 |

**Table 117. PRODUCTION GAINS FROM IMPROVED MORTALITY OF COLORECTAL CANCER WITH THE EXTENDED SCREENING PROGRAMME COMPARED TO BASELINE SCREENING PROGRAMME (MILLION €)**

| | 40-44 | 45-49 | 50-54 | 55-59 | 60-64 | 65-69 | 70-74 | 75-79 | 80-84 | 85+ |
|---|---|---|---|---|---|---|---|---|---|---|
| **Belgium** | 0.0 | 0.0 | 3.7 | 3.3 | 1.8 | 0.6 | 0.3 | 0.0 | 0.0 | 0.0 |
| **Denmark** | 0.0 | 0.0 | 4.1 | 4.6 | 3.7 | 2.3 | 0.8 | 0.0 | 0.0 | 0.0 |
| **France** | 0.0 | 0.0 | 8.2 | 7.4 | 3.8 | 1.2 | 0.4 | 0.0 | 0.0 | 0.0 |
| **Germany** | 0.0 | 0.0 | 27.3 | 85.6 | 59.4 | 23.8 | 14.3 | 3.6 | 0.0 | 0.0 |
| **Italy** | 0.0 | 8.7 | 10.5 | 9.2 | 6.1 | 2.9 | 1.5 | 0.0 | 0.0 | 0.0 |
| **Netherlands** | 0.0 | 0.0 | 0.0 | 11.9 | 8.9 | 4.7 | 1.6 | 0.0 | 0.0 | 0.0 |
| **Poland** | 0.0 | 0.0 | 0.0 | 12.5 | 8.0 | 3.0 | 1.4 | 0.0 | 0.0 | 0.0 |
| **Sweden** | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 1.6 | 0.7 | 0.0 | 0.0 | 0.0 |
| **UK** | 0.0 | 0.0 | 0.0 | 34.6 | 14.7 | 0.9 | 0.4 | 0.0 | 0.0 | 0.0 |

**Table 118. PRODUCTION GAINS FROM IMPROVED INCIDENCE OF COLORECTAL CANCER WITH THE EXTENDED SCREENING PROGRAMME COMPARED TO BASELINE SCREENING PROGRAMME (MILLION €)**

| | 40-44 | 45-49 | 50-54 | 55-59 | 60-64 | 65-69 | 70-74 | 75-79 | 80-84 | 85+ |
|---|---|---|---|---|---|---|---|---|---|---|
| **Belgium** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Denmark** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **France** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Germany** | 0.0 | 0.0 | 0.0 | 34.8 | 39.2 | 12.9 | 9.6 | 0.0 | 0.0 | 0.0 |
| **Italy** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Netherlands** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Poland** | 0.0 | 0.0 | 0.0 | 7.1 | 4.9 | 1.8 | 1.0 | 0.0 | 0.0 | 0.0 |
| **Sweden** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **UK** | 0.0 | 0.0 | 0.0 | 10.8 | 11.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

**Table 119. TOTAL PRODUCTION GAINS OF COLORECTAL CANCER WITH THE EXTENDED SCREENING PROGRAMME COMPARED TO BASELINE SCREENING PROGRAMME (MILLION €)**

| | 40-44 | 45-49 | 50-54 | 55-59 | 60-64 | 65-69 | 70-74 | 75-79 | 80-84 | 85+ |
|---|---|---|---|---|---|---|---|---|---|---|
| **Belgium** | 0.0 | 0.0 | 3.7 | 3.3 | 1.8 | 0.6 | 0.3 | 0.0 | 0.0 | 0.0 |
| **Denmark** | 0.0 | 0.0 | 4.1 | 4.6 | 3.7 | 2.3 | 0.8 | 0.0 | 0.0 | 0.0 |
| **France** | 0.0 | 0.0 | 8.2 | 7.4 | 3.8 | 1.2 | 0.4 | 0.0 | 0.0 | 0.0 |
| **Germany** | 0.0 | 0.0 | 27.3 | 120.3 | 98.7 | 36.7 | 24.0 | 3.6 | 0.0 | 0.0 |
| **Italy** | 0.0 | 8.7 | 10.5 | 9.2 | 6.1 | 2.9 | 1.5 | 0.0 | 0.0 | 0.0 |
| **Netherlands** | 0.0 | 0.0 | 0.0 | 11.9 | 8.9 | 4.7 | 1.6 | 0.0 | 0.0 | 0.0 |
| **Poland** | 0.0 | 0.0 | 0.0 | 19.6 | 12.8 | 4.9 | 2.3 | 0.0 | 0.0 | 0.0 |
| **Sweden** | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 1.6 | 0.7 | 0.0 | 0.0 | 0.0 |
| **UK** | 0.0 | 0.0 | 0.0 | 45.3 | 26.6 | 0.9 | 0.4 | 0.0 | 0.0 | 0.0 |

**Table 120. GAINS IN UNPAID WORK DUE TO IMPROVED MORTALITY OF COLORECTAL CANCER WITH THE EXTENDED SCREENING PROGRAMME COMPARED TO BASELINE SCREENING PROGRAMME (MILLION €)**

| | 40-44 | 45-49 | 50-54 | 55-59 | 60-64 | 65-69 | 70-74 | 75-79 | 80-84 | 85+ |
|---|---|---|---|---|---|---|---|---|---|---|
| **Belgium** | 0.0 | 0.0 | 0.4 | 0.6 | 0.7 | 0.6 | 0.4 | 0.0 | 0.0 | 0.0 |
| **Denmark** | 0.0 | 0.0 | 0.5 | 0.8 | 1.2 | 1.5 | 0.8 | 0.0 | 0.0 | 0.0 |
| **France** | 0.0 | 0.0 | 1.1 | 1.6 | 2.0 | 1.5 | 0.9 | 0.0 | 0.0 | 0.0 |
| **Germany** | 0.0 | 0.0 | 2.8 | 12.0 | 14.1 | 12.4 | 12.2 | 5.2 | 0.0 | 0.0 |
| **Italy** | 0.0 | 0.2 | 0.2 | 0.3 | 0.3 | 0.3 | 0.2 | 0.0 | 0.0 | 0.0 |
| **Netherlands** | 0.0 | 0.0 | 0.0 | 2.5 | 3.1 | 3.1 | 1.8 | 0.0 | 0.0 | 0.0 |
| **Poland** | 0.0 | 0.0 | 0.0 | 1.9 | 2.1 | 1.3 | 0.8 | 0.0 | 0.0 | 0.0 |
| **Sweden** | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 1.0 | 0.7 | 0.0 | 0.0 | 0.0 |
| **UK** | 0.0 | 0.0 | 0.0 | 4.8 | 3.0 | 0.3 | 0.2 | 0.0 | 0.0 | 0.0 |

**Table 121. GAINS IN UNPAID WORK DUE TO IMPROVED INCIDENCE OF COLORECTAL CANCER WITH THE EXTENDED SCREENING PROGRAMME COMPARED TO BASELINE SCREENING PROGRAMME (MILLION €)**

| | 40-44 | 45-49 | 50-54 | 55-59 | 60-64 | 65-69 | 70-74 | 75-79 | 80-84 | 85+ |
|---|---|---|---|---|---|---|---|---|---|---|
| **Belgium** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Denmark** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **France** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Germany** | 0.0 | 0.0 | 0.0 | 1.3 | 2.4 | 3.4 | 4.6 | 0.0 | 0.0 | 0.0 |
| **Italy** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Netherlands** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Poland** | 0.0 | 0.0 | 0.0 | 0.3 | 0.5 | 0.5 | 0.4 | 0.0 | 0.0 | 0.0 |
| **Sweden** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **UK** | 0.0 | 0.0 | 0.0 | 0.6 | 0.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

**Table 122. TOTAL GAINS IN UNPAID WORK OF COLORECTAL CANCER WITH THE EXTENDED SCREENING PROGRAMME COMPARED TO BASELINE SCREENING PROGRAMME (MILLION €)**

| | 40-44 | 45-49 | 50-54 | 55-59 | 60-64 | 65-69 | 70-74 | 75-79 | 80-84 | 85+ |
|---|---|---|---|---|---|---|---|---|---|---|
| **Belgium** | 0.0 | 0.0 | 0.4 | 0.6 | 0.7 | 0.6 | 0.4 | 0.0 | 0.0 | 0.0 |
| **Denmark** | 0.0 | 0.0 | 0.5 | 0.8 | 1.2 | 1.5 | 0.8 | 0.0 | 0.0 | 0.0 |
| **France** | 0.0 | 0.0 | 1.1 | 1.6 | 2.0 | 1.5 | 0.9 | 0.0 | 0.0 | 0.0 |
| **Germany** | 0.0 | 0.0 | 2.8 | 13.3 | 16.4 | 15.7 | 16.8 | 5.2 | 0.0 | 0.0 |
| **Italy** | 0.0 | 0.2 | 0.2 | 0.3 | 0.3 | 0.3 | 0.2 | 0.0 | 0.0 | 0.0 |
| **Netherlands** | 0.0 | 0.0 | 0.0 | 2.5 | 3.1 | 3.1 | 1.8 | 0.0 | 0.0 | 0.0 |
| **Poland** | 0.0 | 0.0 | 0.0 | 2.2 | 2.6 | 1.8 | 1.2 | 0.0 | 0.0 | 0.0 |
| **Sweden** | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 1.0 | 0.7 | 0.0 | 0.0 | 0.0 |
| **UK** | 0.0 | 0.0 | 0.0 | 5.4 | 3.9 | 0.3 | 0.2 | 0.0 | 0.0 | 0.0 |

## *Appendix IX – Potential economic gains of biosimilars*

**Table 123. SALES IN €, PER 100,000 POPULATION, BY COUNTRY**

| Country | Targeted monoclonal antibody | Tyrosine kinase inhibitor for CML |
|---|---|---|
| Belgium | 486 750 | 283 200 |
| Denmark | 462 000 | 228 800 |
| France | 379 200 | 264 000 |
| Germany | 385 900 | 333 200 |
| Italy | 366 400 | 273 600 |
| Netherlands | 364 000 | 224 400 |
| Poland | 128 050 | 118 800 |
| Sweden | 370 500 | 259 200 |
| UK | 322 400 | 201 600 |

**Table 124. POPULATION, BY COUNTRY (2013)**

| Country | Population |
|---|---|
| Belgium | 11 161 642 |
| Denmark | 5 602 628 |
| France | 65 560 721 |
| Germany | 80 523 746 |
| Italy | 59 685 227 |
| Netherlands | 16 779 575 |
| Poland | 38 062 535 |
| Sweden | 9 555 893 |
| UK | 63 905 297 |

**Table 125. AGE STANDARDIZED MORTALITY RATE PER 100,000 INHABITANTS, BY COUNTRY**

| Country | Breast cancer (targeted monoclonal antibody) | Leukaemia, i.e. proxy for CML (tyrosine kinase inhibitor) |
|---|---|---|
| Belgium | 29.5 | 5.9 |
| Denmark | 28 | 5.2 |
| France | 23.7 | 5.5 |
| Germany | 22.7 | 4.9 |
| Italy | 22.9 | 5.7 |
| Netherlands | 26 | 5.1 |
| Poland | 19.7 | 5.4 |
| Sweden | 19.5 | 4.8 |
| UK | 24.8 | 4.8 |

**Table 126. SAVINGS THROUGH BIOSIMILAR AND GENERIC ENTRY FOR CANCER MEDICINES MOVING OFF PATENT 2015-2020 BY COUNTRY 2015-2020 (€M)**

| | | | 2015 €m | 2016 €m | 2017 €m | 2018 €m | 2019 €m | 2020 €m | Total €m |
|---|---|---|---|---|---|---|---|---|---|
| United Kingdom | Biologics | baseline | 905 | 961 | 1,031 | 1,103 | 1,176 | 1,249 | 6,424 |
| | | baseline adjusted for LOE | 905 | 961 | 992 | 1,019 | 1,058 | 1,100 | 6,034 |
| | | **savings** | **0** | **0** | **39** | **84** | **118** | **149** | **390** |
| | Small Molecule | baseline | 1,094 | 1,187 | 1,293 | 1,398 | 1,503 | 1,606 | 8,082 |
| | | baseline adjusted for LOE | 1,090 | 1,128 | 1,173 | 1,241 | 1,232 | 1,230 | 7,095 |
| | | **savings** | **4** | **59** | **120** | **157** | **271** | **376** | **987** |

| | | | 2015 €m | 2016 €m | 2017 €m | 2018 €m | 2019 €m | 2020 €m | Total €m |
|---|---|---|---|---|---|---|---|---|---|
| France | Biologics | baseline | 1,177 | 1,221 | 1,263 | 1,306 | 1,348 | 1,390 | 7,704 |
| | | baseline adjusted for LOE | 1,177 | 1,221 | 1,234 | 1,254 | 1,259 | 1,271 | 7,414 |
| | | **savings** | **0** | **0** | **28** | **52** | **90** | **120** | **290** |
| | Small Molecule | baseline | 1,709 | 1,813 | 1,905 | 1,997 | 2,090 | 2,183 | 11,697 |
| | | baseline adjusted for LOE | 1,707 | 1,776 | 1,803 | 1,822 | 1,834 | 1,852 | 10,792 |
| | | **savings** | **3** | **38** | **102** | **175** | **256** | **331** | **905** |

| | | | 2015 €m | 2016 €m | 2017 €m | 2018 €m | 2019 €m | 2020 €m | Total €m |
|---|---|---|---|---|---|---|---|---|---|
| Germany | Biologics | baseline | 1,411 | 1,490 | 1,550 | 1,611 | 1,673 | 1,734 | 9,470 |
| | | baseline adjusted for LOE | 1,411 | 1,490 | 1,486 | 1,468 | 1,452 | 1,438 | 8,746 |
| | | **savings** | **0** | **0** | **65** | **144** | **220** | **296** | **725** |
| | Small Molecule | baseline | 2,069 | 2,262 | 2,420 | 2,575 | 2,728 | 2,880 | 14,934 |
| | | baseline adjusted for LOE | 2,065 | 2,201 | 2,261 | 2,351 | 2,414 | 2,468 | 13,761 |
| | | **savings** | **5** | **61** | **159** | **223** | **314** | **412** | **1,174** |

| | | | 2015 €m | 2016 €m | 2017 €m | 2018 €m | 2019 €m | 2020 €m | Total €m |
|---|---|---|---|---|---|---|---|---|---|
| Netherlands | Biologics | baseline | 223 | 256 | 287 | 320 | 353 | 388 | 1,827 |
| | | baseline adjusted for LOE | 223 | 254 | 280 | 304 | 323 | 351 | 1,736 |
| | | **savings** | **0** | **2** | **8** | **15** | **30** | **37** | **92** |
| | Small Molecule | baseline | 151 | 172 | 187 | 201 | 216 | 231 | 1,159 |
| | | baseline adjusted for LOE | 151 | 167 | 172 | 181 | 189 | 190 | 1,050 |
| | | **savings** | **0** | **5** | **14** | **20** | **27** | **42** | **109** |

| | | | 2015 €m | 2016 €m | 2017 €m | 2018 €m | 2019 €m | 2020 €m | Total €m |
|---|---|---|---|---|---|---|---|---|---|
| Poland | Biologics | baseline | 191 | 209 | 223 | 236 | 249 | 262 | 1,370 |
| | | baseline adjusted for LOE | 191 | 207 | 210 | 206 | 202 | 203 | 1,220 |
| | | **savings** | **0** | **2** | **12** | **29** | **47** | **59** | **150** |
| | Small Molecule | baseline | 175 | 193 | 204 | 213 | 222 | 229 | 1,236 |
| | | baseline adjusted for LOE | 175 | 193 | 203 | 212 | 218 | 220 | 1,221 |
| | | **savings** | **0** | **0** | **0** | **1** | **4** | **9** | **14** |

| | | | 2015 €m | 2016 €m | 2017 €m | 2018 €m | 2019 €m | 2020 €m | Total €m |
|---|---|---|---|---|---|---|---|---|---|
| Belgium | Biologics | baseline | 210 | 238 | 259 | 278 | 297 | 314 | 1,595 |
| | | baseline adjusted for LOE | 210 | 236 | 255 | 266 | 283 | 298 | 1,546 |
| | | **savings** | **0** | **2** | **4** | **12** | **14** | **16** | **49** |
| | Small Molecule | baseline | 266 | 297 | 316 | 335 | 355 | 376 | 1,945 |
| | | baseline adjusted for LOE | 266 | 284 | 290 | 303 | 312 | 316 | 1,771 |
| | | **savings** | **0** | **12** | **26** | **33** | **43** | **60** | **174** |

| | | | 2015 €m | 2016 €m | 2017 €m | 2018 €m | 2019 €m | 2020 €m | Total €m |
|---|---|---|---|---|---|---|---|---|---|
| Denmark | Biologics | baseline | 137 | 166 | 179 | 192 | 205 | 219 | 1,098 |
| | | baseline adjusted for LOE | 137 | 165 | 176 | 185 | 192 | 202 | 1,057 |
| | | **savings** | **0** | **1** | **3** | **7** | **13** | **16** | **41** |
| | Small Molecule | baseline | 122 | 133 | 139 | 145 | 151 | 156 | 847 |
| | | baseline adjusted for LOE | 122 | 131 | 130 | 132 | 134 | 131 | 779 |
| | | **savings** | **0** | **3** | **9** | **13** | **17** | **26** | **68** |

| | | | 2015 €m | 2016 €m | 2017 €m | 2018 €m | 2019 €m | 2020 €m | Total €m |
|---|---|---|---|---|---|---|---|---|---|
| Italy | Biologics | baseline | 992 | 1,110 | 1,140 | 1,173 | 1,208 | 1,244 | 6,867 |
| | | baseline adjusted for LOE | 992 | 1,102 | 1,125 | 1,139 | 1,175 | 1,211 | 6,744 |
| | | **savings** | **0** | **8** | **15** | **34** | **33** | **33** | **123** |
| | Small Molecule | baseline | 1,200 | 1,223 | 1,234 | 1,250 | 1,273 | 1,301 | 7,481 |
| | | baseline adjusted for LOE | 1,200 | 1,210 | 1,192 | 1,189 | 1,184 | 1,180 | 7,154 |
| | | **savings** | **0** | **14** | **42** | **61** | **89** | **121** | **327** |

| | | | 2015 €m | 2016 €m | 2017 €m | 2018 €m | 2019 €m | 2020 €m | Total €m |
|---|---|---|---|---|---|---|---|---|---|
| Sweden | Biologics | baseline | 149 | 156 | 159 | 163 | 166 | 169 | 962 |
| | | baseline adjusted for LOE | 149 | 153 | 154 | 153 | 156 | 159 | 925 |
| | | **savings** | **0** | **2** | **5** | **9** | **10** | **10** | **37** |
| | Small Molecule | baseline | 185 | 208 | 219 | 229 | 240 | 250 | 1,331 |
| | | baseline adjusted for LOE | 185 | 200 | 200 | 205 | 206 | 208 | 1,204 |
| | | **savings** | **0** | **8** | **18** | **24** | **34** | **42** | **127** |

## *Appendix X – Smoking prevalence and its effects on lung cancer and lung cancer care*

### A1. Expected annual production and unpaid work of healthy individuals

**Table 127. ANNUAL MARKET PRODUCTION FOR MALES, BY AGE GROUP AND COUNTRY**

| Country | 15-19 | 20-24 | 25-29 | 30-34 | 35-39 | 40-44 | 45-49 | 50-54 | 55-59 | 60-64 | 65-69 | 70-74 | 75-79 | 80+ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Belgium | 2 649 | 19 708 | 36 626 | 40 763 | 40 624 | 40 484 | 40 670 | 38 439 | 31 049 | 13 293 | 3 068 | 1 720 | 697 | 0 |
| Denmark | 26 546 | 40 679 | 48 318 | 55 257 | 57 867 | 58 186 | 55 321 | 54 939 | 52 265 | 35 905 | 12 923 | 6 493 | 1 528 | 0 |
| France | 4 245 | 18 641 | 29 124 | 31 708 | 32 410 | 32 594 | 31 634 | 31 598 | 26 393 | 9 376 | 2 658 | 960 | 221 | 0 |
| Germany | 14 718 | 33 446 | 41 312 | 45 524 | 46 438 | 46 844 | 46 133 | 44 560 | 41 972 | 30 350 | 9 085 | 4 060 | 1 421 | 0 |
| Italy | 1 032 | 9 934 | 17 835 | 24 092 | 26 576 | 27 027 | 27 156 | 26 479 | 23 447 | 12 482 | 4 032 | 2 032 | 742 | 0 |
| Netherlands | 24 439 | 34 543 | 42 059 | 44 996 | 44 847 | 44 001 | 43 602 | 42 507 | 39 571 | 29 168 | 10 751 | 4 729 | 1 842 | 0 |
| Poland | 580 | 5 767 | 9 283 | 9 965 | 10 102 | 9 817 | 9 317 | 8 623 | 7 474 | 4 414 | 1 649 | 660 | 296 | 0 |
| Sweden | 7 421 | 23 563 | 31 060 | 34 541 | 35 229 | 35 382 | 35 038 | 33 585 | 32 399 | 26 432 | 10 098 | 5 852 | 918 | 0 |
| UK | 10 756 | 28 656 | 35 430 | 36 990 | 36 661 | 36 825 | 36 333 | 35 060 | 32 063 | 23 237 | 10 263 | 4 968 | 1 765 | 0 |

**Table 128. ANNUAL MARKET PRODUCTION FOR FEMALES, BY AGE GROUP AND COUNTRY**

| Country | 15-19 | 20-24 | 25-29 | 30-34 | 35-39 | 40-44 | 45-49 | 50-54 | 55-59 | 60-64 | 65-69 | 70-74 | 75-79 | 80+ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Belgium | 1 747 | 15 364 | 31 324 | 31 801 | 32 237 | 31 761 | 30 967 | 28 188 | 21 518 | 7 543 | 1 112 | 476 | 278 | 0 |
| Denmark | 23 804 | 31 890 | 35 757 | 39 875 | 42 185 | 41 984 | 42 285 | 40 779 | 38 418 | 19 988 | 5 826 | 1 959 | 352 | 0 |
| France | 2 064 | 12 301 | 19 496 | 20 338 | 21 533 | 21 913 | 21 886 | 20 881 | 18 003 | 6 843 | 1 168 | 434 | 54 | 0 |
| Germany | 9 339 | 24 955 | 30 458 | 31 000 | 31 465 | 32 589 | 32 705 | 31 543 | 28 636 | 18 290 | 4 030 | 1 589 | 349 | 0 |
| Italy | 418 | 5 926 | 11 956 | 15 558 | 16 211 | 16 054 | 15 428 | 14 775 | 12 478 | 5 821 | 966 | 444 | 78 | 0 |
| Netherlands | 19 224 | 25 210 | 30 044 | 30 564 | 29 821 | 28 556 | 28 742 | 27 069 | 23 314 | 13 869 | 2 975 | 855 | 223 | 0 |
| Poland | 315 | 3 377 | 6 235 | 6 596 | 6 911 | 7 225 | 7 003 | 6 457 | 4 570 | 1 434 | 564 | 250 | 74 | 0 |
| Sweden | 8 280 | 19 164 | 24 590 | 26 974 | 27 256 | 28 009 | 27 445 | 26 253 | 25 249 | 19 980 | 5 050 | 1 945 | 220 | 0 |
| UK | 7 101 | 15 477 | 17 505 | 18 048 | 18 142 | 18 544 | 19 063 | 18 449 | 16 043 | 9 437 | 3 963 | 1 675 | 425 | 0 |

## Table 129. ANNUAL UNPAID PRODUCTION FOR MALES, BY AGE GROUP AND COUNTRY

| Country | 15-19 | 20-24 | 25-29 | 30-34 | 35-39 | 40-44 | 45-49 | 50-54 | 55-59 | 60-64 | 65-69 | 70-74 | 75-79 | 80+ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Belgium | 435 | 378 | 849 | 1 727 | 1 665 | 1 095 | 880 | 726 | 877 | 1 798 | 1 226 | 1 380 | 921 | 0 |
| Denmark | 1 333 | 2 092 | 3 379 | 4 201 | 4 385 | 4 320 | 3 723 | 3 108 | 2 523 | 2 926 | 4 382 | 4 493 | 1 542 | 0 |
| France | 422 | 367 | 824 | 1 676 | 1 616 | 1 063 | 854 | 705 | 851 | 1 745 | 1 190 | 1 339 | 894 | 0 |
| Germany | 1 754 | 1 567 | 2 448 | 2 983 | 3 445 | 2 739 | 1 916 | 1 585 | 1 668 | 2 041 | 2 257 | 1 819 | 1 555 | 0 |
| Italy | 134 | 151 | 322 | 957 | 1 170 | 944 | 589 | 232 | 189 | 228 | 232 | 143 | 136 | 0 |
| Netherlands | 614 | 966 | 1 196 | 1 997 | 2 689 | 2 568 | 1 877 | 1 842 | 1 585 | 2 662 | 2 196 | 2 969 | 2 392 | 0 |
| Poland | 142 | 241 | 361 | 681 | 590 | 410 | 201 | 197 | 267 | 436 | 335 | 295 | 164 | 0 |
| Sweden | 1 080 | 1 694 | 2 736 | 3 402 | 3 551 | 3 498 | 3 015 | 2 517 | 2 043 | 2 369 | 3 548 | 3 638 | 1 248 | 0 |
| UK | 659 | 963 | 1 175 | 1 948 | 1 970 | 1 600 | 1 445 | 1 174 | 1 390 | 1 184 | 1 618 | 1 548 | 1 097 | 0 |

## Table 130. ANNUAL UNPAID PRODUCTION FOR FEMALES, BY AGE GROUP AND COUNTRY

| Country | 15-19 | 20-24 | 25-29 | 30-34 | 35-39 | 40-44 | 45-49 | 50-54 | 55-59 | 60-64 | 65-69 | 70-74 | 75-79 | 80+ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Belgium | 411 | 1 339 | 3 620 | 5 153 | 3 479 | 2 183 | 1 439 | 1 104 | 1 474 | 1 431 | 1 178 | 1 222 | 848 | 0 |
| Denmark | 1 318 | 2 531 | 4 459 | 9 414 | 6 955 | 4 692 | 3 032 | 1 710 | 2 688 | 2 359 | 3 162 | 3 011 | 945 | 0 |
| France | 399 | 1 300 | 3 513 | 5 001 | 3 376 | 2 119 | 1 396 | 1 072 | 1 431 | 1 388 | 1 143 | 1 186 | 823 | 0 |
| Germany | 1 419 | 1 870 | 5 357 | 6 741 | 5 490 | 3 440 | 2 234 | 1 782 | 1 634 | 1 890 | 2 084 | 1 412 | 1 282 | 0 |
| Italy | 179 | 649 | 1 706 | 3 175 | 2 802 | 1 313 | 496 | 224 | 89 | 130 | 102 | 97 | 105 | 0 |
| Netherlands | 1 128 | 1 485 | 3 548 | 4 946 | 5 669 | 4 449 | 2 468 | 2 290 | 3 120 | 3 542 | 2 445 | 2 182 | 1 182 | 0 |
| Poland | 105 | 493 | 1 397 | 1 176 | 716 | 329 | 147 | 265 | 328 | 378 | 414 | 202 | 105 | 0 |
| Sweden | 1 068 | 2 049 | 3 611 | 7 623 | 5 632 | 3 799 | 2 455 | 1 385 | 2 176 | 1 910 | 2 560 | 2 438 | 765 | 0 |
| UK | 1 016 | 2 676 | 4 211 | 5 030 | 4 423 | 2 873 | 2 024 | 1 666 | 1 806 | 1 834 | 1 569 | 1 316 | 686 | 0 |

## A2. Smoking Prevalence

### Table 131. SMOKING PREVALENCE IN THE CURRENT SITUATION, IN THE HYPOTHETICAL SCENARIO AND THE INCREMENTAL DIFFERENCE BETWEEN THE TWO, BY COUNTRY

| | Current situation | | | | | | Hypothetical scenario | | | | | | Incremental difference | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Males | | Females | | Total | | Males | | Females | | Total | | Males | | Females | | Total | |
| | % | n | % | n | % | n | % | n | % | n | % | n | % | n | % | n | % | % |
| Belgium | 1 391 764 | 30.7% | 1 243 520 | 26.1% | 2 635 284 | 28.3% | 1 043 823 | 23.0% | 932 640 | 19.6% | 1 976 463 | 21.3% | -347 941 | -7.7% | -310 880 | -6.5% | -658 821 | -7.1% |
| Denmark | 452 336 | 19.7% | 420 514 | 17.8% | 872 851 | 18.7% | 339 252 | 14.8% | 315 386 | 13.4% | 654 638 | 14.1% | -113 084 | -4.9% | -105 129 | -4.5% | -218 213 | -4.7% |
| France | 8 819 834 | 34.4% | 7 748 933 | 27.7% | 16 568 767 | 30.9% | 6 614 876 | 25.8% | 5 811 700 | 20.8% | 12 426 575 | 23.2% | -2 204 959 | -8.6% | -1 937 233 | -6.9% | -4 142 192 | -7.7% |
| Germany | 9 551 490 | 28.0% | 7 966 645 | 22.1% | 17 518 136 | 25.0% | 7 163 618 | 21.0% | 5 974 984 | 16.6% | 13 138 602 | 18.7% | -2 387 873 | -7.0% | -1 991 661 | -5.5% | -4 379 534 | -6.2% |
| Italy | 6 811 969 | 27.1% | 5 901 991 | 21.7% | 12 713 961 | 24.3% | 5 108 977 | 20.3% | 4 426 494 | 16.3% | 9 535 471 | 18.2% | -1 702 992 | -6.8% | -1 475 498 | -5.4% | -3 178 490 | -6.1% |
| Netherlands | 1 540 164 | 22.4% | 1 434 904 | 20.2% | 2 975 067 | 21.3% | 1 155 123 | 16.8% | 1 076 178 | 15.2% | 2 231 301 | 16.0% | -385 041 | -5.6% | -358 726 | -5.1% | -743 767 | -5.3% |
| Poland | 4 842 002 | 31.3% | 4 055 904 | 24.1% | 8 897 906 | 27.5% | 3 631 502 | 23.5% | 3 041 928 | 18.1% | 6 673 429 | 20.7% | -1 210 501 | -7.8% | -1 013 976 | -6.0% | -2 224 476 | -6.9% |
| Sweden | 488 162 | 12.3% | 596 435 | 14.8% | 1 084 597 | 13.6% | 366 122 | 9.2% | 447 326 | 11.1% | 813 448 | 10.2% | -122 041 | -3.1% | -149 109 | -3.7% | -271 149 | -3.4% |
| UK | 5 944 480 | 23.0% | 5 452 974 | 20.1% | 11 397 454 | 21.5% | 4 458 360 | 17.3% | 4 089 730 | 15.1% | 8 548 091 | 16.1% | -1 486 120 | -5.8% | -1 363 243 | -5.0% | -2 849 364 | -5.4% |

## A3. Health gains – lung cancer incidence, lung cancer mortality and life years

### Table 132. REDUCTION IN LUNG CANCER INCIDENCE IN MALES, BY AGE GROUP AND COUNTRY

| Country | 15-19 | 20-24 | 25-29 | 30-34 | 35-39 | 40-44 | 45-49 | 50-54 | 55-59 | 60-64 | 65-69 | 70-74 | 75-79 | 80-84 | 85-89 | 90-94 | 95+ | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Belgium | 0 | 0 | 0 | 1 | 1 | 5 | 19 | 55 | 112 | 159 | 180 | 192 | 203 | 176 | 103 | 26 | 2 | 1 234 |
| Denmark | 0 | 0 | 0 | 0 | 1 | 2 | 8 | 15 | 30 | 52 | 89 | 85 | 83 | 72 | 37 | 11 | 1 | 487 |
| France | 0 | 0 | 1 | 6 | 16 | 73 | 179 | 431 | 739 | 1 058 | 919 | 849 | 869 | 768 | 418 | 127 | 18 | 6 472 |
| Germany | 0 | 1 | 1 | 3 | 8 | 36 | 153 | 348 | 625 | 852 | 1 048 | 1 530 | 1 276 | 925 | 409 | 92 | 11 | 7 318 |
| Italy | 0 | 0 | 1 | 2 | 11 | 30 | 73 | 157 | 300 | 589 | 824 | 1 062 | 1 136 | 1 035 | 559 | 130 | 17 | 5 928 |
| Netherlands | 0 | 0 | 0 | 1 | 2 | 8 | 22 | 54 | 105 | 184 | 243 | 256 | 282 | 226 | 110 | 29 | 5 | 1 527 |
| Poland | 0 | 0 | 1 | 2 | 5 | 24 | 71 | 259 | 565 | 778 | 635 | 642 | 605 | 367 | 129 | 18 | 3 | 4 104 |
| Sweden | 0 | 0 | 0 | 0 | 1 | 2 | 4 | 8 | 17 | 41 | 68 | 66 | 66 | 56 | 34 | 11 | 1 | 374 |
| UK | 0 | 0 | 0 | 3 | 7 | 24 | 58 | 125 | 255 | 484 | 696 | 802 | 827 | 696 | 467 | 149 | 22 | 4 614 |

## Table 133. REDUCTION IN LUNG CANCER INCIDENCE IN FEMALES, BY AGE GROUP AND COUNTRY

| Country | 15-19 | 20-24 | 25-29 | 30-34 | 35-39 | 40-44 | 45-49 | 50-54 | 55-59 | 60-64 | 65-69 | 70-74 | 75-79 | 80-84 | 85-89 | 90-94 | 95+ | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Belgium | 0 | 0 | 0 | 1 | 1 | 4 | 10 | 24 | 41 | 49 | 46 | 42 | 40 | 38 | 28 | 10 | 1 | 337 |
| Denmark | 0 | 0 | 0 | 0 | 0 | 1 | 6 | 12 | 23 | 28 | 50 | 48 | 51 | 40 | 23 | 6 | 3 | 293 |
| France | 0 | 0 | 0 | 3 | 9 | 36 | 79 | 156 | 212 | 230 | 196 | 161 | 204 | 217 | 158 | 59 | 14 | 1 735 |
| Germany | 0 | 0 | 1 | 2 | 5 | 25 | 77 | 163 | 235 | 307 | 332 | 419 | 336 | 299 | 198 | 75 | 12 | 2 488 |
| Italy | 0 | 0 | 0 | 2 | 6 | 15 | 34 | 69 | 95 | 134 | 170 | 199 | 217 | 222 | 170 | 60 | 14 | 1 408 |
| Netherlands | 0 | 0 | 0 | 0 | 2 | 8 | 22 | 46 | 74 | 96 | 103 | 96 | 91 | 69 | 41 | 9 | 2 | 659 |
| Poland | 0 | 0 | 0 | 2 | 3 | 8 | 24 | 79 | 156 | 236 | 172 | 147 | 138 | 109 | 52 | 13 | 2 | 1 141 |
| Sweden | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 6 | 12 | 25 | 44 | 38 | 39 | 29 | 21 | 8 | 1 | 227 |
| UK | 0 | 0 | 0 | 2 | 5 | 13 | 36 | 76 | 162 | 248 | 370 | 401 | 426 | 424 | 296 | 118 | 25 | 2 600 |

## Table 134. REDUCTION IN LUNG CANCER RELATED MORTALITY IN MALES, BY AGE GROUP AND COUNTRY

| Country | 15-19 | 20-24 | 25-29 | 30-34 | 35-39 | 40-44 | 45-49 | 50-54 | 55-59 | 60-64 | 65-69 | 70-74 | 75-79 | 80-84 | 85-89 | 90-94 | 95+ | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Belgium | 0 | 0 | 0 | 0 | 1 | 4 | 15 | 44 | 91 | 129 | 147 | 156 | 165 | 143 | 83 | 21 | 2 | 1 003 |
| Denmark | 0 | 0 | 0 | 0 | 1 | 1 | 7 | 12 | 25 | 43 | 74 | 71 | 68 | 59 | 31 | 9 | 1 | 403 |
| France | 0 | 0 | 1 | 5 | 13 | 56 | 138 | 332 | 569 | 814 | 708 | 654 | 669 | 591 | 322 | 98 | 14 | 4 984 |
| Germany | 0 | 1 | 1 | 3 | 7 | 32 | 134 | 305 | 547 | 746 | 918 | 1 340 | 1 118 | 810 | 359 | 81 | 10 | 6 411 |
| Italy | 0 | 0 | 1 | 2 | 10 | 27 | 65 | 141 | 270 | 529 | 740 | 954 | 1 021 | 930 | 502 | 117 | 15 | 5 325 |
| Netherlands | 0 | 0 | 0 | 1 | 2 | 7 | 19 | 47 | 91 | 159 | 210 | 221 | 244 | 196 | 95 | 25 | 4 | 1 321 |
| Poland | 0 | 0 | 1 | 2 | 4 | 21 | 61 | 224 | 488 | 672 | 548 | 555 | 523 | 317 | 111 | 16 | 3 | 3 546 |
| Sweden | 0 | 0 | 0 | 0 | 1 | 2 | 3 | 7 | 16 | 38 | 62 | 60 | 60 | 51 | 31 | 10 | 1 | 344 |
| UK | 0 | 0 | 0 | 2 | 6 | 21 | 51 | 110 | 224 | 426 | 612 | 705 | 727 | 612 | 411 | 131 | 19 | 4 057 |

## Table 135. REDUCTION IN LUNG CANCER RELATED MORTALITY IN FEMALES, BY AGE GROUP AND COUNTRY

| Country | 15-19 | 20-24 | 25-29 | 30-34 | 35-39 | 40-44 | 45-49 | 50-54 | 55-59 | 60-64 | 65-69 | 70-74 | 75-79 | 80-84 | 85-89 | 90-94 | 95+ | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Belgium | 0 | 0 | 0 | 1 | 1 | 3 | 9 | 20 | 34 | 40 | 37 | 34 | 32 | 31 | 23 | 8 | 1 | 274 |
| Denmark | 0 | 0 | 0 | 0 | 0 | 1 | 5 | 10 | 19 | 23 | 41 | 40 | 42 | 33 | 19 | 5 | 2 | 242 |
| France | 0 | 0 | 0 | 2 | 7 | 28 | 61 | 120 | 163 | 177 | 151 | 124 | 157 | 167 | 122 | 45 | 11 | 1 336 |
| Germany | 0 | 0 | 1 | 2 | 4 | 22 | 68 | 143 | 206 | 269 | 291 | 367 | 294 | 262 | 174 | 66 | 10 | 2 180 |
| Italy | 0 | 0 | 0 | 2 | 5 | 13 | 31 | 62 | 85 | 120 | 153 | 179 | 195 | 199 | 153 | 53 | 12 | 1 264 |
| Netherlands | 0 | 0 | 0 | 0 | 2 | 7 | 19 | 39 | 64 | 83 | 89 | 83 | 79 | 59 | 36 | 8 | 1 | 570 |
| Poland | 0 | 0 | 0 | 1 | 2 | 7 | 21 | 68 | 135 | 204 | 148 | 127 | 120 | 94 | 45 | 12 | 2 | 986 |
| Sweden | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 6 | 11 | 23 | 40 | 35 | 36 | 27 | 19 | 7 | 1 | 209 |
| UK | 0 | 0 | 0 | 2 | 4 | 11 | 32 | 67 | 142 | 218 | 325 | 353 | 374 | 373 | 261 | 103 | 22 | 2 287 |

## Table 136. LIFE-YEARS GAINED IN MALES DUE TO REDUCED LUNG CANCER MORBIDITY AND MORTALITY, BY AGE GROUP AND COUNTRY

| Country | 15-19 | 20-24 | 25-29 | 30-34 | 35-39 | 40-44 | 45-49 | 50-54 | 55-59 | 60-64 | 65-69 | 70-74 | 75-79 | 80-84 | 85-89 | 90-94 | 95+ | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Belgium | 0 | 13 | 12 | 21 | 38 | 171 | 528 | 1 339 | 2 332 | 2 785 | 2 609 | 2 215 | 1 783 | 1 130 | 467 | 80 | 5 | 15 531 |
| Denmark | 13 | 12 | 11 | 0 | 27 | 55 | 230 | 363 | 636 | 915 | 1 294 | 982 | 732 | 476 | 180 | 37 | 3 | 5 965 |
| France | 0 | 13 | 60 | 230 | 565 | 2 253 | 4 891 | 10 277 | 15 251 | 18 567 | 13 447 | 9 999 | 7 967 | 5 204 | 1 998 | 411 | 42 | 91 176 |
| Germany | 14 | 51 | 70 | 149 | 307 | 1 258 | 4 684 | 9 263 | 14 286 | 16 412 | 16 612 | 19 301 | 12 407 | 6 644 | 2 080 | 322 | 28 | 103 886 |
| Italy | 0 | 26 | 72 | 77 | 447 | 1 104 | 2 393 | 4 531 | 7 421 | 12 277 | 14 139 | 14 506 | 11 941 | 8 092 | 3 113 | 504 | 46 | 80 689 |
| Netherlands | 0 | 12 | 0 | 42 | 75 | 295 | 690 | 1 442 | 2 398 | 3 508 | 3 787 | 3 166 | 2 632 | 1 547 | 533 | 94 | 11 | 20 231 |
| Poland | 0 | 12 | 32 | 67 | 154 | 715 | 1 843 | 5 794 | 10 791 | 12 507 | 8 391 | 6 882 | 5 072 | 2 346 | 622 | 67 | 9 | 55 303 |
| Sweden | 12 | 11 | 10 | 0 | 42 | 67 | 126 | 231 | 429 | 857 | 1 149 | 880 | 665 | 409 | 173 | 37 | 3 | 5 102 |
| UK | 13 | 12 | 11 | 115 | 264 | 837 | 1 815 | 3 409 | 5 983 | 9 575 | 11 321 | 10 431 | 8 365 | 5 263 | 2 589 | 591 | 60 | 60 655 |

**Table 137. LIFE-YEARS GAINED IN FEMALES DUE TO REDUCED LUNG CANCER MORBIDITY AND MORTALITY, BY AGE GROUP AND COUNTRY**

| Country | 15-19 | 20-24 | 25-29 | 30-34 | 35-39 | 40-44 | 45-49 | 50-54 | 55-59 | 60-64 | 65-69 | 70-74 | 75-79 | 80-84 | 85-89 | 90-94 | 95+ | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Belgium | 0 | 0 | 0 | 51 | 54 | 138 | 332 | 683 | 1 000 | 1 012 | 791 | 576 | 425 | 299 | 150 | 35 | 3 | 5 550 |
| Denmark | 0 | 0 | 0 | 7 | 19 | 34 | 183 | 339 | 542 | 568 | 829 | 642 | 535 | 317 | 133 | 26 | 8 | 4 182 |
| France | 0 | 0 | 10 | 135 | 368 | 1 274 | 2 501 | 4 390 | 5 229 | 4 870 | 3 481 | 2 334 | 2 312 | 1 842 | 936 | 236 | 38 | 29 954 |
| Germany | 20 | 19 | 61 | 95 | 217 | 949 | 2 651 | 4 937 | 6 164 | 6 842 | 6 132 | 6 202 | 3 799 | 2 465 | 1 129 | 290 | 31 | 42 001 |
| Italy | 0 | 19 | 27 | 114 | 253 | 605 | 1 268 | 2 239 | 2 700 | 3 253 | 3 433 | 3 260 | 2 755 | 2 090 | 1 131 | 267 | 42 | 23 457 |
| Netherlands | 0 | 18 | 8 | 23 | 97 | 287 | 751 | 1 355 | 1 903 | 2 117 | 1 884 | 1 422 | 1 040 | 575 | 243 | 35 | 4 | 11 762 |
| Poland | 0 | 0 | 17 | 71 | 114 | 288 | 773 | 2 216 | 3 797 | 4 846 | 2 921 | 2 002 | 1 458 | 849 | 290 | 55 | 7 | 19 706 |
| Sweden | 0 | 0 | 0 | 20 | 12 | 27 | 77 | 196 | 328 | 584 | 850 | 599 | 475 | 256 | 128 | 32 | 3 | 3 588 |
| UK | 0 | 9 | 25 | 99 | 207 | 486 | 1 254 | 2 294 | 4 233 | 5 529 | 6 862 | 5 994 | 4 978 | 3 690 | 1 876 | 517 | 76 | 38 129 |