

## Investing in European health R&D A pathway to sustained innovation and stronger economies

an update of the 2013 publication



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# Foreword



No one would argue against the importance of fostering investment in health research and development (R&D) to keep Europe at the forefront of future medical interventions and maintain its position as a world centre for innovation. It would, however, be a mistake to assume that such investment can be taken for granted. Working with Janssen in 2013 on the original version of this paper, Deloitte's European Centre on Health Economics and Outcomes Research drew together relevant data and new research to demonstrate the fall in public investment in health R&D over recent years. Using both existing data and primary research, we set out the future impact of not keeping pace with the demand for healthcare and made recommendations to policy-makers on what could be changed to put health R&D investment back on the agenda as a priority issue.

Much has happened since 2013: for example, the adoption of a new EU Regulation on clinical trials; creation of e-infrastructure initiatives between stakeholders; and an increase in the number of mergers, licensing agreements and biotech acquisitions by large biopharmaceutical companies. This activity has helped to shed light on other areas that could have a positive impact on health R&D, such as stakeholder collaboration.

Notwithstanding these developments, the present context is still overshadowed by the continuing decline in public investment in health R&D and the reality that further austerity measures make improvements in this area of funding very unlikely.

This paper updates the data and lines of argument in our 2013 paper by providing new evidence and case studies, thereby highlighting some of the measures and initiatives across stakeholders that are positively affecting health R&D. We aim to demonstrate that:

1. Collaboration is at the core of public and private health R&D but that to create the necessary impact we need to ensure innovators are adequately rewarded;
2. Collaboration should be based on high quality outputs that target the areas of expertise of each stakeholder; and
3. Creation/improvement of national and regional e-infrastructures enables earlier and wider exchange of data, providing efficiencies across all stages of health technology development.



# Introduction

Jane Griffiths, Janssen Company Group Chairman

Janssen has a long heritage as a medical innovator. We focus on leveraging our scientific expertise to deliver innovative solutions that transform patients' lives. To address unmet medical needs, we invest in 'best in class' research capabilities, including genomics, biotechnology, biomarkers, companion diagnostics and vaccine platforms, and bring together top scientists and researchers to create visionary medical solutions.

Increasingly, such innovation comes at a high price. The cost of conducting pharmaceutical research has multiplied by approximately eight times over the last 20 years, from an average of US\$320 million for developing a single new medicine in the mid-1980s to \$2.6 billion today. Research has become more complex and lengthy, with more trials being conducted for each potential drug, more tests included in each trial, and more patients enrolled for longer periods of time. This is, first and foremost, good news for patients. More rigorous testing has yielded safer, more effective medicines, which in turn have saved millions of lives and helped people suffering from debilitating illnesses to recover and lead more fulfilling lives.

It is more crucial than ever that the industry rises to face the current challenges head-on. Only then will we be able to realise the promise of the remarkable advances in our understanding of basic science, help solve the continuing biological puzzles of cancers and rare diseases, and reduce the overall cost and health burden of disease. Research-based pharmaceutical companies such as Janssen have needed continuously to evolve their business and operating models in order to ensure that capital is being allocated in the right way to meet future market and business needs. That flexibility is necessary now more than ever.

No longer the model of the past whereby pharmaceutical companies operated largely in autonomous silos: in order to maintain a flow of innovative medicines, there has been a growing realisation of the need to identify sources of appropriate knowledge and expertise outside industry walls. Collaborative alliances with governments, academia, healthcare professionals, patient advocates, as well as



other biopharmaceutical companies are the future, and at Janssen, the idea of partnerships is central to our corporate vision. For example, the Johnson & Johnson Innovation Centers were set up to facilitate the exchange of ideas with entrepreneurs and external scientists and to provide a framework to source external innovation early, both of which are critical for advancing transformative innovations. Recently we announced that researchers from Karolinska Institutet and Janssen will establish a collaborative research program based on analysis of real world data, seeking to improve the understanding of medical interventions and treatment outcomes under real world conditions in our common areas of interest. Similarly Janssen Healthcare Innovation was established to identify new partnership concepts and business models to develop pioneering health solutions to modernise healthcare delivery.

Any potential deterioration in R&D investment is a matter of major concern given the rising demand for innovative medicines as a result of an increasing, ageing and more sedentary population. A healthy R&D climate is a necessary precondition if we are to realise the many potential breakthroughs of the future, leading to population health gains that will touch all our lives.

In this context, Janssen Health Policy Centre has commissioned a series of in-depth reports looking at the health R&D investment climate. These studies provide an opportunity to gain a deeper insight into the market variables underlying the dynamics of the industry and hence a greater understanding of the environment in which we operate. By generating new data, the Janssen Health Policy Center Centre aims to raise awareness of the issues that have an impact on healthcare policy, build consensus through dialogue with multiple stakeholders, and shape recommendations for future policies that will benefit patients and society.

The first of these, published in 2013, sought to bring to public attention the many uncertainties around the level of investment in health R&D. It outlined the arguments and underlying facts in support of increased investment in health R&D in Europe. A second study published last year (High value, high uncertainty: Measuring risk in biopharmaceutical research and in other industries – Investing in the future of health) focused on how investment risk for biopharmaceuticals compares with other industries and also looked at the reward system for innovation.

This report serves as an update to the 2013 publication and here we look in detail at the specific measures required to create a successful environment for a sustainable R&D process that will enable the continued delivery of innovative medicines for the benefit of patients and society. We see this as one of the critical issues in healthcare today: indeed, the future of innovation depends on it.

**Jane Griffiths**

Company Group Chairman

Janssen Pharmaceutical Companies of Johnson & Johnson Europe,  
Middle East & Africa

# Executive summary

A large number of factors point to an unavoidable rise in healthcare expenditure of an estimated 5 percentage points to 13%-18% of Europe's GDP by 2030, even with policy interventions or budget caps that aim to counterbalance these pressures. Trends that pushed up healthcare expenditure in the past will become even more intense in the coming decades.

- First, there is an expansion of **demand** for healthcare services mainly due to an ageing and more obese population; better-informed patients influencing drug development and pushing for wider drug reimbursement; and an increase in the societal and individual willingness to pay for healthcare as a result of higher income levels.
- Second, **supply** is accelerating thanks to the biomedical revolution of recent medical advancements, such as the mapping of the human genome leading to the development of personalised medicine, and the convergence of different technologies.
- Third, **the nature of healthcare provision**, which allows productivity gains in care delivery (e.g. the development of treatment pathways and specialised care centres), but still heavily rely on trained labour to deliver healthcare services (unlike other sectors such as the computing and automotive industries).

Over time, healthcare therefore inevitably claims an increasing share of a country's economy. This growth in healthcare costs is frequently stated as burdensome; however, it should not be the case, especially when it leads to improved health outcomes, which affect productivity and life expectancy. With this in mind, the challenge is not "how do we reverse the growth of healthcare costs?" but "how can we best deploy the increasing resources spent on healthcare to create optimal benefits for the European population?"

Health R&D is the key to being able to respond to this dilemma. Increased investment in R&D (and local R&D) has a fundamental role to play in economic growth in Europe as there are direct and indirect links between increasing R&D spend on healthcare, improved healthcare services, and the consequent wider benefits to the overall economy. This is even more the case in a context of growing healthcare expenditure.

- First, there is the direct impact of innovative technologies on the quality of healthcare provision, leading to **improved health outcomes** and extended years of life.
- Secondly, shifting healthcare budgets from delivery of care to newer technologies leads to higher **efficiency gains** in the long-term, as the cost of new technologies tends to decrease over time for both medicines (through the loss of patent exclusivity) and medical devices (due to decreasing prices, e.g. for bare metal stents). This creates further budgetary room for better care and newer and better technologies – which, in turn, have their own positive impact on population health gains.
- Third, improved health leads to **better productivity** among the working population and may even increase the maximum working age from its current level.
- Fourth, R&D investments, if appropriately rewarded, have the potential to provide high **economic yields** both in terms of return on investment and also by creating a knowledge economy and deploying a highly educated workforce with technical skills. This has a widespread positive impact on society and not only on a section of society (i.e. the patients).



The outlook for Europe is not as positive as it could be. Recently there has been a stagnation or even decline in European private and public investment in health related R&D. However there are opportunities for EU countries to have an impact on this trend. In this report we focus on three areas for action:

- **R&D-related public funding policies:** stricter reimbursement and pricing decisions can compromise the potential for companies to re-invest in new R&D after a product reaches the market. In contrast, improvements in utilisation policies can foster R&D investment and attract talent to create the solutions needed to tackle pressing population health problems. Policy makers need to recognise that innovative technologies can only be developed if sufficient time and financial resources are invested. This can only happen if there are economically viable options for innovators. It is the industries' opinion that there is potential to improve current utilisation practices by building further ties between innovation cycles and market access processes for innovative medical therapies.
- **Public Health Stakeholder collaboration:** initiatives for stakeholder collaboration should be result oriented, with clear goals and planned outputs. Consortia provide a good framework for such collaborations because they maximise resources and leverage expertise among stakeholders to create a shared output. However it is crucial to ensure that each partner focuses on their true area of expertise, in order to achieve the research goals fully and efficiently. Additionally, it is important to remember that not all collaborations are successful. Hence follow-up mechanisms should be in place to track best practices and to identify the initiatives that should continue to receive funding/investment.
- **E-infrastructure:** Large quantities of data are generated and collected across European healthcare-related institutions but this data can normally only be accessed within each individual organisation. The creation of data-sharing platforms, and the establishment of compulsory and standardised data collection methods, can help streamline the research that is conducted within academia, governmental organisations, and pharmaceutical/medical devices companies. Development of e-infrastructure for this purpose could speed up the R&D cycle

and promote innovation. Although such initiatives have started and are currently being funded (e.g. via the EU framework program), awareness of the R&D potential of having such interoperable data systems needs to be increased across all participating stakeholder groups. For instance, one of the current main barriers for improving e-infrastructure in life science and healthcare is the importance of safeguarding privacy when sharing data. This has delayed the funding and completion of such projects and further efforts are needed to overcome this hurdle.

Taken together, these three areas are currently hindering health R&D by impeding new investment and curbing outputs from scientific partnerships. This has a knock-on negative impact on current health gains as well as on the future efficiency, productivity and economic benefits associated with the health sector (from both an economic and societal perspective).

**The potential of R&D investment to increase the health of the populations and positively impact on Europe's economies makes it crucial for policy makers to revise policies, initiatives, and priorities that will encourage growth and success in the health sector, via its primary activity: research and development.**

The following chapters outline the arguments and present the evidence in support of increased investment in health R&D in Europe. The paper looks first at current and future trends in healthcare expenditure (chapter 1). It then focuses on rewarding R&D via improved utilisation policies and how this will have a positive impact on the pursuit of innovation (chapter 2). We also demonstrate that a positive environment for collaboration, combined with greater focus on shared responsibilities and the quality of research outputs, can streamline the development and launch of a new health-related technology (chapter 3). We then look at the need for interoperable systems to support cross-country research and make more efficient use of resources, via data-sharing e-infrastructure platforms (chapter 4). Finally, we draw some overall conclusions from the research (chapter 5).



# Methodology



The main objective of updating the 2013 edition of this paper, Investing in European health R&D, was two-fold. The goal was to address important and related topics that are currently being raised by experts from the biopharmaceutical sector, while also providing updated data and information on R&D investment across Europe. Three main sources of investment in health R&D have been reviewed for this study: private R&D from the biopharmaceutical industry; public health-related R&D at country level; and the European Union Framework Programmes.


Recent data sets from GBAORD (Government budget appropriations or outlays for R&D), GERD (Gross domestic expenditure on R&D), EFPIA (European Federation of Pharmaceutical Industries and Associations), Eurostat, WHO National health account database, PhRMA Annual Survey, and Research America were analysed, using (for consistency) the same template created for the original 2013 paper.

Extensive desk research by Deloitte, combined with its industry knowledge, was used to gather the evidence and develop the hypotheses for the paper, focusing on the following areas (but not exclusively): public and private health R&D; healthcare expenditure per country; healthcare expenditure for major disease areas; recent measures in key countries that affect R&D budgets; and ongoing austerity measures in Europe.

As part of its research, Deloitte also carried out eight interviews with internal and external key opinion leaders from different fields, including academia, biopharmaceutical R&D, and information technology, each lasting up to 2 hours.

A hypothesis tree was created to organise, assess and categorise all the relevant lines of argument arising from the primary and secondary research. Deloitte has also used case studies to illustrate some of the particular issues covered by the paper.



The background of the slide is a complex network diagram. It consists of numerous nodes, represented as glowing orange circles with a red center, interconnected by a web of bright blue lines. The nodes are distributed across the frame, with a higher density in the upper right and lower right areas, and fewer nodes in the lower left. The overall effect is a sense of interconnectedness and dynamic activity, typical of a research or innovation landscape.

# Chapter 1

## The current health-related R&D landscape



Healthcare spending in Europe has increased substantially over the past three decades, rising faster than economic growth. Population ageing explains at most one-third of this increase, with technical advancements and medical innovation accounting for up to two-thirds<sup>1 2</sup> (see **Figure 1**). Several studies have also found that health-related expenditure rises faster than income.<sup>3</sup>

**Figure 1 – Historic and economic trends underlying increased healthcare spending**

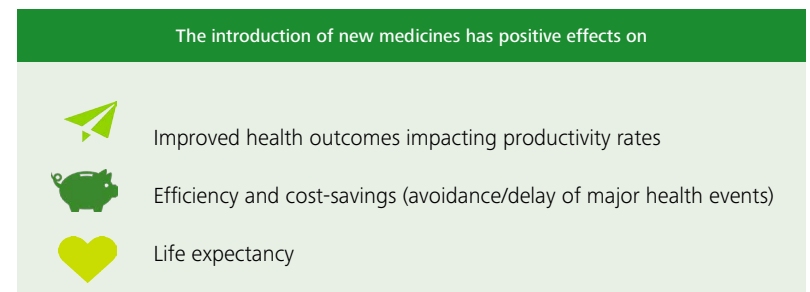
Historic trends	Economic drivers
<ul style="list-style-type: none"> <li>• Ageing populations</li> <li>• Increasing demand for healthcare services</li> <li>• Economic growth leads to rising incomes and therefore to higher demand</li> <li>• Rises in the clinical and economic burden of chronic diseases (e.g. dementia, diabetes, cancer, cardio-vascular diseases)</li> </ul>	<ul style="list-style-type: none"> <li>• Although productivity gains can be achieved in care delivery, the rate is lower than in other sectors as healthcare sector is labour-intensive</li> <li>• Healthcare inflation is historically higher than overall inflation</li> <li>• Growth in the supply of new health-enhancing and cost-effective medical technologies is likely to accelerate faster than budget allocations to healthcare</li> <li>• Incentives for generic use</li> <li>• Investment in targeted therapies and biomarkers provide a limited return on investment, as they address a narrower population</li> </ul>

Recent decades have seen the greatest ever advances in healthcare and the development of effective technological innovations. Biopharmaceutical R&D has made a huge contribution to the improvements in health and longevity, with the launch of newly discovered drug therapies increasing the probability of survival by one-third compared to older medications.<sup>4</sup> The introduction of new medicines is estimated to have accounted for 40% of the increase in life expectancy between 1986 and 2000 alone.<sup>5</sup>

Effective biopharmaceutical intervention is also helping to avoid the heavy costs of early retirement due to illness. As Ulf Smith, President of the Alliance for Biomedical Research in Europe stated in an interview: “Also for our economies, we need healthy

people who can work longer.”<sup>6</sup> Despite improvements, however, in a number of countries (such as Finland, Norway, Ireland and UK), up to 20% of older employees still stop working before retirement due to disability.<sup>7</sup>

**Figure 2 – The positive impact of innovative healthcare therapies**

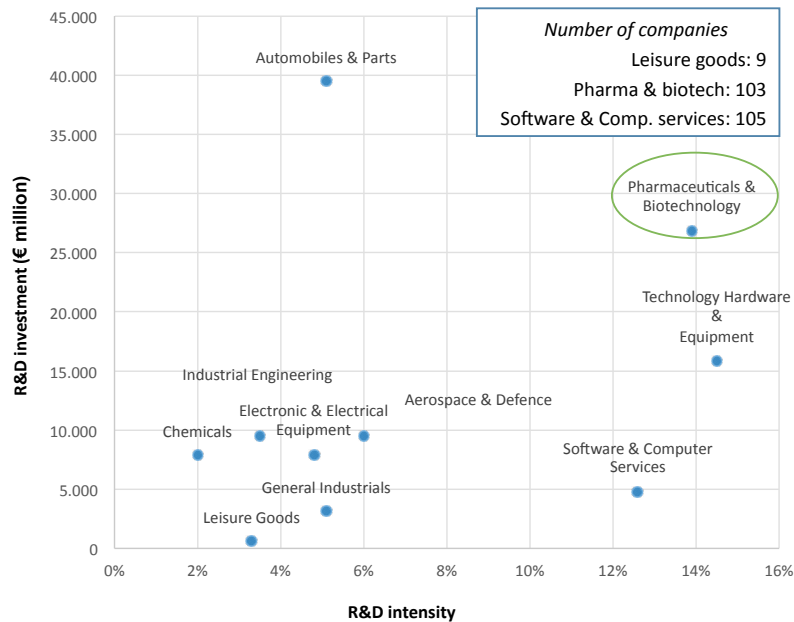


From an industrial and economic policy perspective, private and public R&D investments not only benefit future patients, they also benefit the whole population through economic growth and efficiency gains (see **Figure 2**).<sup>8</sup> Hence it is crucial for Europe’s economy that investment in R&D is given the priority it needs to ensure future growth.

The European Commission estimates that the pharmaceutical industry is the second most R&D intensive sector in Europe (defined in terms of the extent of research and innovation activities undertaken in a given country in terms of resources input ) and also represents the second largest R&D sector in absolute investment (see **Figure 3**).<sup>9</sup> It is therefore one of the key contributors to a growing market globally as well as regionally. Creating a knowledge-based economy is one of the priorities set by the European Commission for 2020, so the life sciences industry will be pivotal in the overall future of the European Union (EU) economies.<sup>10</sup> Máire Geoghegan-Quinn, the former European Commissioner for Research, Innovation and Science, has illustrated this feature of health R&D in her comments on the wider impact of research in neuroscience:

*"In terms of the economy: in the last few years, several pharmaceutical companies reduced or closed their neurosciences R&D facilities because the development of drugs takes too long, is too expensive and too risky. Fewer drugs are being developed and at higher cost. (...) Brain research and innovation contribute to Europe 2020's aims, not just by improving quality of life and helping integrate patients back into their social and working lives, but also by creating jobs and increasing competitiveness through innovative new products such as medicines, diagnostics, nanotechnologies and robotics."*<sup>11</sup>

Figure 3 - R&D distribution and intensity\* by sector in Europe, 2012



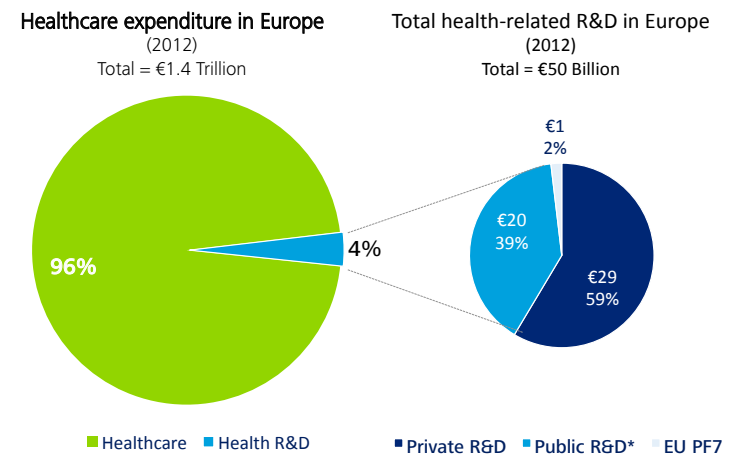
Top 1000 R&D investing companies based in the EU\*

Investment in biomedical research yields economic returns both through improved health gains and as a result of the commercial exploitation of research outputs.<sup>12</sup>

### Total health R&D spending

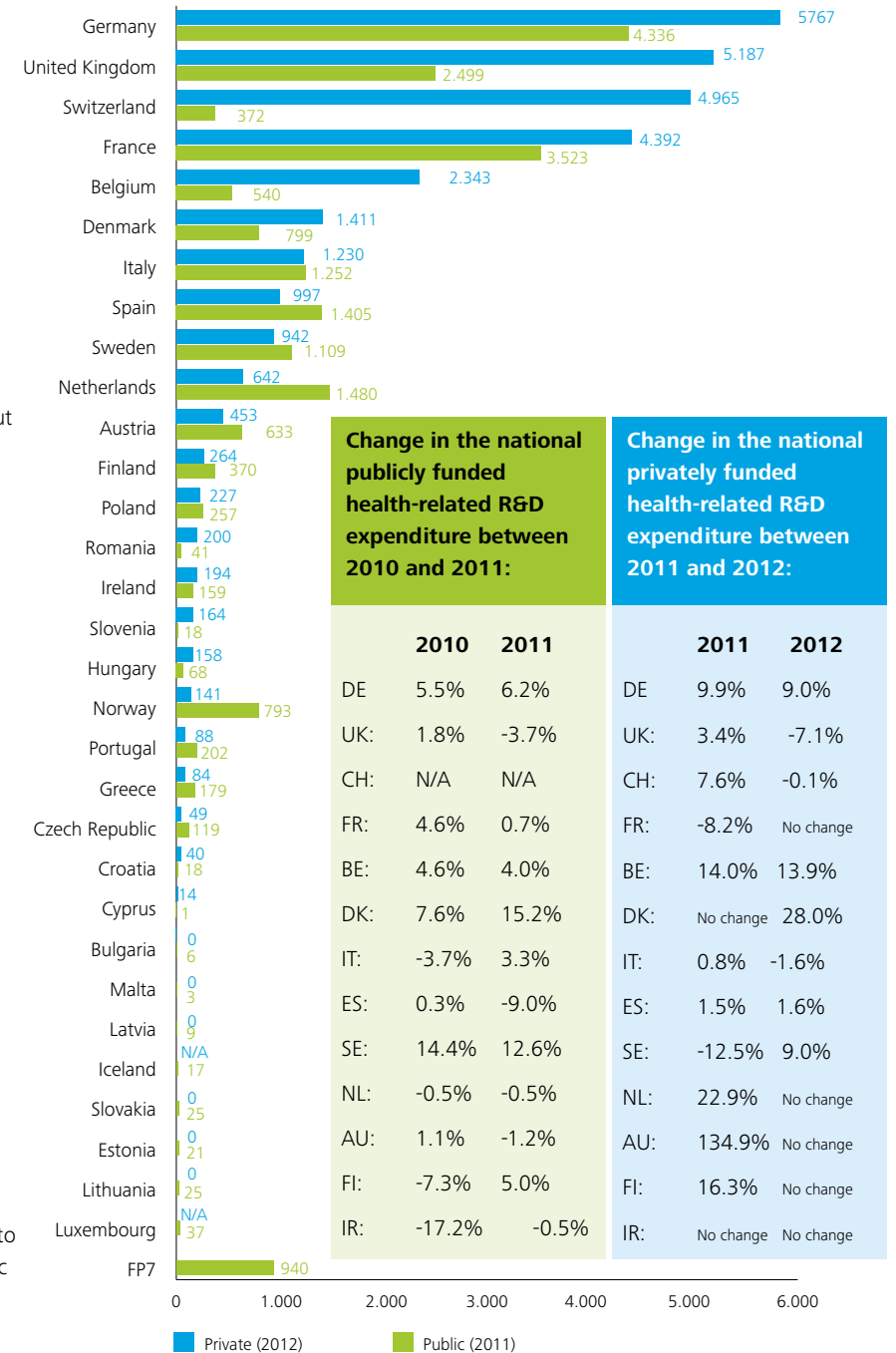
In absolute terms, total health R&D<sup>13</sup> spending in Europe is mainly driven by private sector funds: at a total of €29 billion, investments from pharmaceutical companies accounted for almost two-thirds (59%) of total R&D investments in 2012 (Figure 4).<sup>14,15</sup> This does not include another €8 billion invested by the medical device industry.<sup>16</sup> The remainder comes primarily from public R&D at the national level, plus a relatively small contribution at European level, most of which in recent years has come through the EU's Seventh Framework Programme for Research and Technological Development (FP7).<sup>17</sup> It is notable that Health R&D accounted for only 4% of total healthcare expenditure in Europe in 2012 (Figure 4), the majority of which, as mentioned, being private investment.

Figure 4 - Total health-related R&D in Europe in 2012 (Euros)



Note: private R&D only includes biopharmaceutical companies (numbers were rounded up) \*2011 data

Figure 5 – Private and public health-related R&D expenditures per country (millio Euro)



Since 2008, the growth in overall investment has slowed, with 2011 even seeing an absolute decline in public health R&D for the first time in recent decades. Growth in EU private investments slightly declined in 2008, at the start of the financial crisis, but has increased by €1 billion per year since then.<sup>18</sup>

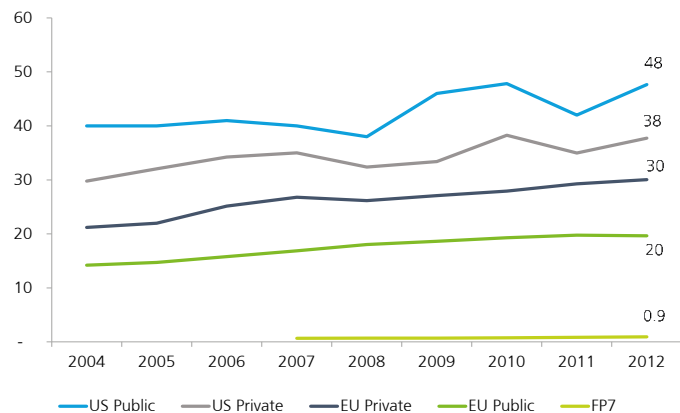
Looking at the level of total R&D investments, four countries (Germany, UK, Switzerland and France) stand out as making the biggest absolute private sector financial commitments as well as large public expenditure (apart from Switzerland) (see Figure 5).<sup>19</sup> Relative to the size of the countries, there are nations with high private R&D activity, such as Switzerland and Belgium, and those with a greater emphasis on public R&D, such as the Netherlands.

Analysing the sources of investment in Europe over time, both public and national private health R&D investments have historically contributed to an overall increase. However, this trend has tailed off in the last few years (see boxes in Figure 5), with the majority of countries between 2010 and 2012 seeing slower growth rates or actual declines in public and/or private health-related investment. This situation is jeopardising the potential of the biopharmaceutical and healthcare industries to address important population health needs and also undermining Europe’s role as a global centre of reference for innovation.

The 2012 Government budget appropriations or outlays on R&D (GBAORD) data<sup>20</sup> indicate a decline in 2008 and 2012, and an absolute decline of 1% in 2012 for publicly funded health R&D.<sup>21</sup> At the same time, the growth rate in private health R&D investment has also decreased in 2008, after which it slowly increased again (see Figure 6).<sup>22</sup>

There remains a significant gap between total spending on health R&D in Europe and the US. At the height of the recent financial crisis, the US increased its public health-related R&D budgets by US\$10.4 billion over the period 2008-2009 through the American Recovery and Reinvestment Act (ARRA), a stimulus package designed to counteract the economic crisis.<sup>23</sup> Although there was a decline of 8% in 2011, public R&D investments in the US recovered in 2012.

**Figure 6 - Private and public health-related R&D in Europe and the US (2004-2012; billion Euro)**



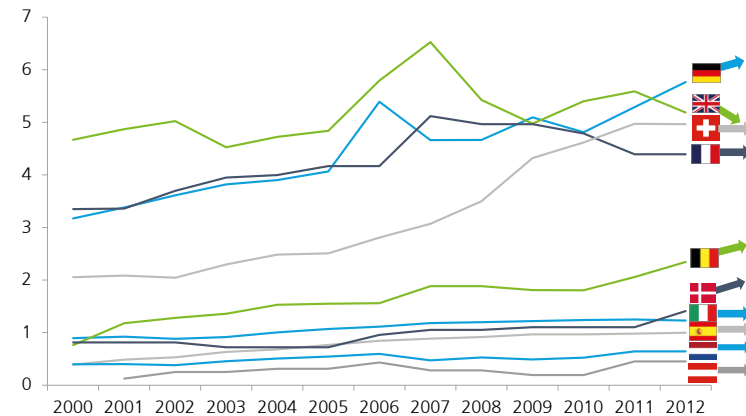
In Europe, there are a range of sources for publicly funded health-related R&D. The majority of resources (94%) come from national funding organisations; the rest derives from the European Union itself (6%) through the Framework programmes and the European Research Council (ERC). However, from **Figure 6** we conclude that the slow down in overall health-related R&D investment across Europe is not likely to be resolved by publicly-funded initiatives at the European level alone, that is to say European level investment will not make up for any contractions at national level.

National publicly funded health R&D in Europe (spending from governments and higher education institutions) has grown significantly over the last decade but since 2009 has slowed down; showing a slight decrease. Between 2010 and 2011, of the major European economies Denmark and Sweden saw growth (17% and 13% respectively), Belgium and Germany have both grown, but at a lower rate of 6% and 4% respectively during the period. Despite the lower growth, Germany and Belgium still maintain a level of public in health-related R&D investment that is higher than other countries such as France and the UK.

### Private health-related R&D spending

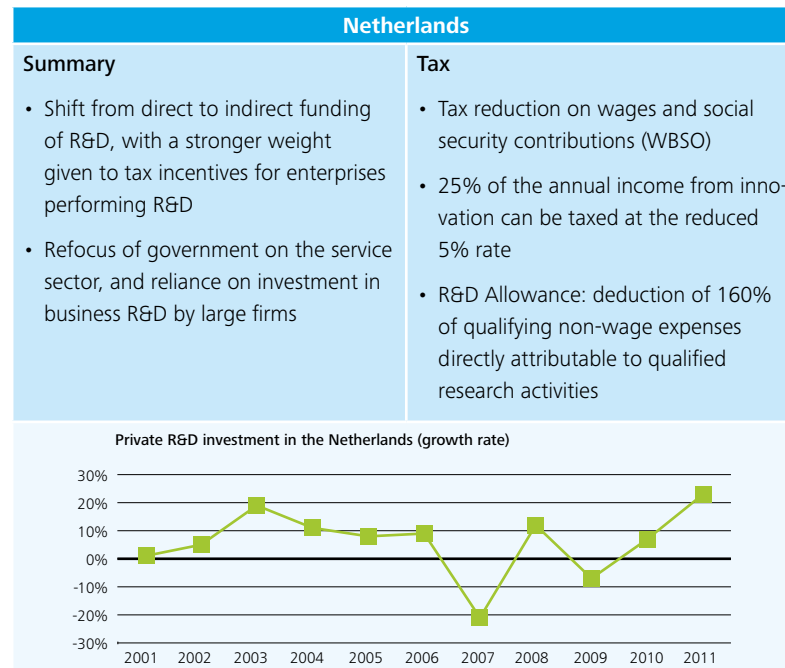
More than 85% of private health R&D investment in Europe is concentrated in the EU-5 countries (France, Germany, Italy, UK and Spain), Switzerland, Belgium, Denmark, the Netherlands, and Austria<sup>24</sup> (see **Figure 7**). These countries in general have offered incentives (such as tax breaks) to foster R&D investment (see Figures 8 and 9).

**Figure 7 - Private health-related R&D expenditure in selected EU countries (2000-2012; billion Euro)**



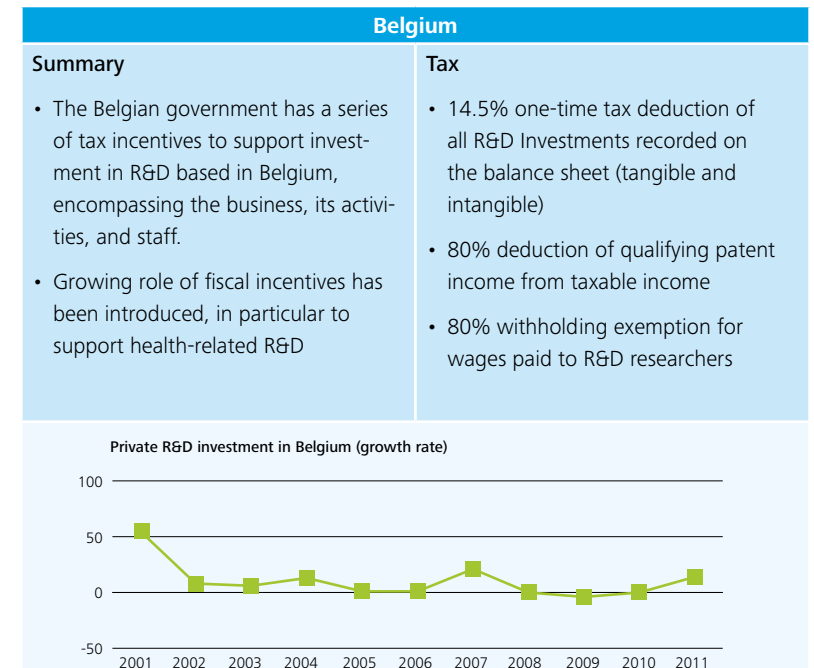
In line with the trends illustrated above, most of these countries are investing at similar or lower absolute levels than at the start of the financial crisis.<sup>25</sup>

Figure 8 – Private R&D investment and incentives in the Netherlands



Possible drivers of R&D location decisions, according to Belderbos et al.<sup>26</sup> are: industry agglomeration; the technological strength of regions at the industry level; R&D tax incentives; wage costs; and proximity to centres of academic excellence. Additionally, Eger and Mahlich<sup>27</sup> have investigated the deteriorating effect of regulation on firms' incentives to invest in R&D; they note the move of many R&D facilities from Europe to the US (e.g. Novartis), the reliance on the US market for drug/technology utilisation and now also for R&D output, and the flow of foreign investment towards areas with less strict price regulations.

Figure 9 – Private R&D investment and incentives in Belgium



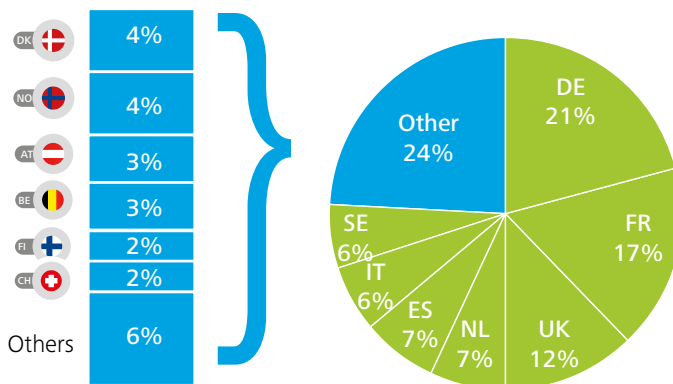
Another influential criterion, which will continue to play a strong role in R&D investment, is the extensive and different requirements across Europe that govern the conduct of clinical trials. Previously companies had to submit individual applications in each country in which a clinical trial was going to be set up; this was followed by an analysis of the trial dossier and requests for amendments by the country's ethics committee. Overall, the process had a high administrative burden and there was a low level of harmonisation for clinical trials across different countries. This resulted in a decrease in clinical research in Europe, with a 25% reduction in trials between

2007 and 2011 (from over 5,000 to 3,800 during the period).<sup>28</sup> The new clinical trials regulation, (that will replace Directive 2001/20/EC)<sup>29</sup>, came into effect in 2014 and will apply as of May 2016 at the earliest, will removed the need to submit a dossier in each country individually: now manufacturers and researchers will be able to submit one application via an EU portal and nominate one country as the 'Reporting Member State' (RMS) for the application. Although this will undoubtedly lead to a more streamlined process, there are areas where concerns and discrepancies across countries remain; for example, there is still a lack of harmonised quality standards across RMS Member States and the potential timeframe from submission to approval remains lengthy.<sup>30, 31</sup>

### Public health-related R&D spending

At national level, there are significant differences between European countries in their levels of health R&D spending. Overall, the EU-5 plus the Netherlands and Sweden account for more than 70% of total publicly-funded health R&D expenditures (see Figure 10)<sup>32</sup>.

Figure 10 – Public health-related R&D in Europe, share per country (2011)



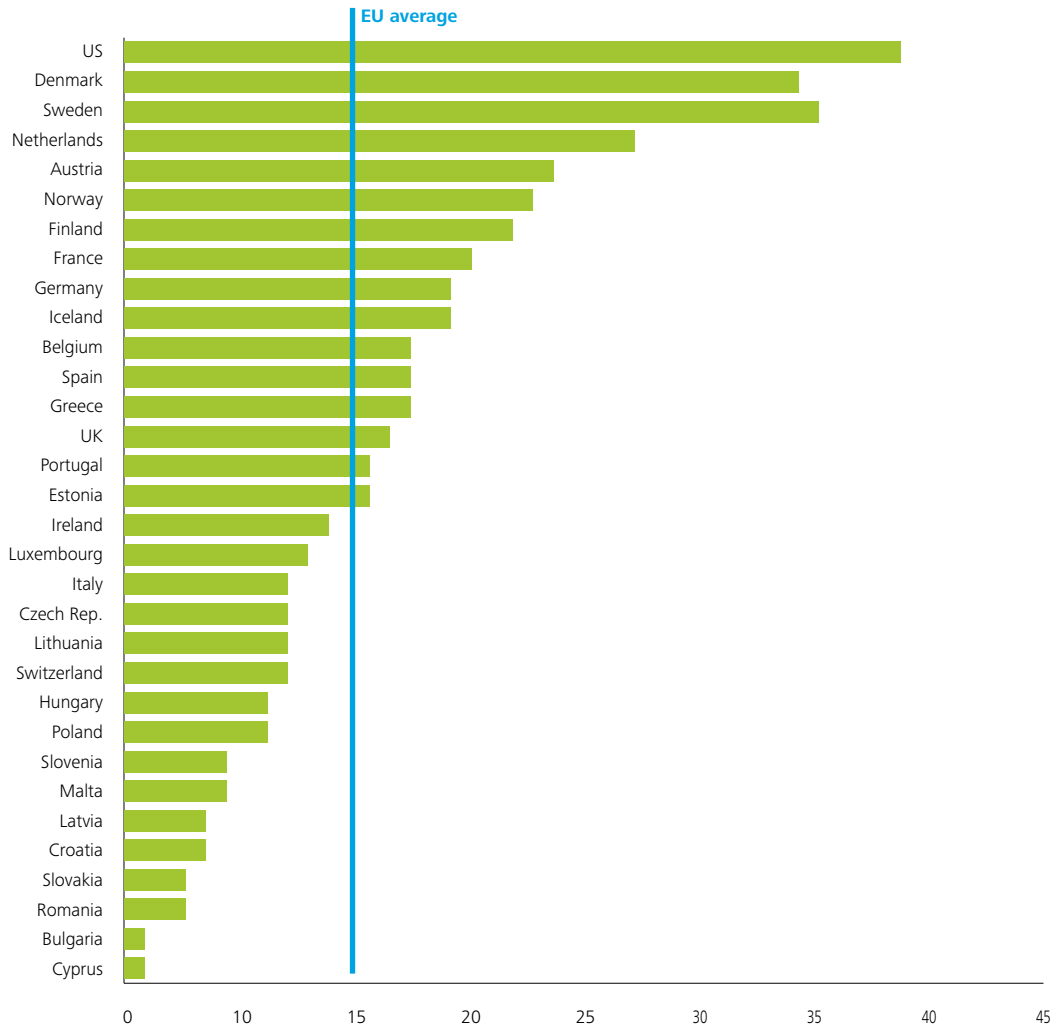
2008 data for: Switzerland and Luxemburg

As noted earlier, there is a significant gap between public spending on health R&D in Europe and the US. For instance, the average 2011 European national health-related R&D spending, at 0.14% of GDP, was considerably lower than the investment made in the US, which was 0.38%. As a percentage of GDP, the Nordic countries, Netherlands and Austria are the countries with the highest investment in Europe. Most Eastern European countries, but also Italy and Ireland, are investing proportionally less from public sources on health R&D than the EU average (see Figure 11).<sup>33</sup>

It is essential that public and private sectors collaborate to foster R&D, as this type of interaction fuels innovation. One of the most recent advances towards building a robust public private partnership (PPP) to support technology growth in bio-pharmaceuticals has been the launch of the Innovative Medicines Initiative (IMI), a joint undertaking between the EU and the pharmaceutical industry association EFPIA that aims to speed up the development of medicines through collaborative research projects.<sup>34</sup> PPPs generally have been important for drug development consortia, and are recommended by experts as a valuable framework for stakeholder collaboration. Although such initiatives will not solve all the current R&D investment issues, they could promote a more active dialogue on how to make funding and partnerships more efficient.

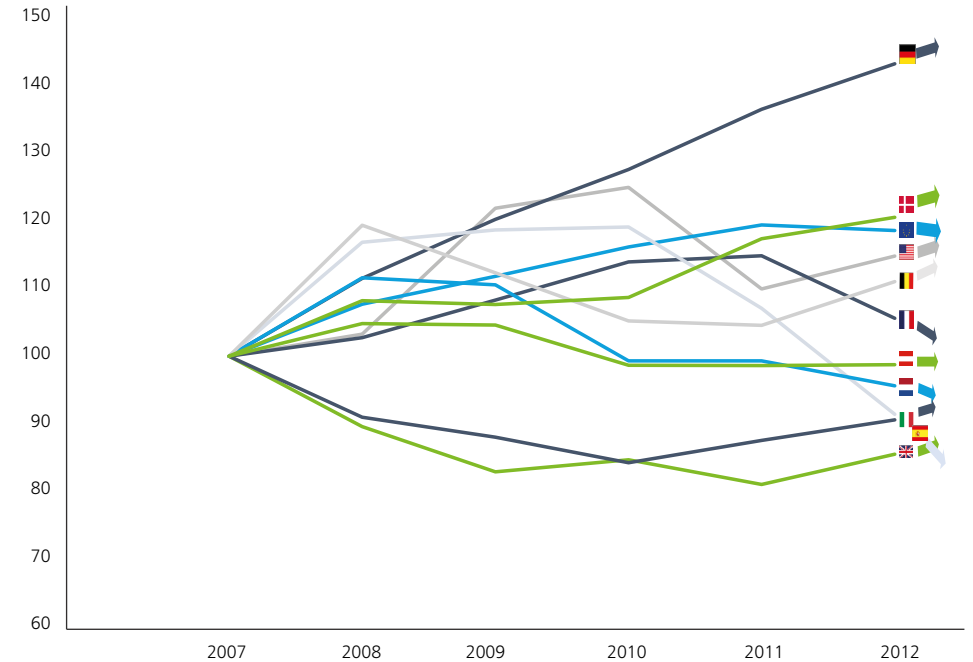
In summary, recent economic conditions in Europe have had a detrimental effect on private investments in R&D, and uncertainties about future market conditions might negatively influence current investment decisions. Public R&D is not likely to make up for this loss, as it is less than half the size of private R&D. Given the role of health R&D on healthcare and economies, it is crucial for governments to adopt policies that will encourage its growth and success, as well as providing adequate rewards for innovation (as argued in the 2013 version of this paper).<sup>35</sup>

Figure 11 – Public health-related R&D as a percentage of GDP (2011)



There are a number of factors influencing changes in public health-related R&D. These can include a change of government, national economic policy, and decisions on academic investment. Overall, it is therefore not always possible to identify the triggers for specific decreases in health R&D investment that lie behind the reported figures.

Figure 12 - Public health-related R&D growth in selected European countries (2007-2012; index)





# Chapter 2

## The impact of utilisation policies on health-related R&D investment



4234

87667

234

63456

96

88

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44

35

Since the start of the financial crisis in 2008, as part of their wider austerity measures governments have limited the rewards for new and innovative therapies. However, these stricter reimbursement and pricing decisions can compromise the potential for companies to re-invest in new R&D after a product reaches the market. In contrast, improvements in utilisation policies can foster R&D investment and attract talent to create the solutions needed to tackle pressing population health problems (e.g. hospital-acquired infections). This is because utilisation policies (such as pricing and reimbursement) are crucial to maintain the ability of biopharmaceutical companies to fund future investments in health-related R&D.

During the research for this paper, we compiled a selection of measures introduced by governments in different European countries that are putting stress on both the revenues and costs of biopharmaceutical companies:

- According to EFPIA, in five European countries alone (Greece, Ireland, Italy, Portugal and Spain), discounting and price cuts contributed to more than €7 billion of government savings in 2011. For example, in Portugal a payback system was introduced, whereby the pharmaceutical industry pays the amount of overspend if expenditure on prescription drugs exceeds the target of 1.25% of GDP. There were additional mandatory price cuts in 2012, such as the in the agreement between the Irish Pharmaceutical Healthcare Association (IPHA) and the Department of Health and the Health Service Executive in October 2012, which reviewed the prices of 400 patent protected drugs, cut by 70% the price of drugs within the first year of patent expiry, and by 60% the price of generic drugs.<sup>36</sup>
- International reference pricing systems (i.e. price control mechanisms whereby a government considers the price of a medicine in other countries in order to inform or establish the price in its own country) disregard the fundamentals of rewarding innovation and focus only on price reduction.

- Compulsory price cuts for molecules launched in disease areas with several available similar compounds can have a detrimental impact on R&D, for example when a 4th compound is launched in the market at the average price of the three other existing drugs for the same indication.

A recent study has shown that lower drug prices have a direct impact on R&D expenditure.<sup>37</sup> By using industry level data for the period between 1952 and 2001, the researchers calculated the impact that varying levels of reward for innovation have on the level of re-investment in R&D. The findings suggest that cutting drug prices by 40-50% in the US would lead to 30-60% fewer new R&D projects. Conversely, the study estimated that a 10% increase in prices would result in a 6% increase in R&D expenditure.

Tough negotiations on premium prices for branded drugs and the implementation of strict market access processes or prescribing restrictions – for example Germany’s 2011 introduction of the Act on Reform of the Market for Medicinal Products (Gesetz zur Neuordnung des Arzneimittelmarktes - AMNOG) – have had an impact on R&D, and may lead to a decrease in the availability of drugs for patients.<sup>38, 39</sup>

The investment in the development of targeted medicines and biomarkers, which aim to select patients who that should receive, or are most likely to respond (or not) to a certain treatment (e.g. the gene mutation anaplastic lymphoma kinase (ALK+) found in lung cancer cells), promotes a better use of medical and financial resources. Such technologies are resource intensive because they require not only the development of the compound, but also research to identify the correct biomarkers and the creation of diagnostic tests for patient selection. However, stringent pricing and uptake policies at national and regional levels can lead to restrictions or non-recommendations of these drugs for reimbursement, based on a judgement of lack of cost-effectiveness – even though they bring efficiency to health systems by only treating appropriate patients.

Regulatory and market access challenges effectively lead to a reduction in a drug’s market exclusivity period and hence to the volumes of sales while under patent protection. This has an important impact on the expected return on investment in

health R&D. In the US and Japan, market access automatically follows the granting of market authorisation for a biopharmaceutical product. In Europe this is the case in selected countries (e.g. Germany, the UK), but many others still have policies that hinder a straightforward transition between European Medicines Agency (EMA) or national medicines agencies' approval for drugs and market access – for instance through delays in the reimbursement decision process. Local experts confirm that some countries are postponing approval decisions for new innovative molecules to the maximum permitted time of 180 days (under the EU directive) in order to delay additional expenditures.<sup>40</sup>

The issue of utilisation is particularly noticeable in the case of 'orphan drugs'. Although there are incentives in place for innovative companies to develop treatments for rare diseases, there are severe restrictions in place that limit patients' access to these treatments (see Table 1). In brief, lack of appropriate utilisation policies jeopardises access to therapies, with patients resorting to compassionate use programmes, or legal action.

**Table 1 – Orphan drug reimbursement in England and Wales, and the Netherlands <sup>41</sup>**

Country	Drugs fully reimbursed	Drugs reimbursed with restrictions	Drugs not reimbursed
England and Wales	21	12	15
The Netherlands	79	22	13

Another example is the development of antibiotics, an area of high unmet need but limited private investment (the low prices of current therapies limits the chances of

return on investment).<sup>42</sup> In contrast, oncology is also an area with high unmet need but which has been a focus for innovation in recent decades (not only in terms of more effective treatments exploring targeted pathways, but also for personalised medicine). An analysis of data from biomedical consortia<sup>43</sup> showed that in recent years 42% of government groups and 34% of third-party/private groups were focused on oncology; of the total investment, 39% of research was on biomarker development.<sup>44</sup>

At the same time, most cost components driving the total expenditure on health R&D have been steadily increasing in price. These include:

- rises in input costs
- higher complexity of clinical trials
- extensive additional data requests (e.g. for post-approval and real world evidence data)
- reduced R&D productivity.




These factors, taken together, challenge the traditional approaches to investing in health R&D. In economic theory (and practice), investment rates are directly correlated with confidence in a potential investment area. With R&D only offering returns over the long-term, uncertainty around the potential prices governments are willing to pay for new medicines, combined with shifting regulatory requirements, serve to undermine companies' willingness to invest. As one industry specialist stated: "It is not the price decrease now that influences investments, it is the uncertainty around the price level in the future that is fatal". Specifically in the biopharmaceutical industry, where the top 20 companies account for almost 80% of total worldwide investments in biopharmaceutical private R&D, any policy change that has an impact on investment decisions by just one of these companies has an immediate and strong effect on the total health R&D investments in Europe.

Policy makers need to recognise that innovative technologies can only be developed if sufficient time and financial resources are invested. At the same time, in order for these discoveries to reach patients and affect disease management, they need to be commercialised. This can only happen if there are economically viable options for innovators. The return on investment achieved through improved utilisation policies helps to create a positive environment by providing the resources needed for R&D investment in new therapies and areas of unmet need.

It is the industries' opinion that there is potential to improve current utilisation practices by building further ties between innovation cycles and market access processes for innovative medical therapies. According to Adrian Thomas, VP Global Market Access at Janssen, both governments and industry need to be more aware of each other's challenges and work closer, in order to better address the current and future healthcare challenges within the stringent economic environment:

"A better share of understanding on what the industry is doing, and what government is doing is needed to build synergies to improve cost of care. Ultimately it is down to politicians to establish national strategies that are executed in the health system."



## Chapter 3

# Efficient stakeholder collaborations in health-related R&D

### The importance of close collaboration in health R&D

Over the past decade, close collaboration networks between industry and government bodies have been an important driver for biomedical research, with an increasing number of partnership projects. Mark Lim, a member of the scientific advisory board for the Quebec Consortium for Drug Discovery (CQDM), analysed this trend in Asia, North America and Europe. While in 2001 there were seven biomedical consortia launched across the three regions, in 2013 this number was 46 (it had peaked in 2012 at 63 biomedical consortia).<sup>45</sup> The rise in biomedical consortia has been particularly strong in Europe, a result of investments made through the European Union framework programs: between 2007 and 2013, 61% of all biomedical consortia projects in Europe was funded via the FP7 program.<sup>46</sup> According to Professor Isabelle Huys and Dr Hilde Stevens, who analysed key performance indicators of IMI funded initiatives, research carried out via consortia creates mutual benefits due to risk-sharing and efficiencies: "This type of partnership can make research more efficient as the need to work together to reach individual and common goals becomes evident."<sup>47</sup>

A main pillar of this principle is the steady and sustainable collaboration between different stakeholders. However, there can still be a number of issues to overcome, including:<sup>48</sup>

- Strict requirements to form a consortia
- Stakeholders operating under different operating models
- Assessing impact of responsibilities and defining rewards that come with the partnership.
- These issues are explored in greater detail below:

### Conditions that can compromise the project

The large number of stakeholders required to form a consortium (sometimes from a variety of countries and organisations) may present challenges for the project's management and outcomes, including on issues such as focus, quality, and efficiency. Consortia are formed because partners have a common project goal: something that is of interest to all the partners, but also relevant to each institution individually.

Although expectations and reasons for collaboration differ, synergies among members are important for building trust between consortium members, fulfilling the project's objectives, and fostering further partnerships and follow-up engagements among participant institutions.<sup>49,50</sup> Aware of the disadvantages of having too large a number of stakeholders in a consortium, the European Commission sets a minimum of 3 members for a consortium funded through the EU framework programmes.<sup>51</sup>

For optimum levels of efficiency to be achieved, clear project goals and stakeholder rewards have to be identified at the very beginning. It should be noted that consortia initiated with public funds can at times have to operate under strategic research plans influenced by governmental agencies. This may pose restrictions on the scope of the collaboration and have an impact on its success, if objectives and project outputs need to be re-focused to meet various requirements of sponsors. In Europe, there was government involvement in the research agenda of 58% of biomedical consortia initiated between 2007 and 2013; in contrast, government was involved in the research agenda of 24% of such projects in the US.<sup>52</sup>

### Stakeholders operating under different operating models

One of the main pillars of R&D research is the collaboration between industry and academia, but differences in operating models can undermine the chances of building synergies between these stakeholders: while industry follows its business model, academia has a more limited focus and less experience on the "business side" of R&D (i.e. how to take a technology profitably to market). Although academia has an important role in pre-clinical research, it looks for long-term commitments from the industry at a stage when future return on investment is still highly uncertain.

There are clear differences in the priorities of each stakeholder: while academic research is motivated by understanding the rationale behind the scientific objectives of a particular study, the industry is focused mainly on the applicability and transferability of the study's results to potential treatments.<sup>53</sup> One very important issue raised across different fields was the current grading system in academia, which values the volume of original publications by the author and institution. This creates barriers (even among project partners) as no data are shared until results

are published in peer-reviewed publications.<sup>54</sup> Professor K. C. Nicolaou from Rice University suggests these different operating models can be bridged by a few adaptations of the way academia and industry are used to working. He argues that dissemination of results should happen after the filing of a patent application, which does not compromise ownership of discovery but enables earlier sharing and usage of study data.<sup>45</sup>

#### Defining the rewards from partnerships

One of the most important aspects of partnership working, aside from the benefits of combining effort and expertise from different stakeholders, is being able to drive individual research that is generated from the consortium's output. Ownership of research – which can ultimately provide a financial reward – can advance the commercialisation of results and incentivise investment in innovation. One indicator of ownership of research is through intellectual property (IP) rights. When assessing the rate of invention through forward citation<sup>55</sup> (i.e. references to a particular patent by later patent filings), research sponsored by the National Institute for Health (NIH) in the US has a much higher rate of forward citation than other European institutes (an average of 7.9 per patent, against 1.3).<sup>56</sup> Appropriate ownership of innovation has been found to feed into further innovation and, based on this principle, some of the research collaborations assign direct ownership of the innovation to its creators. For example, research conducted by the Québec Consortium for Drug Discovery (CQDM) grants IP rights to both researchers and their institutions<sup>57</sup>.

In addition to IP rights, consortia with advantageous terms for licensing and commercialisation can fast track the use of innovation at patient level. The Center for Translational Molecular Medicine (CTMM) offers a discount to consortium partners interested in using research findings for commercial use.<sup>58</sup>

In cases where an exclusive/semi-exclusive license has not been negotiated, foreground IP<sup>59</sup> can be licensed to other interested stakeholders (with the resulting fees being directed to the academic institution and inventors responsible for the research). The invention can also be used by the academic institutions for their internal research, even if they decided not to take part in the application for IP protection.

#### Case study: Center for Translational Molecular Medicine (CTMM) stakeholder collaboration principles (IP)

Center for Translational Molecular Medicine	
The CTMM focuses on the development of molecular diagnostics and imaging technologies, especially in the translational aspects, with the aim of transferring outcomes from research to patient and commercial use. As a partnership between government, industry, and academia, it gives priority to members when patenting innovation and offers better terms for the commercialisation of research outputs	
<b>CTMM IP rules:</b> <ul style="list-style-type: none"> <li>• IP ownership stays with the inventor</li> <li>• Organisations pay a market rate for commercial use of innovation</li> <li>• Members of the project receive a discounted rate</li> <li>• There should be a balance between academia's need to publish and industry's need to protect IP</li> </ul>	<b>Steps from discovery to IP protection</b> <ul style="list-style-type: none"> <li>• CTMM project consortium members are made aware of invention and requested to declare interest towards IP and license</li> <li>• A licensee group is created with the interested parts, who commit to share the patent filing costs</li> <li>• Industry partners can use the invention for their R&amp;D up to Phase IIa (drugs) or prototype stage (medical device)</li> </ul>

## Case study – abiraterone <sup>60,61,62, 63</sup>

The development of abiraterone was initiated by the Institute of Cancer Research (ICR) in the UK, after having received a grant from the British Technology Group (BTG). The first abstract demonstrating efficacy of the molecule was published in 1994 in the Journal of Medicinal Chemistry.

After conducting pre-clinical studies, BTG licensed abiraterone to Boehringer-Ingelheim (BI), and a Phase I trial was initiated. At this point in the drug's development, the clinical research on prostate cancer was increasingly sceptical about methods of avoiding disease progression by blocking androgens, with particular concern being raised regarding blocking CYP17 (abiraterone's mode of action). Given these doubts and the potential for later molecule failure, BI returned the drug's licence to BTG.

Development of the molecule continued through Cougar Biotechnology and positive results were seen in the Phase I/II clinical trial. Acquisition of Cougar Biotechnology by Johnson & Johnson took the project further and eventually to its completion, through Phase III and the commercialisation stages.

The drug's development touched upon several issues that are relevant to health R&D, especially the need of multiple parties to collaborate to facilitate and foster innovation:

- The importance of establishing partnership: BTG, ICR, and J&J each played a key role in the development and commercialisation of abiraterone.
- The importance of funding for R&D: partnerships provide mechanisms, through milestone/royalty payments, for releasing funds that can go back into R&D.
- The need for partners to work exclusively on their areas of expertise: academic institutions and biotechnology players can focus on the development of the molecule and its proof of concept, with larger experienced companies utilising their capabilities and knowhow to conduct large clinical trials and deal with regulatory approval, drug production, distribution and market access.

### Focusing resources on research outputs, within stakeholder areas of expertise

It is usually a long time from early research of an innovative therapy to testing and commercialisation (and the financial returns delivered by successful market access). This lengthy process can lead to lack of focus, with some stakeholders trying to become involved in pre- and post-R&D areas in which they may have limited expertise. This type of challenge can be due to lack of experience, limited resources (not only financial, but also human capital) and conditions to invest in a product from development up to market access. It needs to be understood that stakeholders are embedded in different structures, each presenting opportunities to engage efficiently with the health-R&D process. In order to ensure that a collaboration is efficient (within any framework), it is key to consider the different profiles and incentives of the main stakeholders (industry, academia, biotech, government) involved in health-related R&D – and then encourage participants to focus on their particular areas of expertise.<sup>64</sup>

**Table 2 – Summary of health-related R&D expertises of academia, biotech, biopharmaceuticals, and government**

Academia	Address hypothesis through a holistic approach, identifying individual research questions
Biotech	Confirm/reject hypothesis through the development of molecules and early clinical stage testing
Biopharmaceuticals	Confirm clinical and commercial potential; work on the regulatory and market access requirements for drug launch
Government	Foster R&D as a pillar for improvements in population health via funding initiatives at transnational, national, regional, and local levels; and create an environment to incentivise investment in R&D, via public initiatives and utilisation policies

Academia's involvement in drug development is crucial for understanding disease and to determine the rationale behind a particular scientific mechanism and its impact. Academia is particularly important when an unmet need has been identified, and basic transformational research is needed. The biopharmaceutical companies are used to working on later stages of drug development, setting up larger clinical trials



and dealing with regulatory agencies (something for which partners in academia and research institutes have low experience and few resources). The higher costs of R&D for an innovative therapy are concentrated in the later stages of development, hence having big players with experience involved in regulatory and practical matters can ensure a drug is brought to market earlier and more efficiently.

Partnerships between pharmaceutical companies and biotech companies are equally important and mutually beneficial.<sup>65</sup> A biotech firm might be working on an asset that is ready for further testing (i.e. it has already been through the pre-clinical stages of development). This creates greater incentives for collaboration with biopharmaceutical companies as the risk of development failure of an asset is slightly lower. The biotechs can benefit greatly from such collaborations as licensing fees, development milestone payments, and royalties can contribute towards their long-term revenues – and guarantee research on the asset will not stop due to funding issues.

**At government level, there are many ways to create incentives to promote the R&D industry:**

- Taxation, tax credits and tax exemptions are some of the most direct ways to incentivise R&D. They can influence a company when it is choosing a location for its activities (e.g. setting up headquarters and plants) and in this way generate numerous economic benefits for the host country, including beyond the sphere of healthcare itself.<sup>66</sup>
- Government funded schemes are also one of the most important ways to advance research and promote stakeholder collaboration. The European Commission's Framework Programmes have injected several billions of euros into different scientific areas. Most recently, Horizon 2020 is investing €70 billion between 2014 and 2020 in seven research areas. The new programme has also addressed some of the criticisms from the previous FP6 and FP7 programmes regarding the high levels of bureaucracy for the stakeholders, and has set aside specific funds for investment in small-medium enterprises.

In summary, finding the right partners and balance for a fruitful collaboration is key to the success of any health R&D project. Within any framework of collaboration, it is important that partners understand each other's roles and responsibilities, and focus on their own areas of expertise. In addition, the efficiency of health R&D partnerships as they progress through the development of a new therapy can be greatly enhanced by having joint project governance structures in place to manage expectations, with full transparency and regular reviews so that any contentious issues can be resolved without compromising the quality of the research output.<sup>67</sup> The sharing of best practices (but also failures and learnings) can also greatly improve collaboration and enable faster discoveries by avoiding inefficiencies. This process starts with the sharing of anonymised patient data, to enable better understanding of the disease and therapies.

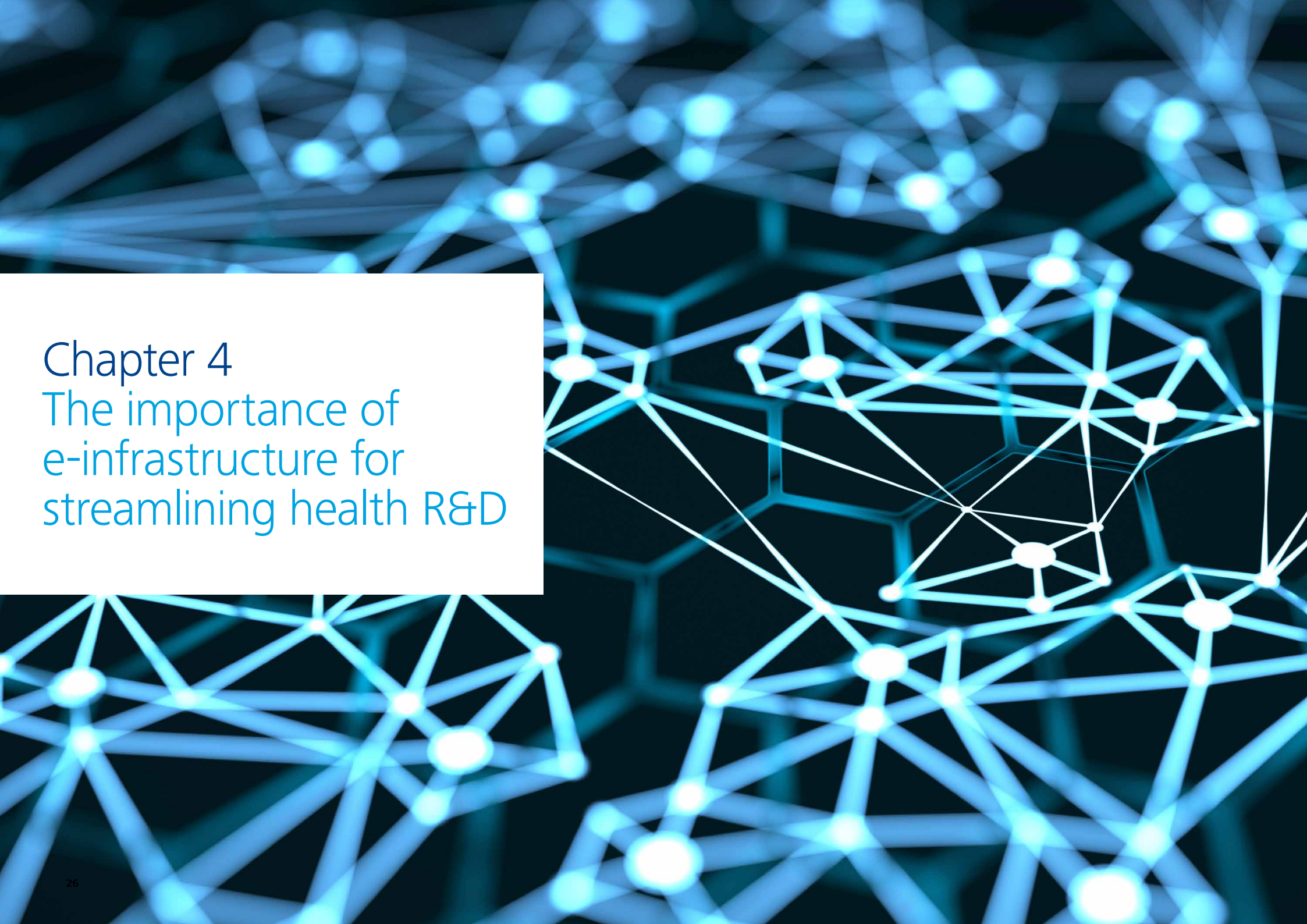
**Case study: The Johnson & Johnson Innovation Centre**

With four different locations in important world R&D hubs (Boston, California, London, and Shanghai), the Innovation Centre grants entrepreneurs, academics, and investors access to integrated teams of scientific and business experts from Johnson & Johnson. The centre aims to offer early stage support and build a bridge between innovators and pharmaceutical, medical devices, diagnostics and consumer companies.

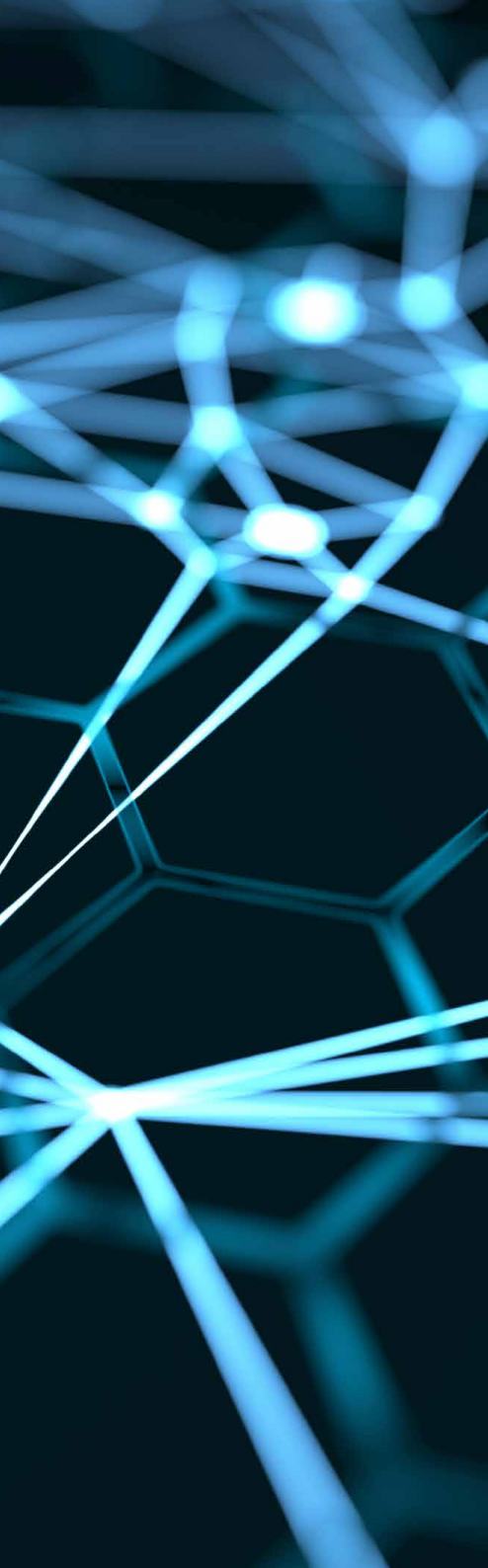
"Across our enterprise, and across the broad innovation ecosystem, we have significant opportunities to catalyse new science and technology. We do this by helping entrepreneurs realise their dreams of creating healthcare solutions that improve peoples' lives around the world. We work side-by-side with innovators throughout their journey, providing a robust exchange of ideas and resources to support their success." – Diego Morales (Global Head of Innovation for Johnson & Johnson)

J&J's expertise in the development and commercialisation of consumer and healthcare products gives weight to such collaborations, while innovators are incentivised to focus on their areas of expertise and further develop their ideas and business.

Source: J&J Innovation website. Accessed on 4<sup>th</sup> May 2015.



Chapter 4  
The importance of  
e-infrastructure for  
streamlining health R&D



In the last decade, there has been an increasing demand for the creation of common data-sharing platforms across the R&D sector to decrease research overlap, and improve standardisation of information and processes (enabling comparison). These measures can all help to promote efficiencies. The European Commission has been investing in improving interoperability of data across Europe since 2002 and funding projects to build the underlying data infrastructure through the EU Framework Programmes. One such project is BioMedBridges, which has the goal of developing shared e-infrastructure for biological, medical, translational, and clinical data across 10 emerging European research infrastructures on the ESFRI (European Strategy Forum for Research Infrastructures) roadmap.<sup>68</sup> Some of its consortium members include the Karolinska Institute, the University of Oxford, and the European Molecular Biology Laboratory (EMBL)<sup>69</sup>.

Stephanie Suhr, BioMedBridges Project Manager at the EMBL-European Bioinformatics Institute (EMBL-EBI), which coordinates the project, highlighted that there is a strong consensus among partners on the need to improve e-infrastructure in life sciences but challenges remain, especially related to cross border data-sharing: “In order to maximise the willingness and openness of organisations and institutions to collaborate on data interoperability it is important to raise the visibility of its direct, tangible benefits for the research community as well as the general public.”

Stakeholders involved in health-R&D have also started to tackle e-infrastructure issues collaboratively by linking government, academia and industry. The European Medical Information Framework (EMIF) aims to use existing patient data and structures to link these types of data through a Europe-wide platform to allow improved early stage research (e.g. proof of concept). The EMIF initiative includes the Electronic Health Records for Clinical Research (EHR4CR) (see box). However, although there are several such initiatives fostering e-infrastructure, a greater push – especially from a policy perspective – is needed to put the patient (through data) at the centre of health research, development, and collaboration.



### Case study: The European Medical Information Framework (EMIF)

Until recent times, the pharmaceutical industry only managed the evidence generated from its products. These days, data that are immediately outside industry influence have gained increasing importance. Such data (which include evidence substantiating the value and outcomes of pharmaceutical products, such as clinical, epidemiological and patient-reported data from primary, secondary/tertiary and academic settings) are becoming more critical to informing important processes, negotiations and research across multiple stakeholders within healthcare.

In response to this situation and other gaps in the identification, access and (re)use of health data, a number of Innovative Medicines Initiatives (IMI) were set up, such as the European Medical Information Framework (EMIF), the Electronic Health Records for Clinical Research (EHR4CR), as well as other initiatives. The objective is to build platforms, and more importantly foster collaboration across stakeholders who are data custodians and/or are interested in accessing data for research and development. The need to link disparate sources of health data (especially longitudinal anonymised patient data), while ensuring ways in which to link custodians and researchers, through managed and governed processes, is a critical imperative for future progress in healthcare.

To help improve access to patient-level data, in 2013 the European Medical Information Framework (EMIF) was launched via the IMI to develop a common technology and governance platform, initially for two disease areas: Alzheimer's disease and metabolic disorders (e.g. diabetes mellitus, obesity). The EMIF-Platform incorporates federated tools for identification, access and (re)use of health data, ultimately working towards a sustainable model for research within the EU.

Within the framework, the EHR4CR is linking hospital electronic health records to support clinical research and clinical trial execution, reducing the current bottlenecks and speeding up outcomes, but also aiming to reduce costs. These and other initiatives are supported at the EU level, but also by EFPIA as well as academic and clinical stakeholders, as there is a common belief that investments in technology, human capital and knowledge will improve future healthcare and life science outcomes.

Source: EMIF website (accessed on 5th May 2015), and correspondence with staff from the member companies

A compelling example of the importance and benefits of investing in e-infrastructure is the protein database UniProt, where the stated mission is to provide the scientific community with a comprehensive, high quality and freely accessible resource of protein sequence and functional information.<sup>70</sup> The database has existed for more than 20 years and is a collaboration between EMBL-EBI, the Swiss Institute of Bioinformatics (SIB), and the Protein Information Resource (PIR). One of the most important enablers of UniProt was the continuous funding received since its conception, not only for setting up the required infrastructure and for collecting data collaboratively, but also to analyse and maintain the information collected. The SIB group leader, Ioannis Xenarios, explains the importance of having uninterrupted funding: “People tend to create and collect data rather than analyse it, as the latter is more resource intensive. Having long-term funds enables UniProt to establish certain standards and continuously update and improve the database, as we can count on approximately 100 full time employees. Any project that provides a service to the scientific community has to go for a long time.”

In this regard, data usability and traceability needs to be assured in order to make data sharing useful. This can be achieved by making the cross-implementation of data collection standards part of research responsibilities.<sup>71</sup> With different data resources being maintained by different institutions, ensuring systems are interoperable (in a secure environment) can facilitate innovation and discovery. Stephanie Suhr comments: “To be able to use data from different resources, a researcher first of all has to know it is there, have access to the data, and know how to use the data. If it is sensitive data, he/she will also need to be authorised to use this data. Overcoming these hurdles is a challenge for a large number of researchers and projects and is best addressed systematically by providing suitable data infrastructures.”

Improvement of e-infrastructures for data exchange can facilitate innovation because it helps to optimise the whole research process. It is also important to introduce better data practices within R&D, such as complete data and model annotations, and common frameworks for data collection that are relevant throughout the R&D process. Taken together these measures can streamline research via data-sharing, thereby supporting more innovative discoveries in health R&D.<sup>61</sup>

As outlined earlier, broader initiatives on e-infrastructures have started at the European level but a combined cross-sector effort is now needed, given the research and healthcare discoveries that could result from improved data interoperability between institutions. We need to foster data sharing as a tool to promote better care. This requires further discussion by all stakeholders involved in healthcare research, as it is an issue that goes beyond just the actual personal and commercial information. The potential for information sharing to accelerate health-related scientific discoveries can ultimately benefit us all.



Chapter 5  
Conclusion



The current level of R&D investment in Europe leaves a lot to be desired. Although announcements made by policy makers regularly underline the importance of innovation in healthcare, the various components necessary to achieve that outcome are currently not in place.

It is two years since we published our first report on European health R&D but many of the issues identified then still need to be addressed and resolved. As concluded in the 2013 paper, in order to maximise the full benefits of health R&D and to avoid declines of slower growth in health R&D investment:<sup>72</sup>

- Governments need to reward new technologies adequately and transparently through appropriate reimbursement systems, allowing for fast and broad market access in line with the European approval process.
- Governments can have a direct impact on healthcare by investing public funds in health R&D and/or by creating explicit incentives for private health R&D; such measures can include increased contributions to programmes such as the FP7 and direct tax incentives.
- The future willingness to pay for innovation should already be reflected in transparent and predictable policy decisions, to allow for long-term investment decisions.

A successful cycle of R&D and innovation is achieved when patients have access to new therapies and innovators have been appropriately rewarded for their discoveries. When evaluating the costs and benefits of new products, policy makers tend to underestimate the high level of investment and uncertainty that exists throughout the R&D process (for all collaborators involved: from conception to market authorisation). A better shared understanding among stakeholders on how to make health R&D more efficient could lead to more discoveries and improved healthcare provision – the latter being the ultimate goal across academia, biotech, biopharmaceuticals, and government.

Additional measures also need to be in place to create an environment for successful innovation. In this study, we have drawn attention to two specific matters: creating synergies through formally structured and mutually beneficial consortiums/

collaboration networks; and developing better platforms for electronic data sharing. There have been examples of successful research collaborations established in Europe in the past; however, there are still ways in which such partnerships could be encouraged further. Similarly, the recent European focus on the more widespread use of healthcare data via interconnected European networks is expected to have a positive impact on the levels of innovation in Europe; but here too there is more to be done to maximise the full potential of e-technologies in R&D.

As outlined in our previous report on health R&D in Europe<sup>67</sup>, spending on healthcare will continue to increase globally over the coming decades. This should be welcomed. Healthcare spending improves the wellbeing of populations as a whole and has a positive impact on economies and society. The key issue to tackle is how we ensure that policies designed to constrain short-term costs and limit demand do not also lead to damaging uncertainty in the healthcare field, as is currently the case. Such uncertainty makes it much harder for researchers, investors and life science companies to take the mid- to long-term decisions necessary to achieve success in the decades-long course of developing new treatments. Without a steady policy environment, combined with incentives to generate and deploy innovative therapies, we run the risk of unavoidably spending more on healthcare yet still failing to secure optimal levels of health and wellbeing for Europe's population.

# Endnotes

- 1 Smith SD. 'The impact of technological change on healthcare costs spending: An evaluation of the Literature'. Health Care Financing Administration Health Care Financing Administration. 2000
- 2 Willemé P, Dumont M. 'Machines that go 'ping': medical technology and health expenditures in OECD countries'. Federal Planning Bureau. Working Paper 2-13. 2013
- 3 Newhouse JP. Medical Care Costs: How Much Welfare Loss?. *The Journal of Economic Perspectives*, vol. 6, no. 3, 1992, pp. 3-21;
- 4 Lichtenberg FR, Frank R. 'The Impact of Biomedical Innovation on Longevity and Health'. 2012.
- 5 Lichtenberg FR. 'The impact of new drug launches on longevity: evidence from longitudinal disease-level data from 52 countries, 1982-2001'. *International Journal of Healthcare Finance and Economics* 5, 2005, 47-73
- 6 Health Economics Research Group, Office of Health Economics, RAND Europe. 'Medical Research: What's it worth? Estimating the economic benefits from medical research in the UK'. London, UK Evaluation Forum; 2008
- 7 OECD. 'Trends in Retirement and in Working at OlderAges', in *Pensions at a Glance 2011: Retirement-income Systems in OECD and G20 Countries*, OECD Publishing. 2011 [http://dx.doi.org/10.1787/pension\\_glance-2011-6-en](http://dx.doi.org/10.1787/pension_glance-2011-6-en)
- 8 See note 6.
- 9 European Commission – EU R&D Scorecard. Companies whose ultimate parent has its registered office in a Member State of the EU.
- 10 European Commission Horizon 2020 website. Available at: <http://ec.europa.eu/programmes/horizon2020/en/>. Accessed on 14th Sep 2014.
- 11 Excerpt of speech from the EU Commissioner Maire Geoghegan-Quinn on the 'Healthy Brain: Healthy Europe' conference in Dublin, June 2013. Available at <http://horizon2020projects.com/sc-health-interviews/healthy-brain-healthy-europe/>. Accessed on 14th Sep 2014.
- 12 See note 6.
- 13 We define health R&D as any public and private investment (in capital and/or in kind) on research and development related to healthcare, biopharmaceuticals and medical devices.
- 14 EFPIA; Eurostat GERD; European Commission; WHO National health account database)
- 15 European Federation of Pharmaceutical Industries Association. *The pharmaceutical industry in numbers*. 2014. Available at: [http://www.efpia.eu/uploads/Figures\\_2014\\_Final.pdf](http://www.efpia.eu/uploads/Figures_2014_Final.pdf). Accessed: 10 September 2014.
- 16 Eucomed. No systematic link between medtech innovation and increase in healthcare expenditure. 2013. [press release] 11 June 2013
- 17 Data from the most recent framework program 'Horizon2020' is not part of the analysis as overall data is only available up to 2012.
- 18 See note 14.
- 19 EFPIA; Eurostat GERD; European Commission; Local Sources for UK and France (Public R&D)
- 20 Please see annex for an explanation about the GBAORD data
- 21 Eurostat. Government budget appropriations or outlays for research and development (GBAORD). Available at: [http://epp.eurostat.ec.europa.eu/statistics\\_explained/index.php/Glossary:Government\\_budget\\_appropriations\\_or\\_outlays\\_for\\_research\\_and\\_development\\_%28GBAORD%29](http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Glossary:Government_budget_appropriations_or_outlays_for_research_and_development_%28GBAORD%29). Accessed: 29 August 2013
- 22 European Federation of Pharmaceutical Industries Association. *The pharmaceutical industry in numbers*. 2014. Available at: [http://www.efpia.eu/uploads/Figures\\_2014\\_Final.pdf](http://www.efpia.eu/uploads/Figures_2014_Final.pdf). Accessed: 10 September 2014.
- 23 Research America. 2008 Investment in U.S. Health Research. Available at: <http://www.researchamerica.org/uploads/healthdollar08.pdf>. Accessed: 10 September 2014
- 24 European Federation of Pharmaceutical Industries Association. *The pharmaceutical industry in numbers*. 2014. Available at: [http://www.efpia.eu/uploads/Figures\\_2014\\_Final.pdf](http://www.efpia.eu/uploads/Figures_2014_Final.pdf). Accessed: 10 September 2014.
- 25 EFPIA. Data made available in 2014.
- 26 Belderbos R, Van Roy V, Leten B, Thijs B. 2014, "Academic research strengths and multinational firms' foreign R&D location decisions: evidence from R&D investments in European regions" *Environment and Planning A* 46(4) 920 – 942
- 27 Eger and Mahlich: Pharmaceutical regulation in Europe and its impact on corporate R&D. *Health Economics Review* 2014 4:23.
- 28 European Commission. "Fostering EU's attractiveness in clinical research: Commission proposes to revamp rules on trials with medicines". Press release 17th Jul 2012, MEMO/12/566.
- 29 Regulation (EU) No 536/2014 of the European Parliament and of the Council of 16 April 2014 on clinical trials on medicinal products for human use, and repealing Directive 2001/20/EC.
- 30 Westra A, Bos W, Cohen, A. "New EU clinical trials regulation". *BMJ* 2014;348:g3710.
- 31 Deloitte Health Economics group. "High value, high uncertainty: Measuring risk in biopharmaceutical research and other industries Investing in the future of health. Commissioned by Janssen Pharmaceutica N.V., 2014.
- 32 Eurostat GERD. Data made available in 2014.
- 33 Eurostat GERD. Data made available in 2014.
- 34 See <http://www.imi.europa.eu/>.
- 35 Deloitte Health Economics group's. 'Investing in European health R&D - A pathway to sustained innovation and stronger economies', c. Commissioned by Janssen Pharmaceutica N.V., 2013
- 36 Framework agreement between the Irish Pharmaceutical Healthcare Association LTD and the Department of Health and the Health Service Executive on the supply terms, conditions and prices of medicines. IPHA 2012.
- 37 *The World Financial Review*. 'International variation of drug prices can increase social welfare in the long run'. n.d. 2011. Available at: [www.worldfinancialreview.com/?p=791](http://www.worldfinancialreview.com/?p=791).
- 38 Dingerman, T. 'Das Arzneimittelmarktneuordnungsgesetz (AMNOG) und seine Folgen'. *Der Internist*, June 2013, Volume 54, Issue 6, pp 769-774.
- 39 Fernando, S. 'Orphan drug R&D and pricing approach unsustainable for industry survival'. *Financial Times online*, 22nd Nov 2013. Accessed on 10th Sep 2014.
- 40 Interview with Professor Koen Debackere, Managing Director of Leuven University conducted in July 2013.
- 41 Cohen, J, Felix, A. 'Are payers treating orphan drugs differently?'. Tufts Center for the Study of Drug Development. *Journal of Market Access & Health Policy* 2014, 2: 23513.
- 42 Pidock, L. 'The crisis of no antibiotics – what is the way forward?'. *Lancet Infect Dis* 2012; 12: 249–53
- 43 Analysis based on 369 biomedical research consortia and its growth worldwide.
- 44 Lim, M. 'Consortium sandbox: building and sharing resources'. *Science translational medicine*, Vol 6 issue 242, 25th Jun 2014
- 45 See note 6
- 46 See note 6
- 47 Stevens, H., Van Overwalle, G., Van Looy, B., Huys, I. "Perspectives and opportunities for precompetitive public-private partnerships". *Biotechnology Law Report*, 32 (3), 131-139, 2013.
- 48 Mittleman, B; Neil, G; and Cutcher-Gershenfeld, J. 'Precompetitive consortia in biomedicine—how are we doing?'. *Nature biotechnology*, vol 31 number 11, Nov 2013.
- 49 See note 47
- 50 Interviews conducted with key opinion leaders and academics between May and July 2014.
- 51 European Union Directorate-General for Research and Innovation. "Horizon 2020 in brief – The EU framework programme for research and innovation". Publications Office of the European Union, 2014.
- 52 See note 6
- 53 Larkin, M. 'Building successful partnerships between academia and industry'. Elsevierconnect, Research and commercialization. Available at [www.elsevier.com/connect/building-successful-partnerships-between-academia-and-industry](http://www.elsevier.com/connect/building-successful-partnerships-between-academia-and-industry). Accessed on 11th Sep 2014.
- 54 Nicolaou, K. 'Academic-Industrial Partnerships in Drug Discovery and Development'. *Angew. Chem. Int. Ed.* 2014, 53, 4730 – 4731.
- 55 According to Kalutkiewicz, M., and Ehman, R (2014): "Forward citations are references to a particular patent by later patent filings and are useful for identifying whether a particular patent was integral to subsequent technological development in a field. Multiple forward patent citations are indicators of impact in the private sector; each incremental patent citation represents millions of dollars of additional private sector R&D, while substantially increasing the market value of a controlling company."
- 56 Kalutkiewicz, M., and Ehman, R. 'Patents as proxies: NIH hubs of innovation'. *Nature Biotechnology* 32, 536–537, 2014.
- 57 Québec Consortium for Drug Discovery. 'Programs and competitions'. Information available at <http://www.cqdm.org/en/programs-and-competitions/overview.php>. Accessed on 14th Sep 2014.
- 58 Center for Translational Molecular Medicine. 'Intellectual property'. Information available at [http://www.ctmm.nl/en/programmas/infrastructuren/intellectuel-eigendom-en?set\\_language=en](http://www.ctmm.nl/en/programmas/infrastructuren/intellectuel-eigendom-en?set_language=en). Accessed on 14th Sep 2014.
- 59 Foreground IP is the intellectual property generated during the course of a research project. Ref: Imperial College London. 'Research support glossary'. Available at: <http://www3.imperial.ac.uk/researchsupport/glossary>.
- 60 The Institute of Cancer Research. 'Abiraterone: a story of scientific innovation and commercial partnership'. 11th May 2014. Available at <http://www.icr.ac.uk/news-features/latest-features/abiraterone-a-story-of-scientific-innovation-and-commercial-partnership>. Accessed on 11th Sep 2014.
- 61 Information available at the BTG's website <http://www.btgplc.com>. Accessed on 11th Sep 2014.
- 62 Scowcroft, H. 'Where did abiraterone come from?'. *Cancer Research UK, Science blog*, 21st Sep 2014. Available at <http://scienceblog.cancerresearchuk.org/2011/09/21/where-did-abiraterone-come-from>. Accessed on 11th Sep 2014.
- 63 National Institute for Health and Care Excellence. 'Guide for commissioners on end of life care for adults'. Available at <http://www.nice.org.uk/guidance/cmg42/chapter/1-commissioning-services-for-end-of-life-care-for-adults#12-defining-end-of-life>. Accessed on 11th Sep 2014.
- 64 Interviews conducted with key opinion leaders and academics between May and July 2014.
- 65 Kim, H. 'Formulation of a success model in pharmaceutical R&D: efficient innovation model'. *SAGE Open January - March 2014*, 1-9
- 66 Rao, A. 'R&D Tax Credits - A Tool to Advance Global Health Technologies?'. Center for Global Health R&D Policy Assessment. Results for development institute, 2011.
- 67 Interviews conducted with key opinion leaders and academics between May and July 2014.
- 68 "The ESFRI Roadmap identifies new Research Infrastructures (RI) of pan-European interest corresponding to the long-term needs of the European research communities, covering all scientific areas, regardless of possible location". – from the European Commission Research and Infrastructure webpage, available at [http://ec.europa.eu/research/infrastructures/index\\_en.cfm?pg=esfri-roadmap](http://ec.europa.eu/research/infrastructures/index_en.cfm?pg=esfri-roadmap). Accessed on 14th Sep 2014.
- 69 BioMedBridges website: [www.biomedbridges.eu/](http://www.biomedbridges.eu/). Accessed on 14th Sep 2014.
- 70 UniProt website: [www.uniprot.org/](http://www.uniprot.org/). Accessed on 14th Sep 2014.
- 71 Marti-Solano, M. et al. 'Integrative knowledge management to enhance pharmaceutical R&D'. *Nature reviews, Drug discovery*, Volume 13, Apr 2014.
- 72 Deloitte Health Economics group. 'Investing in European health R&D - A pathway to sustained innovation and stronger economies'. Commissioned by Janssen Pharmaceutica N.V., 2013.



# Annex

## **Private R&D spending – Source: European Federation of Pharmaceutical Industries and Associations (EFPIA)**

- The data on private health-related R&D were extracted from information held by the European Federation of Pharmaceutical Industries and Associations, the body that represents the pharmaceutical industry in Europe. The data were collected by EFPIA's 33 national member associations and relate to the R&D carried out by pharmaceutical companies in each country.

## **Public R&D spending – Source: Eurostat**

- Gross Domestic Expenditure on R&D (GERD): GERD statistics contain the R&D spending by country as reported by different sectors. It is divided into four sectors of activity (business enterprise, government, higher education and private/non-profit institutes) and by field of science. This source was mainly used to calculate the growth of public health-related R&D (medical sciences) spending; therefore, only the government and higher education sectors' data were used.
- Government Budget Appropriations or Outlays on R&D (GBAORD): the GBAORD is classified using the Nomenclature for the Analysis and Comparison of Scientific Programmes and Budgets (NABS). This classification includes the funding allocated to health, which comes from different funders: government, general university funds (GUF) and other sources. The government contributes directly through R&D contracts and specific grants. GUF include own funds from universities such as income from endowments, shareholdings and property, as well as receipts from the sale of non-R&D services such as fees from students, subscriptions to journals and other sources of income. GUF can also include general grants received from the Ministry of Health or from provincial or local authorities. Finally, 'other sources' represent all other funding streams apart from the government and university funds. It is important to mention that, although the classification sounds straightforward, the way funds are allocated and categorised depends on the individual methodologies employed in each country.
  - o Differences between GBAORD and GERD: according to the Frascati Manual, GBAORD and GERD differ mainly in three aspects.
    1. The reporting unit of GERD is formed by R&D performers, whereas GBAORD reporting unit is formed by funders.
    2. GERD covers only R&D performed on national territory, whilst GBAORD includes payments to foreign performers, including international organisations.

3. Government-financed GERD include R&D financed by central (or federal), provincial (or state) and local government, whereas GBAORD excludes local government and sometimes provincial government.
- Public R&D sources used in this report: the main source for Public Health-related R&D spending in this report is the Eurostat GERD complemented with local sources for France (DREES) and the UK (BIS) due to missing observations for these countries. The main drivers to use GERD instead of GBAORD is that it (1) includes R&D financed by federal, provincial and local government, whereas GBAORD only includes federal investments, and (2) includes investments from the higher education sector with a higher degree of completeness than GBAORD.

## **NABS**

- The Nomenclature for the Analysis and Comparison of Scientific Programmes and Budgets (NABS) is mainly used for government budget appropriations or outlays on R&D (GBAORD) and R&D statistics at a national and international level. This classification, developed and maintained by Eurostat and linked to the Frascati Manual (OECD), breaks down annual spending according to socio-economic objectives. In its last revision (2007), Eurostat improved and updated chapters according to user requirements, improved data availability at the country level and aligned its content with the Revised Field of Science and Technology Classification (FOS), the Classification of the Functions of Government (COFOG), Essential Public Health Functions (EPHF) and the Statistical Classification of Economic Activities in the European Community (NACE).

## **The Frascati Manual**

- The Frascati Manual, developed by the OECD, sets the international methodology for definitions of basic concepts, collection guidelines, and classification for compiling R&D statistics. It is considered the standard for R&D surveys, having become essential for statistical systems not only for OECD members, but for other countries as well.

## Figures

- **Figure 3** – The data of the ‘R&D distribution and intensity in Europe by sector’ is derived from the European Commission, R&D Scoreboard (2012). 1000 top R&D investing companies based in the EU were considered.
  - R&D investment in the Scoreboard is the cash investment funded by the companies themselves. It is expressed as the R&D investments as the percentage of turnover. It excludes the R&D undertaken under contract for customers such as governments, but also companies’ share of any associated company or joint venture related to R&D investment.

R&D intensity is the ratio between R&D investment and net sales of a given company or group of companies. At the aggregate level, R&D intensity is calculated only for those companies for which data exist for both R&D and net sales in the specified year. The calculation of R&D intensity in the Scoreboard is different from official statistics (e.g. BERD), where R&D intensity is based on value added instead of net sales.
- **Figure 4** – We have reviewed three main sources of investments in health R&D: private R&D from the biopharmaceutical industry; public health R&D at country level; and the European Framework Programmes. In absolute terms, total health R&D spending in Europe is mainly driven by private sector funds: at a total of €29 billion, investments from pharmaceutical companies accounted for almost two thirds of total R&D investments in 2012. This does not include another €8 billion invested by the medical device industry. The remainder comes primarily from public R&D at the national level (GERD Eurostat data from 2011), plus a relatively small contribution at European level, more recently through the EU’s Seventh Framework Programme for Research and Technological Development (FP7).
- **Figure 5** – The private R&D expenditures is derived from ‘The pharmaceutical Industry in numbers’ EFPIA reports. The figures relate to the R&D carried out in 2012 for each country. For Austria, Croatia, Finland, France, Greece, Ireland, the Netherlands, Portugal, and Slovenia data was only available up to 2011, Czech Republic up to 2009 and Cyprus up to 2007.

The public R&D expenditures were retrieved from the GERD data of Eurostat. For the public R&D spending for the UK and France we used local sources, as data was not available on Eurostat. Note also that the Public R&D spending for Luxemburg and Switzerland are from 2008.

- **Figure 6** – For the EU private and public R&D spending we used data from the EFPIA and EUROSTAT respectively, as described previously, whereas for the US private and public R&D spending we used PhRMA Annual Survey, 2014 (PhRMA members only) and Research America (Investment in US) respectively.
- **Figure 7** – The private R&D expenditures derived from ‘The pharmaceutical Industry in numbers’ EFPIA reports. Data for the majority of countries was available up to 2012, except for Austria, France, Ireland, and The Netherlands, where data was available only up to 2011.
- **Figure 10** – We have calculated the share in public health-related R&D per country by means of public R&D expenditures – retrieved from the GERD, Eurostat. For the public R&D spending for the UK and France we have used local sources, as data was not available on Eurostat. Note also that the data for Switzerland and Luxemburg are from 2008.
- **Figure 11** – The health-related public R&D as a percentage of GDP was retrieved from the Eurostat. For Switzerland and Luxemburg only data up to 2008 was available.
- **Figure 12** – **Figure 12** shows the public health-related R&D expenditure growth over time. The index was calculated by use of the GERD, Eurostat (with data up to 2011). For France and the UK we have used national sources (UK: Department of Business, Innovation & Skills (BIS); France: Directorate for Research, Studies, Evaluation and Statistics, (DREES)), as data was not available on Eurostat. The 2012 growth was estimated using GBAORD data from Eurostat.

# Table of abbreviations

ARRA	American Recovery and Reinvestment Act	GDP	Gross Domestic Product
BTG	British Technology Group	GERD	Gross Expenditures on Research and Development
CQDM	Consortium for Drug Discovery	ICR	Institute of Cancer Research
CTMM	Center for Translational Molecular Medicine	IMI	Innovative Medicines Initiative
EBI	European Bioinformatics Institute	IP	Intellectual Property
EFPIA	European Federation of Pharmaceutical Industries and Associations	IPHA	Irish Pharmaceutical Healthcare Association
EHR4CR	Electronic Health Records for Clinical Research	J&J	Johnson & Johnson
EMA	European Medicines Agency	NIH	National Institute for Health
EMBL	European Molecular Biology Laboratory	OECD	Organisation for Economic Co-operation and Development
EMIF	European Medical Information Framework	PIR	Protein Information Resource
ERC	European Research Council	PPP	Public Private Partnership
EU	European Union	R&D	Research and Development
FP6	Sixth Framework Programme	RMS	Reporting Member State
FP7	Seventh Framework Programme	SIB	Swiss Institute of Bioinformatics
GBAORD	Government Budget and Appropriations or Outlays for Research and Development		

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