THE £1 BILLION CONTRIBUTION BY MEDICAL RESEARCH CHARITIES

WORKING TOGETHER
THE IMPACT OF MEDICAL RESEARCH INVESTMENT ON THE HEALTH AND WEALTH OF THE NATION
WORKING TOGETHER: THE IMPACT OF GOVERNMENT MEDICAL RESEARCH SPENDING ON THE HEALTH AND WEALTH OF THE NATION

MAY 2013

CONTENTS

Executive Summary 2
Sources of public funding for medical research 4
Chapter 1: Income generation and cost efficiencies for UK PLC 5
Chapter 2: Interdependency of funders 8
Chapter 3: Leveraging investment 12
Chapter 4: The standing of the UK globally 16
Chapter 5: Continuous improvements in healthcare 19
Conclusion 21

This report was written by Jennifer Boon and Daniel Bridge with input from Cancer Research UK staff and funded researchers. For more information please contact jennifer.boon@cancer.org.uk or daniel.bridge@cancer.org.uk 0203 469 8523
EXECUTIVE SUMMARY

Cancer Research UK spends over £300 million each year funding medical research in the UK. We do this because research is the only way to save more lives by pioneering new ways to prevent, control and cure cancer. Cancer Research UK receives no Government funding for our research, and our work to bring forward the day when all cancers are cured is made possible due to the overwhelming generosity of the public.

Cancer Research UK is not alone; medical research charities throughout the UK all channel their funding through research to push forward knowledge and understanding of disease. Members of the Association of Medical Research Charities play a pivotal role in the medical research landscape of the UK, spending over £1 billion each year.

Funding for medical research is essential for a healthy nation and a healthy economy. Medical research in the UK not only leads to improvements in health that benefit millions, but also generates significant wealth and investment. Our work does not take place in isolation. Medical research in the UK benefits from a unique combination of stakeholders. The mixture of support from Government, charity and industry partners, university research laboratories, and a National Health Service, provides the breadth and diversity that are crucial to tackling existing and future healthcare challenges.

This report provides striking evidence that research infrastructure and funding from Government is key to providing the foundations on which the rest of the medical research sector is built. Through our extensive experience of funding cancer research in the UK we demonstrate the impact of medical research on the health and wealth of the nation. Specifically, we show how Government investment in medical research contributes to:

Chapter 1. Income generation and cost efficiencies for UK PLC
Chapter 2. Allowing interdependency between funders to take place
Chapter 3. Leveraging investment from additional sources
Chapter 4. Developing and maintaining the UK’s standing globally
Chapter 5. Providing patients with continuous improvements in healthcare

Medical research has historically been a significant area of strength for the UK and continues to be so because of investment and support from Government.

Government was right to continue its support for medical research in the 2010 spending review. A sustained guarantee for future investment in research provides confidence for industry to invest in the UK and delivers clear and substantial improvements in the health of the UK population. Statements from Government within, for example, the 2011 Strategy for UK Life Sciences, further prove the commitment to supporting the sector:

---

2 Leverage from public funding of science and research, Department of Business, Innovation and Skills, March 2013 p.5
If we can become better at recognising and rewarding innovation; ensure that good ideas don’t get lost; and adopt them more quickly and efficiently across the NHS, then we can deliver better patient outcomes at home and take a leading role in life sciences globally.

But we will only achieve our ambitions through clear commitment and leadership from Government working with the NHS, regulators, academia, charities and industry.3
David Willetts Ministerial forward to the Strategy for Life Science

The benefits derived from this support must not be lost; it is vital that Government support for medical research continues now, and in the future.

Cancer Research UK calls on the Government to maintain its current spend on science and research so that patients and the public can continue to reap the benefits of a vibrant medical research sector. The Government must protect the UK’s investment in medical research by continuing to ring fence the science budget in its upcoming spending review.

The Government should maintain the diversity of funding streams including funding to Research Councils, Funding Councils and the National Institute of Health Research. The Government should produce a plan outlining how it will support future capital spending on the infrastructure that is required for research to take place in publicly funded institutions. This will help to help provide certainty for future funding decisions.

The UK has benefitted from a unique funding model, derived from the interdependency of funders which include the Government, the National Health Service, universities, industry and charity funders. All parts of the infrastructure are crucial in ensuring that research in the UK continues to deliver significant benefits to the health and wealth of the nation. This collaboration has resulted in great research successes so far. Continued investment by all funders is vital to future growth.

---

SOURCES OF PUBLIC FUNDING FOR MEDICAL RESEARCH

- The Department for Business, Innovation and Skills (BIS) funds capital spend, including on buildings, facilities, maintenance and equipment.
- BIS allocates money to Research Councils UK (RCUK) (total spend around £3 billion annually), which supports research that has an impact on the growth, prosperity and wellbeing of the UK. Research is interdisciplinary, but within RCUK, four of the seven funding councils deal directly with medical research (the Medical Research Council, the Science and Technology Facilities Council, the Biotechnology and Biological Sciences Research Council and the Engineering and Physical Sciences Research Council).
- BIS includes the Higher Education Funding Council for England (HEFCE) which distributes Quality Related research funding to universities (equivalent functions are performed in Scotland, Wales and Northern Ireland, by the Scottish Funding Council, the Higher Education Funding Council for Wales and the Department for Employment and Learning, Northern Ireland, respectively). The spend in England in 2013/14 will be £1.69 billion. The science ‘ringfence’ encompasses both RCUK and HEFCE funding.
- Research within the NHS is funded by a number of separate bodies. The National Institute for Health Research (NIHR) (funded by the Department of Health) ensures that the NHS supports clinicians and research staff and medical research infrastructure, to conduct world class research focused on the needs of patients and the public. The NIHR covers English and UK wide studies (spending £1.06 billion in 2013/14) while funding in Scotland, Wales and Northern Ireland comes from NHS Research Scotland, the National Institute for Social Care and Health Research, and Health and Social Care, Research and Development, respectively.
- UK charities also spend over £1 billion funding medical research, a unique strength of the UK research environment.
CHAPTER 1: INCOME GENERATION AND (COST) EFFICIENCIES FOR UK PLC

As the UK’s economy becomes increasingly knowledge intensive it is vital that investment in science is maintained in order to provide the basis for growth. The UK has a prestigious history of success in science to build upon, especially in life sciences. The UK has created nearly a quarter of the world’s top 100 medicines and one sixth of the most popular prescription medicines were developed in the UK.

The clearest way that Government spending impacts on income generation is through its support for the development of new therapies. Bringing new drugs to market is not the responsibility of either Government or charitable funders. The amount of capital that is required together with the risks associated with the drug development process means that only industry can undertake the large scale trials that are required to be granted marketing authorisation. However, charities and Government funders have a critical role to play, typically by contributing to drug discovery through the development of the underlying science associated with the new compounds and also the early phase studies to demonstrate proof of concept. Case Study 1.1, below, provides a good illustration of the interdependencies of the process.

CASE STUDY 1.1: TEMOZOLOMIDE

The development of Temozolomide, a drug for a form of brain cancer, was driven by Cancer Research UK funded staff based in Aston University, Birmingham, and now thousands of people benefit from treatment with this drug. The Government played a crucial role in the development of Temozolomide by providing QR (quality related) funding and support costs for universities which allowed the research to take place in the UK across the decades it took to develop.

In the 1970s Cancer Research UK scientists began the work at Aston University, which resulted in a new molecule being produced in 1987 – Temozolomide. Following a promising early phase trial, Cancer Research UK supported larger trials, which were also successful – showing extended survival for patients with glioblastoma. Based on these results in 1997, Cancer Research Technology licensed the drug to the pharmaceutical company Schering-Plough, who funded further trials. Once clinical trials started, demand for the drug increased and researchers at Cancer Research UK’s Formulation Unit at The University of Strathclyde developed a process to bulk-produce the drug as capsules.

Once the results of the pharmaceutical company’s trials began to be reported, the potential of the

---

5 ABPI: Innovating for a healthy tomorrow, 2004; OHE calculations based on IMS World Review data, extracted 2010.
drug was realised. It is now used worldwide to treat the most common type of adult brain cancer. Cancer Research UK scientists continue to develop the drug and are now testing Temozolomide’s effectiveness in treating other types of cancer. To date, Temozolomide has generated over £650 million in sales annually.

From the initial scientific breakthrough almost 40 years ago to it being brought onto market, Temozolomide provides an accurate representation of the time and collaboration required to develop a new medicine. Sustained funding is crucial for medical research as the certainty allows for long term investment by other funders in drug development.

UK scientists are developing understanding of whole new areas of biology where targets for drug development could potentially emerge. Many exciting recent scientific breakthroughs have the potential to be developed into new therapies, for example see Case Study 1.2, below.

CASE STUDY 1.2: TELOMERE DYNAMICS DURING REPLICATIVE SENEENCE AND EARLY STAGE NEOPLASIA

Researchers at Cardiff University, who receive QR support via HEFCE funding distributed by BiS, are currently leading on developing understanding of telomere dynamics which underpin many aspects of diseases relating to cancer, as well as age-related and genetic diseases. Telomeres help to protect DNA as it replicates and also regulate cell division. The basic research uncovered how telomeres become dysfunctional, causing instability and damage to chromosomes inside cells. This has allowed researchers to develop a technique that could provide doctors with effective prognostic tools for certain cancers.

A patent has been filed for the assays involved and the researchers are now looking for ways to partner this research commercially so that this discovery can eventually benefit patients. The research team anticipates setting up a company to provide high resolution telomere analysis as a service for cancer patients.

Telomere dynamics demonstrate why the UK is an attractive location for global pharmaceutical and biotech companies. Having the basic research in the UK provides incentives for early phase development of the new technology which would not have taken place otherwise.

The benefits that derive from Government’s investment in research can be seen in:

- the generation of income from commercialised products
- therapies and in the cost efficiencies delivered to the health service by reducing the incidence of disease or limiting its impact (see Section 5: Continuous Improvements in Healthcare, for more details).
- The development of screening technologies presents another way in which research and innovation can save lives and deliver healthcare savings.
CASE STUDY 1.3: BOWEL SCOPE SCREENING

Research funded by the Medical Research Council, NIHR and Cancer Research UK published in April 2010\(^7\) has shown that a new method for bowel screening could prevent at least 5,000 people from being diagnosed with bowel cancer and at least 3,000 people from dying from the disease each year in the UK.

Estimated cost of diagnosis, treatment and palliative care for bowel cancer patients is around £1.1 billion a year assuming that 27,000 patients are diagnosed.\(^8\) Working with the assumption that screening would save 8000 people from developing later stage bowel scope screening has the potential to save the NHS £325 million.

In 2008, a team from the Health Economics Research Group (Brunel University), RAND Europe and the Office of Health Economics published a study commissioned by the Evaluation Forum that estimated the economic returns to medical research as the sum of monetised health gains and economic spill-over benefits. It used cardiovascular research as its main exemplar. It found that for each pound invested by the taxpayer or charity donor in cardiovascular research, a stream of benefits worth 39 pence is produced each year 'in perpetuity'. Cancer Research UK and several partners are undertaking follow-on research to develop this methodology further and demonstrate the return on investment specifically in cancer research. The study is due to publish its results in autumn 2013.


CHAPTER 2: INTERDEPENDENCY OF FUNDERS

To investigate how medical research benefits from funding from the public, private and charity sectors, Cancer Research UK commissioned the Office of Health Economics (OHE) to look at the interdependency of public and charitable research, and the contribution that these partners make to the sector.

In April 2011 the OHE published the report on independencies which concluded that there are significant benefits, in having different partners supporting research. These included:

- That when charities and the Government both support science, this helps the economy.
- That public funding helps charities to raise money by showing that the Government has faith in the research these funds are supporting.
- That UK healthcare would suffer if one of these partners were to cut their contribution.

It outlined the complementary and interlocking partnerships between public, charitable and industry funders, and showed that if public funding was reduced, charities would not be in a position to step in and bolster support for research. Public funding in science underpins UK research and creates a strong environment in which charities and industry can invest. The interdependency is not only financial; the differing skills and knowledge offered by funders leads to more productive collaborations and helps to ensure that funding is complementary.

The benefits of interdependent funding models, both financially and in terms of scientific outputs, are well demonstrated by Case Studies 2.1 and 2.2, below.

---

**CASE STUDY 2.1: FRANCIS CRICK INSTITUTE**

The Francis Crick Institute, scheduled to open in 2015, will be a world-leading bio-medical research centre in central London. Interdisciplinary working is fundamental to the Institute. It will bring together scientists from multiple fields to work together to understand why disease develops and find new ways to prevent and treat illnesses such as cancer, heart disease and stroke, infections, and neurodegenerative diseases.

This interdisciplinary approach extends to the funding model behind the Institute. It is funded by a consortium of six: the Medical Research Council, Cancer Research UK, the Wellcome Trust, UCL (University College London), Imperial College London and King’s College London. The organisations in the consortium will invest a total of around £650 million to establish the Institute. When it is fully operational, it will employ 1,500 staff, including 1,250 scientists, and have

---

9 Office of Health Economics, Exploring the Interdependency between public and charitable medical research, 2011.
an operating budget of over £100 million per year.

The Institute will not only help to improve people’s lives by making sure that laboratory discoveries are turned into treatments as quickly as possible, but will also keep the UK at the forefront of innovation in medical research, attract high-value investment, and strengthen the economy.

The Francis Crick Institute is a powerful example, not only of the way in which the UK continues to promote top quality, innovative research models, but also of the huge potential which can be realised when multiple funders jointly invest in projects of this kind.

The Crick is the culmination of a model of research collaboration that has been developing in the UK for decades. The success of this model is already apparent in organisations such as the Gray Institute which was established in 2008.

**CASE STUDY 2.2: THE GRAY INSTITUTE**

The Gray Institute for Radiation Oncology and Biology is the leading research facility of its type in the world. This Institute was formed following recognition that radiotherapy was a relatively underdeveloped area in cancer treatment. It demonstrates the ability of partners in the UK to identify public health needs and create research infrastructure to address them.

As well as researching into radiobiology, the facility also explores the translational possibilities of the field, which could yield new advances in radiation treatment. There is a particular focus on improving the ‘therapeutic ratio’ (the ratio of the response of the tumour under radiation to the damage which the radiation causes to normal tissue) which is decisive in how helpful radiation is in treating tumours.

Part of the University of Oxford, the Institute is collaboratively supported by the Medical Research Council (MRC) and by Cancer Research UK. The Institute brings researchers from around the world to Oxford and further benefits from adjacencies to other research laboratories, including the Epidemiology Unit and the Medical Oncology Unit (both Cancer Research UK funded) and the multidisciplinary Henry Wellcome Building for Genomic Research. The Institute also enjoys strong links to other complementary departments at the University.

The Gray Institute relies on the University of Oxford, the MRC and Cancer Research UK, to set the global research standard which it does and to deliver innovative, life-saving research outputs.

The contribution made by the pharmaceutical sector is essential to the UK economy. The investment not only helps to boost research infrastructure in the UK but also ensures early access to novel drugs and innovative new treatments for patients. Cancer Research UK and the Government play a significant role in providing a framework for pharmaceutical companies to locate their research in the UK, as demonstrated by Case Studies 2.3 and 2.4, below.
CASE STUDY 2.3: CANCER RESEARCH UK AND NIHR ECMC NETWORK

Established in 2007, Experimental Cancer Medicine Centres (ECMCs) are jointly funded by Cancer Research UK and Government funding through the Department of Health in England as well as receiving funding through devolved administrations. The ECMC Network is a collaborative UK wide initiative, bringing the leading figures in early-phase clinical research together with world class infrastructure, offering patients across the UK access to innovative, new treatment options.

Since the establishment of the network, ECMC funded staff have helped to support over 2000 studies, notably early phase trials of new biological therapies and small molecules, with a majority of early phase trials sponsored by industry. To date over 150 companies have collaborated with the Centres. Currently the Centres fund over 175 staff (2011/12).

The quinquennial review of the Centres by independent international experts concluded that the ECMC network represented a world class asset for the UK and provided a unique driver for locating early phase cancer studies here. A demonstration of the success of the ECMC network is the Cambridge ECMC, which between 2007-2011 secured £4.7 million of investment from collaboration with industry.10

---

CASE STUDY 2.4: CROSS SECTOR COLLABORATION AT MANCHESTER

Cancer research conducted in Greater Manchester demonstrates how vital public funding can leverage significant investment from other funders.

The new Manchester Cancer Research Centre is unique in being one of the only comprehensive cancer centres in Europe where world-class research into cancer biology, drug discovery and clinical trials come together on a single site. This allows research to quickly move from ‘bench to bedside’ and different disciplines within life sciences to work together to develop the best treatments for patients.

---

Dr John Brognard (Cancer Research UK scientist)
“I had been offered places at leading institutes across the US, but I chose Manchester. Why? I think it’s the perfect environment to carry out my lab research – what really excites me is that as soon as I make a discovery, I am able to work closely with the chemists at our Drug Discovery Centre and doctors at The Christie’s Clinical Trials Unit to translate it into patient benefits. Nowhere else came close.”

The development of new state of the art facilities could not go ahead were it not for support from the publicly funded University of Manchester collaborating with Cancer Research UK and the Paterson Institute.

The collaboration at Manchester simultaneously supports the health of the community whilst providing significant employment and technical training for people within the local area. This dynamic partnership model is mirrored across the University, with Manchester attracting over £273.6 million of external funding in 2008 across all disciplines.

Following the decisions in the 2010 Spending Review, and the analysis of the Office of Health Economics on interdependency of funders, Cancer Research UK wanted to further explore the key elements that comprise the medical research environment in the UK. In September 2011 we published The Ideal Environment for Medical Research which drew upon the experience of Cancer Research UK experts. It added to the existing evidence base outlining the value of medical research and the interdependencies between research funders, by considering the current UK medical research environment, and identifying the different mechanisms that are required to support researchers and the wider UK science base.\(^\text{11}\) It concluded:

- **Funding**: The Government should maintain the diversity of funding streams including funding to Research Councils, Funding Councils and National Institute of Health Research. It should also continue to demonstrate long-term commitment to supportive funding (such as the charitable support element of QR funding)
- **Infrastructure**: UK Governments should set a strategic vision for the different funding streams designed to support infrastructure, to reassure researchers and investors of their long-term support.
- **Collaboration**: Funding bodies and research institutions from across the private, public and charity sectors should share best practice on collaborative working. Assessment of the quality of research must be accommodating of multi-disciplinary projects.
- **Investing in people**: Government should invest in and promote the uptake of Science, Technology, Engineering and Maths (STEM) courses
- **Regulation and governance**: Regulation and governance should be streamlined in order to remove barriers to research taking place.

CHAPTER 3: LEVERAGING INVESTMENT

Government spending has demonstrable impact on leveraging investment from other funders. Without the Government’s support, the UK would not have its vibrant and world leading medical research charities. Case Study 3.1 demonstrates how Government funding directly leverages money from the UK charity sector.

CASE STUDY 3.1: CHARITABLE RESEARCH SUPPORT FUND
The Charitable Research Support Fund (CRSF) demonstrates how Government spend supporting the indirect costs of research leads to investment by the charitable research sector. The CRSF forms part of the QR grants issued through HEFCE, its allocations are based on the amount of charitable research a university attracts. It exists because medical research charities spend their money directly on projects that support their stated missions rather than the indirect costs associated with research such as basic infrastructure. Therefore Government funding is required in order to leverage the maximum investment from the medical research community.

In 2011-12, £227 million of costs were allocated through the CRSF in the UK which, in turn, leveraged £1,137 million spend by charities in UK universities. Similarly Excess Treatment Costs support charitable spend on clinical research in the NHS by covering the costs of extra procedures required to undertake research. These costs ensure that research can take place ultimately delivering health gains to patients.

Two of the top five global pharmaceutical companies (GSK and AstraZeneca) have their headquarters in the UK. We also have global leaders in medical devices, Smiths Medical (part of the Smiths Group) and Smith & Nephew. The UK medical biotechnology sector leads Europe in the number of drugs in all stages of clinical development. The pharmaceutical, bioscience and medical technology sectors are growing rapidly with the largest share in Europe at just over 4,500 companies, the majority of which are SMEs, and the sector collectively employs almost 165,000 people across the UK. The UK’s pharmaceutical sector is estimated to invest approximately £11.8 million per day in R&D.

The commercial sector relies on Government investment to support infrastructure and jointly fund projects that private capital alone would not be able to fund. Government spending on research demonstrates to the public and other funders that a particular area is viewed as a priority.

---

12 Association of Medical Research Charities, Enable charitable research funds to be spent only on research, http://www.amrc.org.uk/challenge_value-charitable-investment-in-medical-research_enable-charitable-research-funds-to-be-spent-only-on-research
14 Department of Business, Innovation and Skills, Strategy for UK Life Sciences, 2011, p.4.
15 The Pharmaceutical industry’s contribution to the UK economy and beyond, ABPI, 2009.
helping to attract investment.\textsuperscript{16} Government acting as a stakeholder ensures that costs are shared and risk pooled for research programmes. This enables high cost studies that might not otherwise be funded, and permits each funder to diversify risk across a wider portfolio of projects.

Conducting medical research in itself delivers significant savings to the NHS and offers patients the opportunity to access treatments that may have otherwise not been available to them. This is achieved because academic clinical trials, such as the type run by Cancer Research UK, are often supported by pharmaceutical companies through their supply of free drugs to the trial. Companies derive benefit through generation of extra data on their product which also results in benefits to patients.

Academics in the UK work closely with industry to leverage access to free drugs and/or educational grants, thereby enabling more research to be undertaken. For example, since 2008 over 30 Pharmaceutical companies have provided over £136 million of financial support/free drugs to trials that have been supported by our Clinical Trials Awards and Advisory Committee. Below is a representation of the proportion of support provided by companies to Cancer Research UK clinical trials.\textsuperscript{17}

A representation of industry support for Cancer Research UK clinical trials

As well as leveraging access to drugs to benefit the healthcare system and patients, Cancer Research UK and other medical research organisations partner with the commercial sector to help accelerate the development of new drugs. The collaboration helps pool risk and share expertise, thus allowing for innovative new approaches to be tested for the first time.

\textsuperscript{16} Leverage from public funding of science and research, Department of Business, Innovation and Skills, March 2013 p.5

\textsuperscript{17} Cancer Research UK, Clinical Trials Report 2013, 2013, p.5.
CASE STUDY 3.2: CANCER RESEARCH UK’S COMBINATIONS ALLIANCE

This is a joint initiative between the Experimental Cancer Medicine Centre network which receives funding from the Department of Health funded NIHR and Cancer Research UK, Cancer Research UK’s Drug Development Office and pharmaceutical partners. Its aim is to support the creation of new treatment options for patients by combining different cancer therapies in early phase trials.

The joint funding model is an efficient way to conduct clinical development, providing patient benefit, enhancing the global reputation of the UK for conducting experimental medicine and leveraging significant external funding for each pound that Cancer Research UK commits to the initiative. It also attracts further partnership by offering access to world class UK oncology centres via the ECMC network. It provides a consistent and efficient way for academia and industry to collaborate and expands potential markets for commercial drug development.

“The Alliance allows us to do things we might otherwise not have had the time and resources to do. It gets the drug to a wider pool of patients than would be the case if we could only focus on certain populations.”

Andrew Foxley, clinical director at Astra Zeneca

Partnership with industry is not limited to drug development. Pharmaceutical companies can also work with other funders to promote research into prognostic tools, for example in Case Study 3.3, below. Research of this type has the potential to allow us to detect cancers at an earlier stage, when they may be more responsive to treatment, identify what treatments are likely to be most effective for what patients and to monitor the impact of treatments.

CASE STUDY 3.3: ASTRA ZENECA CLINICAL AND EXPERIMENTAL PHARMACOLOGY GROUP BIOMARKERS ALLIANCE

Work at Cancer Research UK’s Paterson Institute has leveraged £6 million additional funding from AstraZeneca. Our joint goal is the discovery, development, and clinical implementation of predictive, prognostic and pharmacodynamic biomarkers (substances which doctors can measure, for example in blood or urine samples), which help to monitor how a disease is developing or whether a treatment is working. A better understanding of these biomarkers can help us to optimise patient benefit from cancer therapy leading to the right dose of the right drug to the right patient. The programme includes work to evaluate blood borne markers in a range of AZ clinical trials. It also accompanies funding for ‘blue sky’ biomarker discovery projects.

The expertise the UK has in developing existing drugs as demonstrated above is also crucial for leveraging funding for innovative new projects. The ability to draw together expertise from a range of fields coupled with existing infrastructure in both the NHS and academia means that the UK is an attractive location to trial projects that explore whole new systems of medicine.
CASE STUDY 3.4: STRATIFIED MEDICINE

In partnership with the Government funded Technology Strategy Board, Pfizer and Astra Zeneca, Cancer Research UK is undertaking an ambitious programme to lay the foundations for stratified medicine development and treatment in the UK. Stratified medicine will allow patients to receive targeted treatments.

The programme is testing tumour samples from 9,000 patients across six different tumour types to help establish the foundations for a national service that will ensure standardised, high quality, cost-effective genetic testing of tumours is available for people with cancer. Ultimately this has the aim of also helping further research into new targeted therapies. The programme requires collaboration between universities, hospitals and commercial industry to support the infrastructure of collecting tumour samples.

As a direct result of the programme, two pharmaceutical companies, Roche and Bristol-Myers Squibb, are working with Cancer Research UK to set up trials in the UK that draw on this information. Doctors will be able to use the database to see if any of their patients have specific faults in their tumour identified through the stratified medicine programme, which might make them suitable to join the companies' trials.
CHAPTER 4: THE STANDING OF THE UK GLOBALLY

The UK is currently a world-class centre for scientific research. Our research base is highly regarded internationally: over 70 Nobel Prizes have been won by UK scientists; the UK is responsible for 8% of world publications; and we have 14% global share of the most cited papers.18 Four of the top ten universities which specialise in clinical, pre-clinical and health research are located here in the UK.

UK RESEARCH BASE AND INTERNATIONAL COMPARISONS

- Four of the top ten universities in the world are based in the UK.
- The UK attracts 15% of all international doctoral students, second only to the US. 19
- We are now a net importer of scientists and innovators.20
- UK scientists win 10% of internationally recognised science prizes every year.21
- The UK is scientifically the most publication productive nation in the world – ahead of the USA – in terms of citations per researcher.22

The strength of the UK position in the international research community brings with it concrete economic gains. It is because of this world-leading knowledge base that new Intellectual Property is generated and exploited in the UK. In 2010, UK medical biotech companies led Europe in the number of drugs in clinical development with over 20% of the total.23 This is due to established research skills which UK companies possess to develop these drugs and the expertise held by the numerous UK organisations that companies use to support clinical development. The strength of our position globally also allows us to benefit from international collaboration. In 2007, 47% of the UK’s scientific publications had a non-UK co-author - up from 33% in 1999. The impact of these multi-nationality publications, measured by citations, is significantly higher than the average impact of UK papers.24

19 The Royal Society (2008), A higher degree of concern.
24 Ibid.
The Government’s own assessment exercise recognises the international importance of the research being conducted in the UK. The most recent exercise also highlighted the importance of charity funding in promoting this vibrant and world class research environment as demonstrated in Case Study 4.1, below.

**CASE STUDY 4.1: RESEARCH ASSESSMENT EXERCISE RESULTS**

The results of the Research Assessment Exercise published in December 2009 demonstrated the contribution that charities were making to the quality of research conducted in UK universities. Cancer studies received the top rating for all the scientific and medical-related subjects, with around 80% of the studies being funded by charities, the majority from Cancer Research UK.

Medical research charities integrate this world class work with the UK academic sector, and the collaborative environment that this has created has realised significant benefits for science in the UK.

Government funding is critical in supporting, maintaining and building upon our existing excellent research base. The funding provides a stable base of financial support for researchers and having a range of grants and funding sources also creates a competitive environment for researchers seeking funding, leading to an overall increase in the quality of applications for funding.

There are many examples of research work which demonstrates the world class standard of the UK research base, bringing tangible benefits to the UK in both economic and healthcare terms. This has been recognised internationally in prestigious global awards.

**CASE STUDY 4.2: SIR PAUL NURSE: NOBEL PRIZE WINNER**

Since 2000, six Nobel prizes have been awarded to British scientists for their work in physiology or medicine, more than in any other field, demonstrating how the UK continues to lead the world in life sciences.

Sir Paul Nurse’s prize, awarded jointly in 2001 with Sir Tim Hunt and Leland Hartwell for their groundbreaking work into cell cycles, demonstrates the impact that the UK’s world class knowledge base has on the UK. Cancer drugs that block specific molecules involved in the cell cycle are now being tested in clinical trials, demonstrating the clear links between groundbreaking discoveries such as this one and real benefits for patients. Sir Paul continues to head the cell cycle laboratory at Cancer Research UK’s London Research Institute and is the Director of the Francis Crick Institute.

Government investment in the scientific research base has been crucial to the careers of all of the UK’s Nobel Prize winners. The work that formed the basis of Sir Paul Nurse’s work was conducted at the University of Edinburgh and later at the University of Oxford.
CASE STUDY 4.3: CANCER RESEARCH UK TEAM WINS TOP GLOBAL RESEARCH AWARD

In 2012, a research team funded by Cancer Research UK won the American Association for Cancer Research (AACR) Team Science Award. It was the first non-US team ever to win this prestigious award.25

The team, from the Institute of Cancer Research and the Royal Marsden Hospital, were recognised for their success at taking new cancer drugs from concept to patients. Over the past six years, the team has discovered 16 innovative drugs, six of which have progressed to early Phase I clinical trials.

This case study not only illustrates our ability to lead the world in bio-medical research, but also our capacity to collaborate with industry and the NHS to deliver rapid impact on the lives of cancer patients.

The UK demonstrates its excellence in life sciences not only by recognition through awards, but also by being the location for world-leading, specialist research centres, for example the Children’s Brain Tumour Research Centre, described in Case Study 4.4, below. Centres such as these deliver lifesaving research serving to guide national and international developments in clinical practice and also give the UK a voice in international groups and forums.

CASE STUDY 4.4: CHILDREN’S BRAIN TUMOUR RESEARCH CENTRE

Established in 1997, the Children’s Brain Tumour Research Centre brings together a multi-disciplinary team of leading healthcare professionals and researchers – all experts in their fields, and all committed to improving our understanding of childhood brain tumours. The Centre’s research ranges from understanding the biological nature of cancers of the Central Nervous System, exploring potential drug development pathways to looking at clinical referrals and diagnosis. The lead researchers at the Centre represent the UK globally as principal members of clinical trials committees, for example with the Société International d’Oncologie Pédiairque (SIOP).

The Centre is an excellent example of how diversified funding models allow the UK to support cutting-edge research. It is based at Nottingham University and attracts funding grants from a range of organisations, including a number of charities, such as Cancer Research UK, as well as Medical Research Council.

CHAPTER 5: CONTINUOUS IMPROVEMENTS IN HEALTHCARE

The drive to achieve better public health and medical treatments underpins all medical research in the UK. Investment in science and research by Government results in continuous improvement in the UK's public health. Previous sections of this report have outlined how Government investment supports science; the examples below demonstrate the results of this work.

A patient diagnosed with cancer today is now more than twice as likely to survive their disease as a patient would have done 40 years ago. We now understand far more about the causes of cancer, we have more diagnostic tools to pick up cancer cases earlier and, once diagnosed, we have more advanced techniques and treatments which allow us to achieve better outcomes. This progress has been built on a huge growth in our understanding of the fundamental biology of cancer.

The changes in patient survival demonstrate the progress made as a result of research. In the 1970s, 5 out of 10 women diagnosed with breast cancer survived beyond five years, now the figure is over 8 out of 10. Today, more than 9 in 10 men diagnosed with testicular cancer are cured, up from fewer than 7 in 10 in the 1970s. In the 1960s, around a quarter of children diagnosed with cancer survived for at least ten years; today that figure is almost three quarters.

As discussed above, this progress cannot be attributed to a single funder, it is the result of a diversified research environment in which Government funding underpins and complements the input of charitable funders, industry partners, university research laboratories, and the National Health Service.

The case studies used throughout this report demonstrate the impact of research on healthcare in the UK. Case Study 1.1 describes the development of Temozolomide, a drug which thousands of patients with brain tumours now benefit from; Case Study 1.3 illustrates the impact of bowel scope screening which will not only promote early diagnosis, but also reduce incidence of bowel cancer; and Case Study 4.3 illustrates the work of our scientists to promote the rapid development of new cancer drugs from concept to patients. Case Study 5.1, below, also demonstrates evidence that research active hospitals have the potential to deliver better patient outcomes.

CASE STUDY 5.1: RESEARCH ACTIVITY IMPROVES PATIENT OUTCOMES

Research by the University of Leeds has demonstrated that research active centres deliver improved colorectal cancer outcomes. Research activity increased over time with the proportion of hospitals in the high activity group increasing from 16.7% in 2000 to 55.3% in 2008. Preliminary analyses indicate there was a significant reduction in 30 day mortality and an improvement in survival for patients treated in high research active hospitals compared to those with no activity. These effects remained after adjustment for age, sex, socio-economic status, method of admission to hospital, stage of cancer progression and year of diagnosis.

Research delivers improved health outcomes, not only through improved diagnostics and treatments, but also by providing us with population based insights, for example, into cancer incidence and survival. Studies of this kind provide individuals with better information on how to protect themselves from risks, and inform health policy makers on how best to improve national outcomes. Studies such as those described in Case Study 5.2, below, illustrate how research from the UK can influence health decision making in order to promote ongoing improvements in both national and global health.

CASE STUDY 5.2: CONCORD STUDIES

In 2008, the CONCORD study became the first worldwide analysis of cancer survival, estimating relative survival for 1.9 million adults, using 101 population-based cancer registries in 31 countries on five continents. According to the Organisation for Economic Co-operation and Development, CONCORD “contributed to a sea-change in how national policymakers are using international comparisons to improve their health systems”.

Cancer Research UK is now part of a consortium of funders funding the CONCORD-2 study, which aims to provide quantitative and directly comparable estimates of cancer survival from many different countries. This continuous, global surveillance of cancer survival will become a source of information for cancer patient groups and researchers, a stimulus for change in health policy and health systems, and a key metric for global surveillance of cancer control.
CONCLUSION
Throughout this report we have demonstrated the vital elements of the research environment which deliver significant health and wealth benefits to the UK, including the importance of interdependency between funders and the valuable role of public funding in leveraging investment from the private sector.

Investment by Government through the ring fenced science budget and other funding streams has underpinned all of the achievements outlined whether it is delivering new treatments to patients or creating jobs and investment in the UK. It is because of Government support that the public’s generosity in supporting Cancer Research UK can be directed towards our goal of bringing forward the day when all cancers are cured.

It is therefore vital that Government continues to maintain the science budget and that funding for medical research is sustained in the future.
Patron Her Majesty The Queen
Presidents HRH The Duke of Gloucester KG GCVO and HRH Princess Alexandra, the Hon. Lady Ogilvy KG GCVO
Chief Executive Dr Harpal S. Kumar
Registered Charity in England and Wales (1089464), Scotland (SC041666) and the Isle of Man (1103)
Registered Company limited by guarantee in England and Wales (4325234) and registered in the Isle of Man (5713F)
Registered Address Angel Building, 407 St John Street, London EC1V 4AD