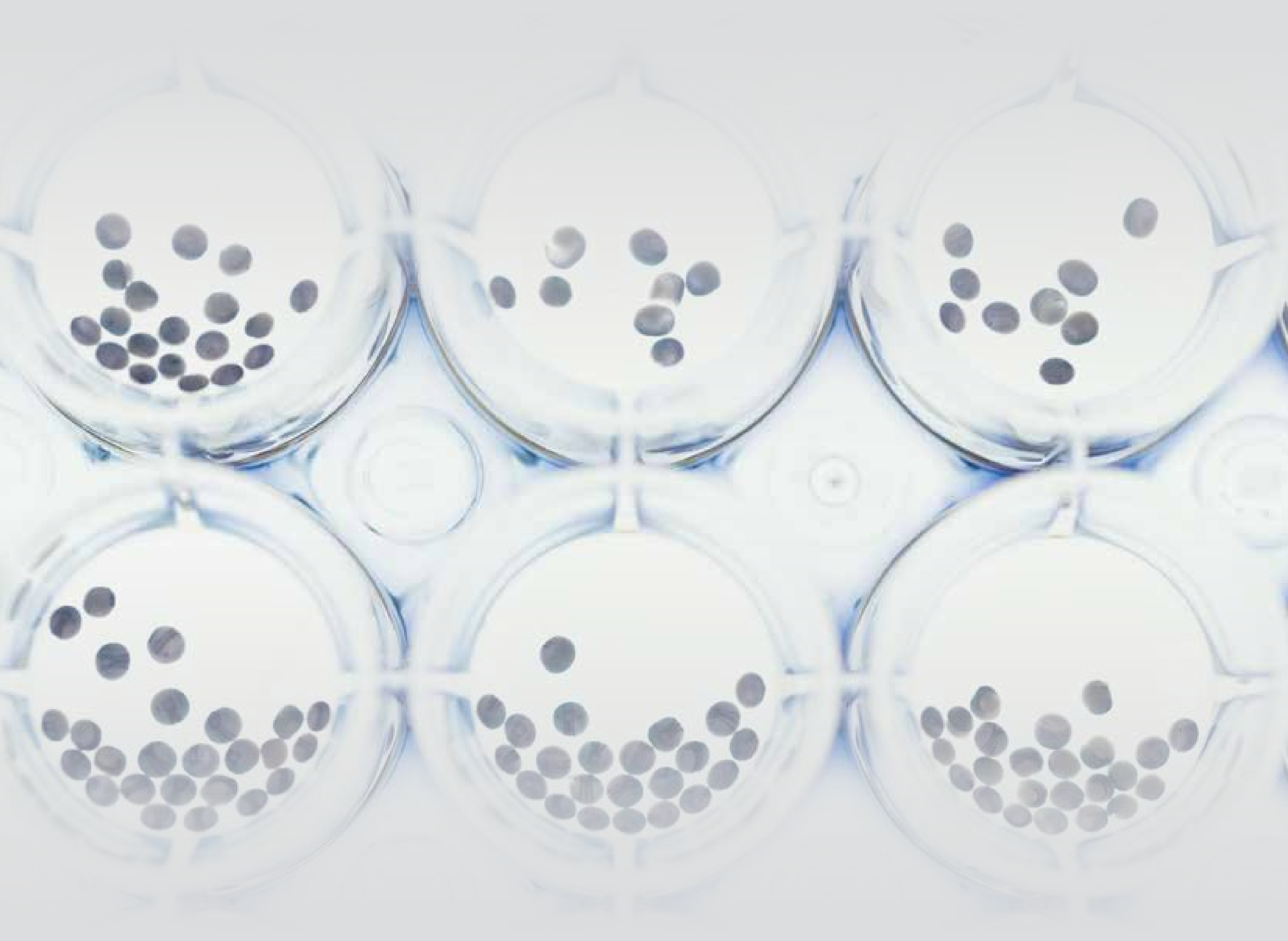
Briefing Document

Medical Research: What's it worth?

Estimating the economic benefits of cancer-related research in the UK



The Academy *of* Medical Sciences

CANCER RESEARCH UK

Department of Health

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Introduction

In recent years, researchers and funders have aimed to better understand the range of impacts arising from public and charitable funding for medical research — including the resulting economic benefits. Such information provides accountability to taxpayers and charity donors, and increases our understanding of how research effectively translates to health gains. Financial returns may not be the key driver in research decisions, but the demands on public funding are substantial and it is therefore important to evaluate investment in research.

While it is easy to cite examples of breakthroughs that have led to substantial patient benefits or improvements in quality of life, it is more difficult to assess the nature and extent of the economic returns arising from investment in a whole body of medical research, some of which may inevitably be less fruitful.

This briefing document summarises the findings of a study to estimate the returns generated by public and charitable investment in UK research. Led by RAND Europe, the Health Economics Research Group (HERG) at Brunel University and King's College London, it focuses on cancer and follows a ground breaking study published in 2008[1], which yielded the first quantitative assessment of the economic benefit of biomedical and health science in the UK. The original report focused on the returns generated from investment in cardiovascular disease research, also testing the methodology to a more limited extent on mental health research.

The study takes a conservative approach to the evaluation and, as with any economic analysis, assumptions were made. These are summarised at the end of this document and detailed in the academic publication on which this summary is based[2].

“Each pound invested in cancer-related research by the taxpayer and charities returns around 40 pence to the UK every year.”

[1]Health Economics Research Group, Office of Health Economics, RAND Europe (2008) *Medical Research: What's it worth? Estimating the economic benefits from medical research in the UK* www.wellcome.ac.uk/economicbenefits

[2]Matthew Glover, Martin Buxton, Susan Guthrie, Stephen Hanney, Alexandra Pollitt and Jonathan Grant (2014) *Estimating the returns to UK publicly funded cancer-related research in terms of the net value of improved health outcomes. BMC Medicine,* 12:99 http://www.biomedcentral.com/1741-7015/12/99

RAND EUROPE
HERG Health Economics Research Group
KING'S College LONDON

The 2014 *Medical Research: What's it worth?* study was carried out by researchers from RAND Europe, the Health Economics Research Group at Brunel University and King's College London. It was commissioned by the Academy of Medical Sciences, Cancer Research UK, the Department of Health and the Wellcome Trust.

This briefing document is available to download from www.wellcome.ac.uk/economicbenefitscancer

Key findings

The UK Government invests approximately £8.6 billion[3] in scientific research and development every year, of which £1.6 billion is spent on medical research. The British public donated an estimated £1.7 billion to medical research charities in 2012/13[4]. A new study provides evidence to support this continued investment in science by demonstrating how funding for cancer research delivers health gains for patients and benefits the UK economy.

- The results of this cancer-focused study strongly suggest that UK public- and charitably-funded biomedical and health research **provides a sizeable return on investment**.

- Each pound invested in cancer-related research by the taxpayer and charities returns around 40 pence to the UK every year. This includes health benefits equivalent to around 10 pence plus a further 30 pence which is the best estimate of the 'spillover' effect from research to the wider economy. This equates to an **average annual rate of return of 40%.**

- Global research efforts have led to key cancer treatments and interventions that have delivered **health gains equivalent to £124 billion for UK patients** between 1991 and 2010 through prevention, early identification and improved survival.

- The average time lag between investment in cancer research and eventual impact on patients is around 15 years. This **evidence demonstrates the importance of long-term funding plans** so that research today can deliver the health gains and economic benefits of the future.

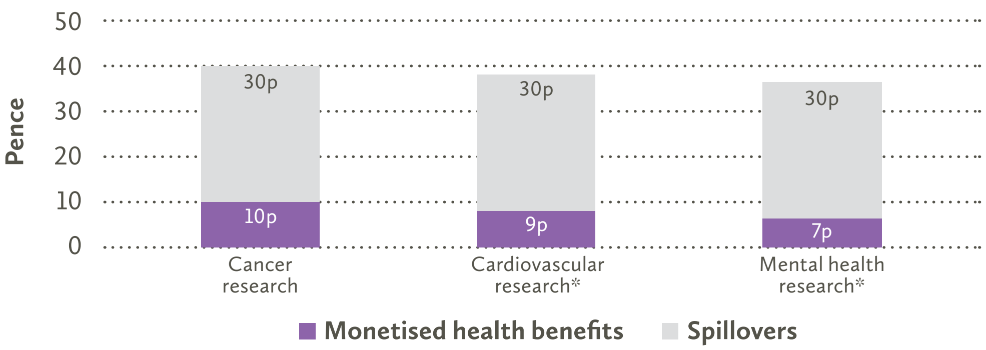
- In current prices, the **British public has funded £15 billion of cancer research** over the past 40 years through their taxes and charitable donations.

- These results for cancer build on a 2008 study which showed that every pound spent on cardiovascular and mental health research generates benefits equivalent to a total annual return of 39 pence and 37 pence respectively. Together, the studies demonstrate the impact of biomedical research more broadly and the return on investment it generates.

[3]National Audit Office (2013) *Research and Development funding for science and technology in the UK* http://www.nao.org.uk/wp-content/uploads/2013/07/Research-and-development-funding-for-science-and-technology-in-the-UK1.pdf

[4]Charities Aid Foundation (2014) *UK Giving Report* https://www.cafonline.org/pdf/UK%20Giving%202012-13.pdf

Estimated annual return from £1 investment by the public or a charity donor



*The 2008 *What's it worth?* study used cardiovascular research as its exemplar and tested the methodology using a more limited dataset focused on interventions targeting mental health disorders.

Methodology

The 2008 study used a cutting-edge methodology to estimate financial returns. In 2010, *Nature* said it was one of the few studies to make a genuine attempt to objectively assess the economic outcomes of research[5]. This approach has been refined in the current cancer-focussed study, which used the following key sources to estimate the rate of return:

1. Public and charitable expenditure on cancer-related research in the UK between 1970 and 2009.

The UK's leading funders of cancer research were identified by examining the National Cancer Research Institute's Cancer Research Database. The eleven principal funders used in the analysis consistently account for over 95% of cancer research spend and include government, research councils and medical research charities.

Although the private sector does undertake early stage research, its contribution is calculated as a cost and is included as part of the price of delivering new medicines (see assumption 1).

2. The net monetary benefit (i.e. the health benefit measured in quality-adjusted life years (QALYs), valued in monetary terms, minus the cost of delivering that benefit) of a prioritised list of cancer interventions in the UK.

This approach required:

- Identification of cancer interventions that can be confidently attributed to research developments and levels of usage.
- Estimates of the QALY gains[6] and NHS costs associated with the interventions (see assumption 2).

With the help of eminent cancer research experts and a review of epidemiological data, the team prioritised the following areas:

- Different cancers where research and resultant health policies have led to health gains through a *reduction in incidence*.
- Screening programmes that have led to health gains from *early detection*.
- Cancers where there have been significant health gains through *increased survival*.

Estimates of the numbers of individuals affected, and patient costs and effects, were obtained from published studies for the following areas: smoking prevention/cessation; cervical, breast and bowel cancer screening; and treatment of breast, bowel and prostate cancer which together account for over

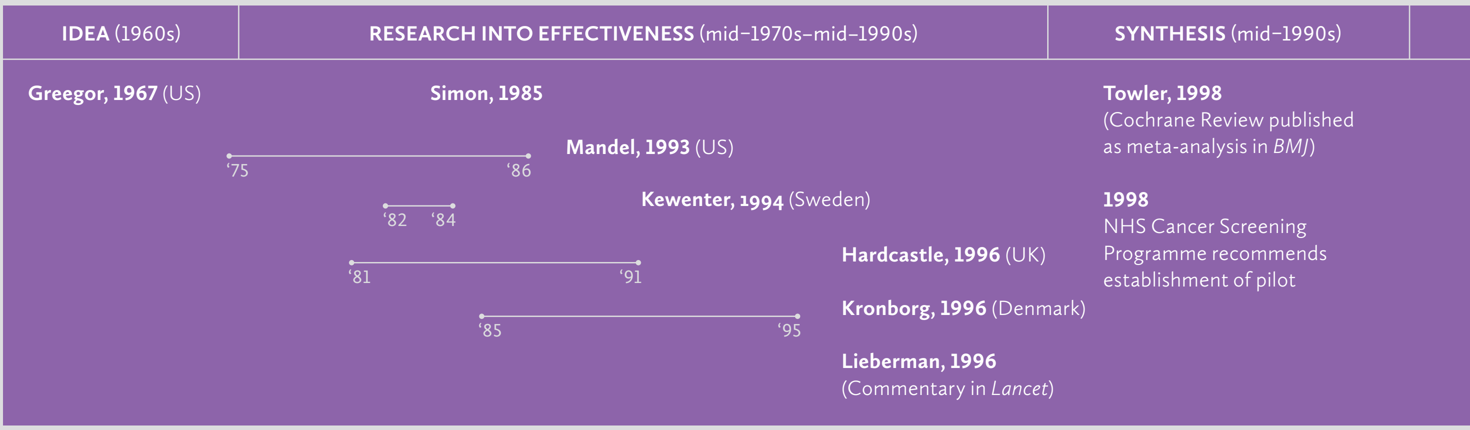
Case Study: Development of a national screening programme for bowel cancer

Globally more than a million people develop bowel (colorectal) cancer every year. In the UK, it causes over 16,000 deaths each year. Around 75% of diagnosed patients have no apparent risk factors other than old age, so screening is particularly important.

Screening aims to detect localised cancer or premalignant growths on the bowel wall called polyps. The NHS Bowel Cancer Screening Programme uses a test to identify faecal occult blood—this is blood in the stools which can't be seen.

Over a few days, the faeces from three separate bowel movements are saved in a disposable container and a small sample is smeared onto a piece of card. This is then posted to a laboratory, where a chemical is added to check for blood. If the test is positive, the patient and GP are notified.

The possibility of home screening for bowel cancer was first proposed in 1967, however discussions about its effectiveness ensued. Several randomised controlled trials followed between 1975 and 1998, and a subsequent



70% of the additional life years gained from improvements in 5 year survival rates for cancer patients over the study period.

The researchers assembled the lifetime monetised QALYs gained, and the net lifetime costs to the NHS of delivering those QALYs, for the selected interventions from 1991 to 2010 — this allowed for the known lag between investment and impact of research funded between 1970 and 2009. It is assumed that the net monetary benefits of other cancer interventions are zero (see assumption 3 and 4).

For smoking reduction/cessation, figures on the proportions of smokers, ex-smokers and non-smokers for England for each year between 1991 and 2010 were used to estimate the net change per year in QALYs gained and NHS savings achieved. This was then extrapolated to the UK population.

3. An estimate of the time lag between investment (research funding) and return (health gain) associated with the selected interventions, and an estimate of the proportion attributable to the UK.

National clinical guidelines produced by the National Institute for Health and Care Excellence, the Scottish Intercollegiate Guideline Network and the National Cancer Screening Programme were used to estimate the time lag between research and practice, and the proportion of research linked to the UK. Research references cited on 22 clinical practice guidelines related to the selected cancer treatments and interventions were examined for their date and the location of the originating research.

[5]Editorial (2010) *Unknown quantities. Nature, 465, 665-666.* http://www.nature.com/nature/journal/v465/n7299/full/465665b.html

[6]The National Institute for Health and Care Excellence's mid-point QALY threshold of £25,000 was used for the main calculation.

Cochrane Review of the evidence found that people allocated to screening had a 16% reduction in mortality.

Informed by this evidence, the NHS National Screening Committee recommended the establishment of the UK Colorectal Cancer Screening Pilot to determine the feasibility of screening in the UK population using faecal occult blood testing. Pilot sites were commissioned in 1999, with recruitment in 2000. In 2004, the Secretary of State for Health announced that the NHS Bowel Cancer Screening Programme would begin in April 2006. This offered a test to men and women aged 60 to 69 every two years.

The programme achieved national coverage in 2010. The millionth test occurred in October 2008 and up to that point, 1,772 cancers and 6,543 high risk adenomas were detected. This indicated that screening in England was on course to match the 16 per cent reduction in bowel cancer deaths found in the randomised trials.

IMPLEMENTATION RESEARCH (Early 2000s)			**HEALTH GAIN** (2006 onwards)	
National Cancer Plan, 2000 National Bowel Cancer Screening Programme would be introduced subject to evidence of effectiveness of the pilot	**Feb/May 2003** Final evaluation report of Colorectal Cancer Screening Pilot published.	**October 2004** Secretary of State for Health announced that the NHS Bowel Cancer Screening Programme would begin in August 2006	**April 2006** NHS Bowel Cancer Screening Programme begins	**2010** The Bowel Cancer Screening Programme achieves national coverage

Guthrie et al (2014) *Investigating time lags and attribution in the translation of cancer research: A case study approach* www.rand.org/pubs/research_reports/RR627.html

Findings

Expressed in 2011/12 prices, total expenditure on cancer-related research from 1970 to 2009 was £15 billion. Over the period 1991–2010, the interventions included in the study produced 5.9 million quality-adjusted life years (QALYs). Using a value of £25,000 per QALY — the midpoint of the National Institute for Health and Care Excellence's normal threshold range — and allowing for the costs of delivery, this resulted in health benefits equivalent to £124 billion. In the calculation of the overall economic rate of return, the proportion of research attributable to the UK was around 17% and the lag between funding and impact for cancer interventions was around 15 years.

Of the interventions considered between 1991 and 2010, smoking reduction accounted for around 65% of the net monetary benefit to the UK, followed by cervical screening (24%) and breast cancer treatments (10%).

Drawing together the investment in research, net monetary benefits, and accounting for the time lag and proportion attributable to UK research, the study estimates that the rate of return from public and charitable funding in this area between 1970 and 2009 is 10%. This greatly exceeds the UK Government's minimum threshold return of 3.5% for its own investments[7].

If this is brought together with the current best estimates of 'spillover' gains[8] — the indirect impact of public and charitable research on the wider economy, such as leveraging private sector R&D activity — the total economic return is estimated to be in the region of 40%. In other words, the study estimates that every pound invested in public or charitable cancer-related research produces a stream of benefits equivalent to an average earning of 40 pence each year in perpetuity.

[7]HM Treasury (2003) *The Green Book: Appraisal and Evaluation in Central Government* https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/220541/green_book_complete.pdf

[8]Health Economics Research Group, Office of Health Economics, RAND Europe (2008) *Medical Research: What's it worth? Estimating the economic benefits from medical research in the UK (Chapter six literature analysis)* www.wellcome.ac.uk/economicbenefits

[9]Murray CJL, Richards MA, et al (2013) UK health performance: findings of the Global Burden of Disease Study 2010. http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(13)60355-4/abstract

A future research agenda

This study further refines the methodological approach used in the original *What's it worth?* study and its utility in calculating medical returns. Nevertheless the analysis is complex and the estimates are based on a range of assumptions and caveats (see boxed text opposite). In taking this field of enquiry forward, there are several streams of research that are important:

1. In developing this methodology, given the dominance of smoking cessation in the estimate of the return for both cancer and cardiovascular disease research, it would be beneficial to assess the magnitude of the return in an area where smoking is not a dominant determinant on incidence of disease.

2. More research is needed to explore the nature of 'spillover' effects from medical research. This analysis uses dated studies largely emanating from the US and their applicability to the current context is uncertain.

3. Further work is needed to understand the flow of knowledge, including how research diffuses across disciplines and international boundaries. This would enable us to learn more about how best to discover, share and ensure efficiency in the research ecosystem.

4. More research is needed to understand the time lags between research and impact, and how this differs across fields. It is important to examine if more can be done to shorten the gap between investment and the realisation of health benefits.

Conclusion

The results of this study strongly suggest that the rate of return derived from UK public- and charitably-funded biomedical and health research is substantial. This is consistent with the findings of the 2008 *What's it worth?* study, which estimated that the annual rate of return for cardiovascular disease research and mental health research was 39% and 37% respectively.

Given that cancer, cardiovascular disease and mental health disorders account for around 45% of the current burden of disease in the UK,[9] we conclude that investments in medical research produce a sizeable return in areas where there is a high morbidity.

Assumptions and caveats associated with estimating the net monetary benefit and rate of return	
Assumption/caveat	**Description**
1. Industry funding	Private sector R&D investments are included as part of the cost of delivering healthcare in the analysis, and are netted off from the net monetary benefits. The costs to the health service of medical interventions produced by industry include the return on its investment.
2. Valuing a quality-adjusted life year (QALY) at £25,000	The calculation used the mid-point of the normal criteria for acceptance of interventions by the National Institute for Health and Care Excellence (£20-30,000 per person per year). Using a lower or higher value would have affected the economic return estimate. This is examined in a sensitivity analysis presented in the academic paper[2].
3. Selection of cancer interventions	The interventions included in the analysis are known to cover a large population and/or a significant proportion of cancer-related morbidity. In the calculations, the total net monetary benefit for interventions not covered is assumed to be zero. In reality, there are cancer interventions and treatments for which the net monetary benefit may be negative due to the high cost of treatment and low incremental health gain; conversely there will be other areas which generate a significant number of QALYs at a relatively low cost.
4. Attributing interventions to cancer research	The methodology assumes that the total net flow of knowledge between disciplines is zero. In reality, research not classified as cancer (including from outside of the bioscience sector) is likely to have contributed to the development of cancer interventions and vice versa. Industry investment was captured as the cost of delivering the intervention, i.e. the costs of product development (see assumption 1).
5. Determining the lag time and link to UK research	Work to determine the lag time between medical research and its impact upon policy and practice is complex — the use of formal healthcare and practice guidelines provides one route to estimate this. A series of case studies has been produced alongside the study and explores how research translates into health benefit[10]. This demonstrates the complexity of biomedical and health innovation, especially when trying to measure the time it takes for research to develop into health benefits.
6. Smoking reduction made the largest contribution to the total net monetary benefit, but was an imperfect estimate	Of the £124 billion total net monetary health benefits used in the study, £80 billion (or 65%) arose from reductions in smoking. However, numbers for the increased proportion of the population who chose not to smoke or gave up are based on self-reported survey data, and this is linked to estimates of the reduced lifetime NHS costs and additional QALYs for these groups. This probably underestimates the advantage of smoking reduction as the analysis takes an NHS perspective and does not include any net benefits to other parts of the economy from the various measures to reduce smoking or passive smoking[11].
7. Variable quality of data on screening effectiveness	Three national screening programmes are important elements in the estimate. The clinical and cost-effectiveness evidence for bowel cancer screening is of high quality. However, it is more difficult to precisely quantify QALY benefits and cost-effectiveness for cervical screening and breast cancer screening.
8. Limited clinical and cost-effectiveness data	There is a lack of robust clinical and cost-effectiveness data for some interventions, especially for some well-established surgical techniques and hormonal therapies. Some older studies may have provided less accurate estimates of the true costs and benefits of interventions.

[10] Guthrie et al (2014) *Investigating time lags and attribution in the translation of cancer research: A case study approach* www.rand.org/pubs/research_reports/RR627.html

[11] Department of Health (2013) *An Audit of the Impact of the Department of Health's Regulations upon Businesses* https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/236741/dhregulations_impact_on_business.pdf

Academy of Medical Sciences
41 Portland Place
London W1B 1QH
T +44 (0)20 3176 2150
E info@acmedsci.ac.uk
www.acmedsci.ac.uk

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Cancer Research UK
The Angel Building
407 St John Street
London EC1V 4AD
T +44 (0)20 3469 8360
E publicaffairs@cancer.org.uk
www.cancerresearchuk.org

Cancer Research UK is the world's largest independent cancer charity dedicated to saving lives through research. In 2012/13, we spent more than £330 million on research. We support research into all aspects of cancer, from exploratory biology to clinical trials as well as epidemiological studies and prevention research.

Department of Health
Research and Development Directorate
Richmond House
79 Whitehall
London SW1A 2NS
E enquiries@nihr.ac.uk
www.gov.uk/dh

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Wellcome Trust
Gibbs Building
215 Euston Road
London NW1 2BE, UK
T +44 (0)20 7611 8888
F +44 (0)20 7611 8545
E contact@wellcome.ac.uk
www.wellcome.ac.uk

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