Medical Research: What's it worth?

A briefing on the economic benefits of musculoskeletal disease research in the UK

This briefing summarises a new peer-reviewed study estimating the economic returns generated by public and charitable investment in UK medical research, using musculoskeletal disease research as an exemplar. Musculoskeletal conditions affect the bones, joints, muscles and spine. They include common conditions such as osteoarthritis and rarer autoimmune conditions such as lupus. They cause pain, fatigue and isolation for over 10 million people in the UK.

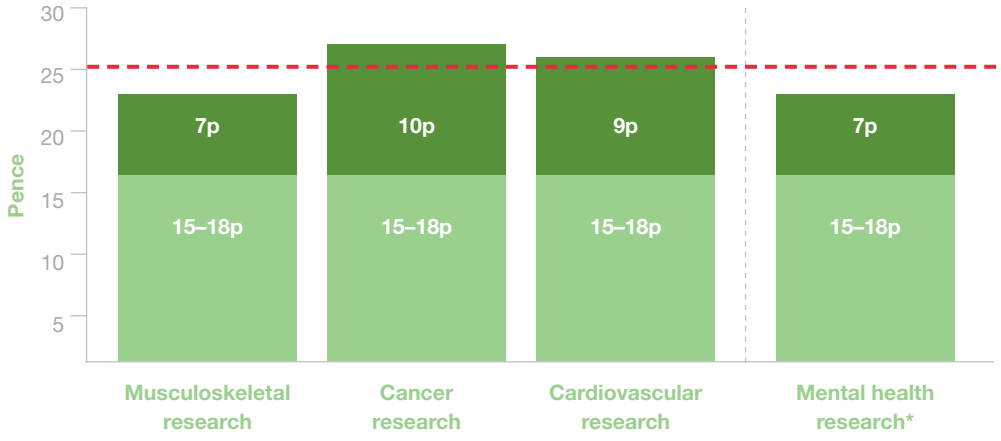
This new analysis was produced by the Policy Institute at King's College London, RAND Europe, and the Health Economics Research Group at Brunel University London, with funding from the Academy of Medical Sciences, Arthritis Research UK, the National Institute for Health Research, the Medical Research Council and Wellcome.

It is the third in the *What's it worth?* series of studies estimating the scale of economic returns from medical research[1,2,3]. Previous studies have focused on cancer, cardiovascular and mental health research, and have delivered consistent results – all of which are reflected in this briefing.

Every £1 invested in medical research delivers a return equivalent to around 25p every year, for ever.

What is medical research worth?

Equivalent yearly return from £1 of public or charity investment



*The figure for mental health research was derived from a more limited application of the methodology and is subject to greater uncertainty than the other figures.

What is the impact of these findings?

Government, charities and the public – through both taxes and donations – invest significant sums of money into medical research each year. Understanding the economic impact of this investment provides accountability, helps secure this investment over the long term and increases our understanding of how research is effectively translated into health improvements.

This briefing document is available to download from welcome.ac.uk/researchinvestment

How was this analysis done?

This new study on musculoskeletal conditions forms part of the wider *What's it worth?* series (referenced below for comparison). It builds on a ground-breaking methodology developed in 2008 which estimates the net health gain – the monetary value of research-led improvements to health and quality of life, offset against the net costs or savings to the NHS of the new treatments being used.

By linking this net health gain to the UK research which underpins it, and factoring in the time taken for research to alter clinical practice, a rate of return on public R&D investment is calculated. This is then combined with a separate estimate of the wider 'spillover' benefits (see below), to estimate the overall economic benefits of R&D.

Methodology

1. Calculate UK **R&D investment** in musculoskeletal disease over time

The major public and charitable funders of musculoskeletal research in the UK were identified and their average annual investments calculated, using annual reports, published accounts and bibliometric data.

Average annual research investment:

Musculoskeletal	£70m (1978–97)
Cancer	£290m (1976–95)
Cardiovascular	£133m (1975–98)
Mental health	£139m (1975–92)

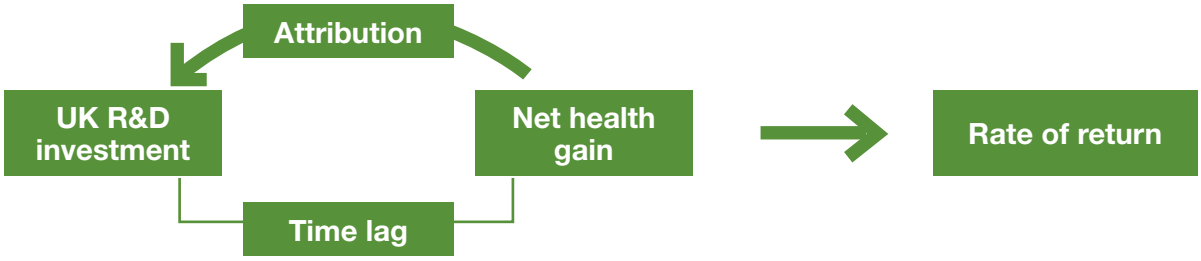
All adjusted to constant 2013/14 prices

2. Determine what proportion of relevant research was **attributed** to the UK

References cited in 22 national clinical guidelines for musculoskeletal conditions, drawn from sources including the National Institute for Health and Care Excellence (NICE) and the Scottish Intercollegiate Guidelines Network (SIGN), were examined to determine what proportion of the research had been carried out in the UK.

Attribution rate:

Musculoskeletal	30%
Cancer	17%
Cardiovascular	17%
Mental health	28%



3. Measure the **time lag** between research investment and its impact on clinical practice

The research referenced in the 22 clinical guidelines was analysed to estimate the average time lag between research findings being published and their use in clinical guidelines. This figure was then combined with estimates of the time lag between research funding being awarded and findings being published, and between the publication of the guideline and clinical practice changing, to estimate the total time between investment and health gains.

Average time lag:

Musculoskeletal	16 years
Cancer	15 years
Cardiovascular	17 years
Mental health	12 years

4. Estimate the **net health gain** from research-based interventions for musculoskeletal diseases

Working with experts, the team identified research-based treatments, their use in the NHS, and the Quality Adjusted Life Years (see Assumptions for details) linked to these treatments – allowing them to calculate the value of the health improvements they delivered. They then subtracted the cost to the NHS of delivering these treatments, such as medicines or physical therapy, giving the net health gain.

Average net health gain:

Musculoskeletal	£0.8bn (1994–2013)
Cancer	£6.5bn (1991–2010)
Cardiovascular	£3.6bn (1992–2005)
Mental health	£1.7bn (1987–2004)

All adjusted to constant 2013/14 prices

What is the spillover figure?

Public research funding stimulates or 'crowds in' private investment, resulting in a boost to economic activity through industry commercialising new products or investing in further research[4]. Previous *What's it worth?* studies used a spillover estimate of 30p per year, which was based on historic US data for agricultural research.

A 2016 study, funded by the Medical Research Council, used the latest UK data covering ten disease areas to give a more robust and specific estimate for the UK life sciences sector, of between 15p and 18p per year. Details of the methodology behind this figure can be found in the 2016 publication[4].

Case study: The development of anti-TNF therapy

The introduction of a new class of treatments (biological therapies) for musculoskeletal disease in the early 2000s revolutionised the treatment of inflammatory arthritis. The process of development that delivered these new therapies demonstrates the complex and lengthy path that leads to improved treatments and economic returns.

These therapies have transformed the quality of everyday life for many people with inflammatory arthritis. The first of these were treatments targeting a molecule called TNF (tumour necrosis factor), which occurs naturally in the body and plays a key role in inflammation. Public and charitable funding was critical throughout the research pathway, and included major investments from Arthritis Research UK (formerly the Arthritis Research Campaign) and the Medical Research Council among others.

1989

Experiments by UK researchers Fionula Brennan, Marc Feldmann and Ravinder Maini link inflammation and joint damage to TNF.

1991

Studies demonstrate that blocking TNF may have therapeutic potential for treating rheumatoid arthritis.

1992

Trials in mice, led by Richard Williams, prove that blocking TNF can protect bone and cartilage in rheumatoid arthritis.

1993

In partnership with a biotech firm, researchers conduct a highly successful clinical trial of anti-TNF therapy in 20 people.

1998

Trials show that using anti-TNF treatment in a combination therapy improves disease symptoms even further.

2000

The new treatment, infliximab, is tested in the large-scale ATTRACT trial, involving patients across Europe and America.

2002

Royalties for anti-TNF therapies begin to be paid out, including to Arthritis Research UK.

2004

Follow-up studies show that health improvements are sustained two years after infliximab treatment.

2007

NICE recommends anti-TNF treatment for people with rheumatoid arthritis.

2013

The European League Against Rheumatism (EULAR) recommends anti-TNF treatment for people with rheumatoid arthritis.

2015

Globally, three top-selling drugs are anti-TNF treatments, with sales totalling £19bn. Infliximab has been used by 1.9m patients, significantly improving clinical outcomes.

The success of anti-TNF therapy spurs new research into other biological therapies.

What are the assumptions/caveats?

The figures discussed in this briefing represent estimates based on a methodological analysis of available data. Crucially, these estimates represent an assessment of investment in, and performance of, musculoskeletal research, and not a guarantee of outcomes for future investments. Due to the complexity of this analysis, several assumptions and caveats apply, some of which are specific to the musculoskeletal study, while many are common across the entire series of *What's it worth?* studies.

Assumption	Reasoning
Industry funding	Industry also invests in R&D, but this investment is not captured as part of the funding inputs. This is because it is assumed that industry recoups their R&D costs through the price they charge for the interventions they develop. The cost to the NHS of implementing new interventions is accounted for in the net monetary benefit calculation, meaning that the industry investment is captured at this stage of the analysis.
Value of a QALY	A quality-adjusted life-year (QALY) is a measure of disease burden which reflects both the quality and the quantity of life, with one QALY equating to one year in perfect health. In this study, a QALY was valued at £25,000, a figure consistent with previous studies in this series and the mid-point of the normal criteria for acceptance of interventions by NICE (£20,000–30,000 per person per year). Using a lower or higher value would affect the economic return estimate, as explored further in the research paper.
Musculoskeletal conditions included	The interventions included in the analysis were prioritised with the support of an expert panel, and cover inflammatory arthritis (including rheumatoid arthritis, juvenile idiopathic arthritis, ankylosing spondylitis, psoriatic arthritis, and gout), osteoarthritis, connective tissue disorders (including lupus and dermatomyositis), back pain and dorsopathies, and osteoporosis. Some treatment advances that have occurred over the period of interest do not yet have sufficiently robust data on their cost-effectiveness, and were therefore excluded.
Selecting interventions	The range of pharmaceutical and non-pharmaceutical interventions included in the analysis are known to cover a large population and/or a significant proportion of musculoskeletal disease-related morbidity. In the calculations, the total net monetary benefit for interventions not covered is assumed to be zero. In reality, there are 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 that generate a significant number of QALYs at a relatively low cost.
Attributing interventions	The methodology assumes that the net flow of knowledge between disciplines is zero. Research not classified as targeting musculoskeletal disease (including from outside the biosciences) is likely to have contributed to the development of musculoskeletal disease interventions, and vice versa, effectively cancelling each other out.
Determining the lag time	Bibliometric analysis of clinical guidelines was used to estimate the time between research investment and health gain, providing empirical estimates but also simplifying a complex and varied process. Although a proxy, the estimates produced are similar to other studies[5].
Impact of smoking cessation	Smoking reduction is a significant contributor to the economic return values for cancer and cardiovascular disease, but is not thought to be a major contributor for musculoskeletal disease. Expanding the *What's it worth?* series to include different disease types, such as musculoskeletal conditions, allows a more robust judgment of the rate of return for medical research as a whole.
Data availability	Data on the cost-effectiveness and usage of drugs was of relatively high quality, but was much poorer for some interventions, such as those for back pain. In part this reflects the complexity and variability of the physical therapies potentially provided to multiple groups of patients.

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