The Added Value of NIHR Biomedical Research Centres – an Update to the 2020 Economic Analysis

April 2026

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The Partnership for Responsive Policy Analysis and Research (PREPARE) provides fast-response analysis to inform developing policy. The research programme is led by the University of York and funded by the NIHR Policy Research Programme (grant number NIHR200702).

Views expressed are those of the authors and not necessarily the NIHR or the Department of Health and Social Care.

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Background

Biomedical Research Centres (BRCs) and Biomedical Research Units (BRUs) were established in 2007 by the National Institute of Health Research (NIHR). The NIHR currently funds 20 BRCs, which are collaborations between world-leading universities and NHS organisations that bring together academics and clinicians to translate laboratory-based scientific breakthroughs into potential new treatments, diagnostics and medical technologies. Through employment and spending they contribute to their local economies and they may also attract investment from other national and international funders, furthering the nation's economic growth.

Together, BRCs and BRUs have received over £2.5 billion of funding from the NIHR and further funding has been raised from other public and private sources such that total funds received to 31 March 2024 were £14.62 billion.

A previous report by the University of York and York Health Economics Consortium (YHEC) in 2020 attempted to quantify the economic impact of government and charity funding on medical research, using an economic model to estimate the complementary relationship between public/charity and private pharmaceutical research and development expenditure, as well as estimating income and the value of job creation of the BRCs using a macroeconomic approach. This report revises the findings and calculations of the 2020 report by updating literature reviews performed for that report, updating the inputs included in the analysis in light of changes in the Treasury Green Book and reviewing the calculation methodologies.

Findings

The economic returns attributable to NIHR funding of the BRCs/BRUs have been estimated from:

- Health gains, net of the health care costs of delivering them.
- Private sector returns from private sector investment leveraged through BRC funding less the cost of capital.
- As a separate analysis, public and private spillover benefits.

The 2020 analysis also included gains to the local and national economy through the use of type 1 multipliers. Use of type 1 multipliers is no longer recommended in the Treasury Green Book and as such have not been included in this updated analysis.

The updated literature review and review of calculation methods resulted in some values used in the economic model being different in the current calculation when compared to the values used in the 2020 analysis. These are summarised in the following table.

Model element	2020 value	Updated value
Increase in private funding for £1 increase in NIHR funding	£0.98	£1.05
Foreign ownership	53.0%	37.1%
Cost of capital (opportunity cost of private funding)	7% per annum (pa)	7% pa
Return on private capital	10% pa	10% pa
Private sector return included in model	10% pa	3% pa (return on capital minus cost of capital)
Depreciation	11% pa	11% pa applied to spillover only
Spillover	50%	50% for private funding, 30% for public funding
Time lag before benefits arise	4 years	4 years for spillover, 10 years for commercial profit and health benefits
Health benefit return	16% pa	13% pa
Negative cash flow included in calculation	NIHR and private funding	NIHR funding only
Discount rate of future cash flows	No discounting	3.5% pa
Discount rate of future QALY benefits	No discounting	1.5% pa
Time horizon	15 years	20 years

The modelling suggests that, excluding spillover, for a £100 increase in additional funding from the NIHR there would be £247.82 in discounted cashflows over 20 years giving a Net Present Value of £147.82. This gives a benefit cost ratio (BCR) of NIHR funding to biomedical research of 1.478 over 20 years, equivalent to an annualised return over 20 years of 4.7% per annum. Around 92% of this return is due to QALY gains generated from investment.

Including spillover, the discounted cashflows over 20 years would be £678.37 with a Net Present Value of the NIHR funding of £578.37. This would give a BCR of 5.783, equivalent to an annualised return over 20 years of 10.0% per annum.

Conclusions

NIHR expenditure on biomedical research appears to provide a good return on investment. Updating the 2020 estimate suggests the annual rate of return from an increase in NIHR investment in BRCs is around 4.7%. Over 20 years this means that every £1 of NIHR funding will generate £2.47 in health benefits and private sector return. If spillover is included, the return increases to 10.0% with, over 20 years, every £1 of NIHR funding generating £5.78 in health benefits, private sector return and wider societal and private benefit.

The rates of return calculated in this report are lower than that estimated in the 2020 report, primarily due to lower spillover rates being used for public sector funding, the application of depreciation to spillover, the discounting of future cashflows and accounting for the cost of capital for private sector return. The approach taken in the current analysis is more transparent and still highlights potential substantial returns from NIHR funding, with BCRs well above 1 even when spillover is not taken into account. We consider that given the uncertainty around spillover (but its significant impact on estimated return) that the return with spillover should only be presented side by side with the return without spillover.

The limitations of the analysis largely remain as those in the 2020 report. Many of the values to populate the cashflow model are not known with confidence and so the actual return on NIHR funding remains uncertain. Given this we have used what we consider to be cautious assumptions where possible, to try to ensure the return presented is an under rather than over estimation. For example, we have estimated the private sector return after the cost of capital at 3% per annum after 10 years. This is likely to be an underestimate as it is based on a return above the cost of capital essential for all industries where the return, on average, is likely to occur well before the 10-year lag assumed in our calculation. Private investment that has longer waits for return will require higher returns over the cost of capital compared to those with shorter lengths of time before returns start to be generated.

The results of this analysis are important in the context of the NHS 10-Year Plan and the Life Sciences Sector Plan.[1] [2] The 10-Year Plan includes a focus on clinical priorities such as cancer, heart disease, stroke and mental health and also includes an emphasis on disease prevention. The Life Sciences Sector Plan has 3 main pillars which are:

- Enabling world-class research and development.
- Making the UK an outstanding place to start, scale and invest.
- Driving health innovation and NHS reform.

BRCs have an important role in this policy context so it is important that investment in their work is evaluated and shown to be value for money.

[1] NHS England (2025), Fit for the Future: 10 Year Health Plan for England, GOV.UK.
[2] UK Government (2025), The Life Sciences Sector Plan, GOV.UK.

1 Introduction

The National Institute for Health and Care Research (NIHR) Biomedical Research Centres (BRCs) are collaborations between universities and NHS organisations that bring together academics and clinicians to translate discoveries from basic or discovery science into clinical research. From their establishment in 2007 to 2020, BRCs and Biomedical Research Units (BRUs) received over £1.4 billion from the NIHR. In 2020, the University of York and York Health Economics Consortium (YHEC) were commissioned to assess the value for money of BRCs. This was via the Partnership for Responsive Policy Analysis and Research (PREPARE), which is a collaboration between the University of York and the King's Fund. The research programme is funded by the NIHR Policy Research Programme.

The analysis was reported in August 2020[3] and the key findings were:

- NIHR expenditure on biomedical research appears to provide a good return on investment, with an estimated annual rate of return from an increase in NIHR investment in BRCs of around 29%.
- NIHR investment also appears to attract further funds from charitable and private sector sources. Up to 2019, BRCs raised further funds from other public and private sources of £7.86 billion.
- BRCs exist across England but funding is highly skewed towards Oxford, Cambridge and London. These areas realise the largest economic benefits, particularly from employment and other spillovers to local economies. They may also benefit disproportionately from innovation, if uptake is faster in areas local to where the research takes place. This creates the potential to perpetuate geographic inequalities in both health and productivity.

New contracts for the 20 current BRCs started in December 2022 and end in March 2028, with around £840 million awarded in the current scheme.

The Department of Health and Social Care (DHSC) has asked for the University of York and YHEC to update the 2020 analysis. In addition, the DHSC also asked how productivity effects of BRCs should be captured.

The first phase of the research was to undertake an initial scoping review of the methods in the 2020 analysis, to consider the value of reperforming each aspect of the analysis. This also explored if, and how, the analysis should change in light of the latest 2022 version of the HM Treasury Green Book [1]. The scoping report suggested that most elements of the 2020 research should be revisited to ensure that the analysis performed remained sufficiently robust and to update it where better evidence is now available.

[3] Craig J, Castro Avila A, Dale V, Hex N, Bloor K. Estimating the economic value of Biomedical Research Centres and Units. University of York and York Health Economics Consortium. August 2020. https://www.york.ac.uk/media/healthsciences/documents/Estimating%20the%20Economic%20Value%20of%20NIHR%20Biomedical%20Research%20Centres%20and%20Units.pdf

This report presents the findings of the evidence searches and the evidence identified to update the analysis (where suggested by the scoping report) as well as updated estimates on the return on investment from BRCs based upon the new evidence found. The report also provides the analysis related to productivity effects of the BRCs.

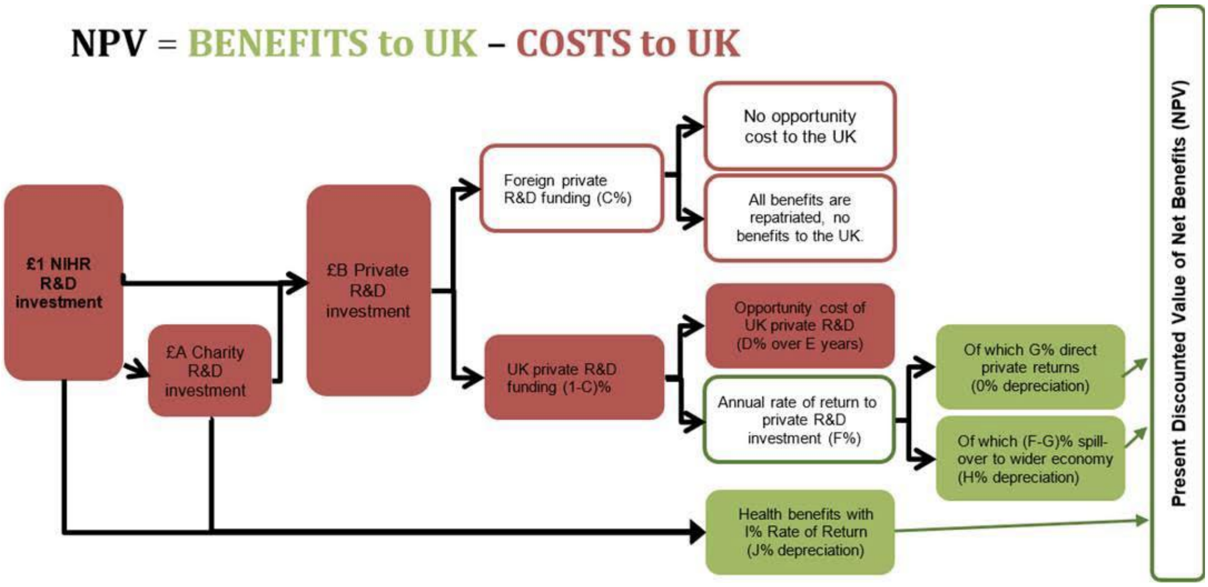
2 Methodology

The 2020 analysis undertook two approaches to assessing the value for money of BRCs:

- Populating a model developed by the DHSC, shown in Figure 2.1.
- Undertaking an input-output analysis.

To update both analyses, the scoping review considered each of the parameters required to undertake the analysis, the approach taken for the 2020 analysis, whether the estimates of the parameters should be updated, and, if so, how the estimates of the parameters should be updated. Each of the parameters is considered in turn in the following sections.

Figure 2.1: Net present value to UK economy from marginal spend by NIHR on BRCs



Abbreviations: BRC, Biomedical Research Centres; NIHR, The National Institute for Health and Care Research; NPV, present discounted value of net benefits; R&D, Research and development.
Source: DHSC 8th November 2020, personal communication

3 Level of Private Sector Research Funding Crowded in by Public Sector Spend

3.1 Summary of the 2020 Report Findings

The 2020 analysis reran a vector error correction model (VECM) created by Sussex et al [2] and estimated that a 1% increase in public (i.e. government plus charity) sector biomedical research and development (R&D) expenditure was associated with a 0.75% increase in private sector expenditure (0.68% for government funding only). Charitable funding was accounted for in the context of total public sector expenditure rather than a specific link to NIHR funding. This was in line with the value reported by Sussex of 0.8%. Both Sussex and the 2020 report highlighted severe limitations in the analysis, notably around data quality and the sensitivity of results to changing model specifications.

3.2 Methods to Update the 2020 Report

A pragmatic search in PubMed highlighted no new studies published since 2020 which undertook similar modelling to estimate the impact of crowding in. Further, quality issues highlighted in the 2020 report will still be apparent if the analysis was to be rerun, with the only benefit now being that there are four more years of data. It is unlikely that additional data would change the relationship suggested in the 2020 report. Given that the COVID-19 pandemic occurred since then, it is more likely that including any additional data would just confound and potentially weaken previous findings.

Updating the VECM undertaken in 2020 would have required a significant amount of time and budget which, at the scoping stage, was considered to add little value to the analysis.

3.3 Values Used in Current Analysis

As no new research was identified and the VECM was not rerun, the parameter value used in the 2020 analysis (0.68%) was used in the updated analysis.

4 Time Lags Between Investment and New Therapies

4.1 Summary of the 2020 Report Findings

The 2020 report updated a literature review by Hanney [3] which itself updated a literature review by Morris [4]. The Hanney and Morris reviews found that time lags in studies were not recorded in consistent ways and that time lags differed between therapeutic areas. Hanney reported mean time lags between investment and new therapies being used in clinical practice in the literature ranged from 8.5 years to 15 years with Morris reporting a mean lag of 17 years. However, Hanney developed a 'process marker model' that defined medical technology development as four stages: discovery research, human research, regulatory approvals and clinical practice. The authors applied this model to 7 case studies and reported lags from 18 to 54 years with a mean lag in the case studies of 34.6 years.

On updating the Hanney literature review, the 2020 report identified 15 studies on lags with an average lag of around 14 years from patent to regulatory approval. Increasing trial complexity and increased bureaucracy were identified in studies as reasons that total time lags had potentially increased. But studies reported that processes by law makers and regulators were being or had been introduced to reduce the time and cost to conduct trials and to speed up the regulatory appraisal process that could reduce lags.

4.2 Methods to Update the 2020 Report

The literature review in the 2020 report was updated to identify what evidence on time lags has been published over the past five years.

The search strategy used in the 2020 report was an adapted version of the Hanney [3] strategy which was replicated for the current analysis. The full search strategies are in Appendix A and the resources searched are in Table 4.1.

Search resources

Table 4.1: Databases searched

Resource	Interface / URL
MEDLINE(R) ALL	OvidSP
Embase	OvidSP

After deduplication, abstracts were uploaded into Covidence with a single reviewer selecting studies for full text review and then final study selection. Studies were only included if they related to technologies that had been approved for routine use in clinical practice with details of the time taken between different stages of technology development through to clinical use.

4.3 Literature Search Results

The literature searches were run on 4 February 2025. 1,621 records were retrieved, with 1,213 unique studies identified. Following abstract screening, 71 studies were assessed at full text for eligibility. After full text review, 8 studies were identified that provided sufficient information on time lags for inclusion in the review.

4.3.1 Studies of single drugs

5 of the studies described the developmental history of single drugs. None of these studies were looking specifically at lags or delays in the development process but provided timeline information on development that allowed lags to be calculated. Only one of the studies provided any information on how delays had been minimised. The findings from the studies are summarised in Table 4.2.

Agarwala [5] reported the bench to bedside history of Bempedoic acid for heterozygous familial hypercholesterolemia (HeFH), starting with drug discovery in 2001 and US Food and Drug Administration (FDA) and European Medicines Agency (EMA) approval in 2020. The authors reported that there was 8 years from drug discovery to Investigational New Drug Application (IND) with the FDA and a further 10 years until New Drug Application with the FDA and Marketing Authorisation Application with the EMA. There was, therefore, a 19-year lag from drug discovery to approval by the FDA and EMA, but only a one-year lag from applications with the FDA and EMA and approval.

Oliveira [6], a poster abstract, provided information on the timeline for development of selpercatinib for RET (rearranged during transfection) fusion positive cancers. The RET mutation was first identified in 1987, with selpercatinib receiving FDA Breakthrough Therapy designation in 2018. Results from the first Stage I/II trial (single arm) for selpercatinib (LIBRETTO-001) were published in 2019 with the first full FDA approval for selpercatinib occurring in 2020. The time lag was, therefore, 33 years from the identification of a therapeutic target until an approved treatment, but just one year from publication of Stage I/II trial results to full FDA approval.

Topol [7] , a poster abstract, detailed the development timeline of the Pfizer-BioNTech mRNA (messenger RiboNucleic Acid) vaccines for SARS-COV-2 infection. There was a 4-month gap between the sequencing of the virus to the first phase I/II trial and a further 6-month gap until efficacy results were released, with the FDA granting Emergency Use Authorization a month later.

Tam [8] described the development of Zanubrutinib, a Bruton tyrosine kinase inhibitor (BTKi) for leukaemia and lymphoma, from the search for a suitable molecule in 2012 to approval by various regulators for different conditions between 2019 and 2023. Taking 1 year from starting the search for a molecule to identification of Zanubrutinib, the drug developers decided to run the first human trials in Australia due to "the country's favourable regulatory environment and rapid clinical research start-up capability". This started 1 year after Zanubrutinib was discovered. It took a further three years for the first pivotal studies and 2, 3 and 4 years after the start of the pivotal studies for the first approvals in the USA, China and the EU respectively. The time lag from identification of Zanubrutinib to first approval was, therefore, 7 to 9 years, depending on the market.

Wilkinson [9] summarised the history of inclisirin (a small interfering RNA) to lower cholesterol from the discovery of RNAi (Ribonucleic Acid interference) in 1998, to FDA approval in 2021. The PCSK9

(Proprotein Convertase Subtilisin/Kexin Type 9) gene, which inclisirin targets, was discovered in 2003, representing a further five years of research until publication of data on agents that target PCSK9. There were then 3 more years until the first human trials. Following the first human trial, it took 6 years for the first phase III trial to start and then a further 3 years for EU approval and 4 years to USA approval. The time lag from the discovery of RNAi to inclisirin gaining regulatory approval was, therefore, 22 years (23 years in the USA). But from the discovery of inclisirin to approval there was a lag of between 12 to 17 years. Inclisirin was discovered some point between 2003 when the PCSK9 gene was identified and 2008 when its discovery was reported in a publication.

Table 4.2: Studies of time lags involving single drugs

Study (year)	Context	Country	Dates	Start of time lag	End of time lag	Time lag (years)	Reasons for time lag	Policy measures to address
Agarwala [5]	Bempedoic acid for heterozygous familial hypercholesterolemia (HeFH)	USA and EU	2001 to 2020	Drug discovered. Investigational New Drug (IND) application in 2009. New Drug Application and Marketing Authorization Application in 2019	FDA and EMA approval	19 years from drug discovery to approval. 11 years from IND application to approval. One year from FDA/EMA application to approval	Not reported	Not reported
Oliveira [6]	Selpercatinib for RET fusion-positive cancers	USA	1987 to 2022	RET fusion first identified	FDA approval	From RET fusion being identified to Selpercatinib having FDA breakthrough designation: 21 years. FDA breakthrough designation to first FDA approval: 2 years. Publication of key phase III trial results to FDA approval: 1 year	Not reported	Not reported
Topol [7]	Pfizer COVID vaccine	USA	2020	Start of phase 1/2 trial	FDA emergency use authorisation	7 months from phase 1/2 trial to emergency authorisation	Not reported	Not reported

Tam [8]	Zanubrutinib in leukaemia and lymphoma	USA, EU, China and Australia	2012 to 2023	Establishment of programme to identify a Bruton tyrosine kinase (BTK) inhibitor	US approval in chronic lymphatic leukaemia and small lymphatic lymphoma	1 year from search for molecule to invention of Zanubrutinib. 1 year from invention to first human study. 3 years from first human study to first pivotal studies. 2 years from first pivotal studies until first approval in USA. 3 years from first pivotal studies until first approval in China. 4 years from first pivotal studies until first approvals in other markets, including EU. 6 years from first pivotal studies until approval for CLL and SLL in USA.	Decision was made in 2013 to run first human trials in Australia due to "the country's favourable regulatory environment and rapid clinical research start-up capability".	Not reported
Wilkinson [9]	Inclisiran to lower cholesterol	USA	1998 to 2021	Discovery of RNAi influence on cholesterol	US approval	5 years from RNAi research published to PCSK9 gene discovered. 5 years from PCSK9 gene discovery and publication of data on agents targeting PCSK9. 3 years from publication of data on agents targeting PCSK9 and first human trials. 3 years from first human trial to first phase 1 trial. 3 years from first phase 1 trial to first phase 3 trial. 3 years from first phase 3 trial	Not reported	Not reported

						to EU approval. 4 years from first phase 3 trial to USA approval.		

4.3.2 Studies of multiple drugs

Two studies provided summaries of the development timelines of multiple drugs in the same disease area.

Berg [10] reviewed factors associated with successful translation of disease modifying therapy (DMT) discoveries for treating multiple sclerosis from animal to human studies. Whilst this is not directly relevant for this review, timelines from first animal study to first trial in patients and FDA approval was provided for 26 DMTs, from 1977 to 2024. The median time from first animal trial to first trial in patients was 4 years, and from first animal study to FDA approval the time lag was 9 years. However, the authors pointed out that the first animal studies published are sometimes after the first human trials. As such, the time lags reported may not be meaningful in understanding delays in the development process.

de Oliveira Lupatini [11] looked specifically at the time taken for research findings to turn into treatments used in clinical practice for rheumatoid arthritis (RA) in Brazil. The authors proposed a three-stage process for translational research: basic research to clinical research (T1), clinical research to research synthesis (T2) and research synthesis to evidence based practice (T3). For the 5 RA drugs that were assessed by SUS (Sistema Único de Saúde), the Brazilian drug regulatory body, between 2012 and 2019, the authors reported the mean time for T1 at 5.3 years, T2 at 5.08 years and T3 at 0.75 years giving a total lag time from the start of T1 (the publication of Phase 1 results) to the end of T3 (the first dispensing record) of 11.13 years.

The authors concluded that delays in basic research occur due to unnecessary time spent on registration activities with regulators and that Brazil has successfully worked to reduce delays in the T1 stages by setting legal timelines on how quickly regulators register investigational drugs and registering clinical trials. The authors consider that whilst Brazil has successfully reduced the time in T2, time lags could be reduced further in Brazil and elsewhere in the world, if Health Technology Assessment (HTA) agencies shared documents and experiences with a standardization of translational research markers. However, delays in the T2 phase continue to occur due to trial results not being published in a timely manner, despite WHO guidelines that trial results should be published within 24 months.

Table 4.3: Studies of time lags involving multiple drugs

Study (year)	Context	Country	Dates	Start of time lag	End of time lag	Time lag (years)	Reasons for time lag	Policy measures to address
Berg [10]	26 disease modifying therapies (DMTs) for multiple sclerosis	USA	1977-2024	First animal or human trial	FDA approval	Median times: First animal trial to first trial in patients: 4 years. First animal trial to FDA approval: 9 years. Authors note that first published animal studies may have happened after first in human trials. Times may not, therefore, be a good indication of lag and so may not necessarily be a good indicator of lag.	Not reported	Not reported
de Oliveira Lupatini [11]	5 biologic treatments for rheumatoid arthritis	Brazil	2012 to 2019	Basic research	Evidence based practice	Mean time lags: Basic research to clinical research (publication of phase one trial to first registration with regulator such as FDA): 5.30 years.	Delays in basic research occur due to unnecessary time spent on registration activities with regulators. Delays then occur due to trial results not being	Time lags could be reduced if HTA agencies shared documents and experiences. There needs to be a standardization of translational research markers. Brazil has set legal timelines on how quickly regulators must assess new technologies which the authors

						Clinical research to research synthesis (first registration with regulator to Brazilian regulator to regulator publishing guideline): 5.08 years. Research synthesis to practice (published guideline to first dispensing record): 0.75 years.	published in a timely manner.	consider has reduced time lags in that part of the process.

4.4 Values Used in Current Analysis

The findings from the updated review broadly align with those from the 2020 study, with time lags between 10 to 15 years from identification of a target molecule to approval by regulators. There are much longer lags from initial discovery of potential therapeutic targets to an approved treatment. As was the case in the 2020 study, comparison of lags between studies is problematic due to the inconsistent way that key developmental points are provided or described. However, the move towards faster approval by regulators, following the publication of pivotal (not necessarily phase III) trials reducing the lag in that part of the development process, appears to be being realised by agencies in the EU, the USA and elsewhere [11].

Studies included in the review also would support a conclusion that significant lags still occur due to the time taken to start and complete clinical trials. There is, however, evidence in Brazil and Australia that suggests that relaxing regulatory requirements and expediating assessment of trial protocols has, in these countries, expedited this part of the process [8], [11].

All studies identified in the review are necessarily historical and may not reflect time lags for technologies being developed currently. Further, treatments that are taking longer to develop and have not yet been approved will not have been included in the review and so conclusions on time lags from the review (and indeed previous reviews) may be biased towards a shorter time lag.

The one study of a recent technology with a very short time lag was that of the Pfizer COVID-19 vaccine. This showed a time lag of less than 12 months from DNA sequencing of the virus to vaccine approval, which at face value suggests that time lags may be reducing.

However, whilst not providing details of time lags, a study by Hanney [12] predicted (before a vaccine was available) that the collaboration between pharmaceutical companies in developing a vaccine and the resources dedicated to vaccine development by national governments, as well as the prioritisation of vaccines by regulators, would likely result in quick adoption. However, these conditions were thought by the authors to be unlikely to be replicated for other new medical technologies and so the shortness of the time lag in developing COVID-19 vaccines was unlikely to be replicated again. Whether any process learning from the speed of development of the vaccine will reduce lags in future drug development remains to be seen.

5 Internal Rates of Return (IRR) Arising From the Health Gain of Public Sector Investment Measured in Quality-Adjusted Life Years (QALYs)

5.1 Summary of the 2020 Report Findings

An IRR value of 16% was used in the 2020 analysis, based on studies from 2008 and 2018 on the IRRs for QALY gains from public sector research in four disease areas (musculoskeletal (MSK) conditions, cancer, mental health and cardiovascular disease (CVD)). This was based upon a QALY value of £60,000 and time lags of 12 to 17 years from research to approved treatments.

5.2 Methods to Update the 2020 Report

A search strategy was developed to identify any literature that had been published since the start of 2020 on QALY gains arising from biomedical R&D. The DHSC stated an interest specifically in dementia, so the strategy was modified to include dementia as a search concept. The dementia search was conducted from 2000 onwards and the search on all biomedical research was conducted from 2020 onwards.

The search strategy was designed to be as sensitive as possible given the project context and resources. The scope of the search was broad and so selected subject headings were focused. The full search strategies are available in Appendix A and the resources searched are in Table 5.1.

Search resources

Table 5.1: Databases searched

Resource	Interface / URL
MEDLINE(R) ALL	OvidSP
Embase	OvidSP
EconLit	OvidSP

After deduplication, abstracts were uploaded into Covidence with a single reviewer selecting studies for full text review and then final study selection. Studies were only included if they provided an estimate of QALY gains or health related IRR from biomedical R&D.

5.3 Literature Search Results

The literature searches were run on 26 February 2025. 3,520 records were retrieved with 2,467 unique studies identified for the search for all conditions, and 225 unique studies from the search specifically for dementia. Following abstract screening, 12 studies were assessed as full text for eligibility for the review of all conditions, and 7 studies were assessed as full text for the dementia specific review. None of the studies provided estimates of QALY gains or health related IRR from biomedical R&D.

The DHSC made YHEC aware that a publication was in preparation updating IRR values reported in HERG et al. 2008 [5], Glover et al. 2014 [16] and Glover et al. 2018 [17] with estimates of cost inflation and also to reflect the latest QALY value of £70,000 recommended by the Green Book.
IRRs for the four disease areas were then weighted to reflect the proportion of NIHR spend in each area giving an average total IRR of 13%. These calculations are estimates are a reworking of the original analysis with no new primary research added.

5.4 Values Used in Current Analysis

As no new studies were identified, the IRR of 13% from the reworked and as yet unpublished analysis was used.

6 Cost of Capital, Accounting and Depreciation Policies

6.1 Summary of the 2020 Report Findings

The 2020 analysis undertook a pragmatic literature review to provide an estimate of the private sector return on investment (ROI) (the monetary value of an investment against its cost) and cost of capital (the return required for investors to finance an activity). This was used to provide evidence for an assumed 10% return and 7% cost of capital. The lifetime of R&D assets was assumed to be 9 years, based upon an Office for National Statistics (ONS) Blue Book value from 2019.

6.2 Methods to Update the 2020 Report

A rapid search was undertaken in the scoping phase to identify whether the values for private sector ROI and cost of capital were still relevant. A literature review was identified from 2024 which suggested a cost of capital of between 8.1% and 14.5% for the biomedical sector in the US [13]. A report by Deloitte in 2023 suggested the ROI on pharmaceutical R&D in the US fluctuated between 1.5% and 7.2% between 2013 and 2023 [14]. The scoping assessment concluded that an accurate estimate of the cost of capital and ROI for UK investment in pharmaceutical investment was probably not available, and that the rates used in the initial analysis (which are of UK-based investment) remained reasonable. Further, there have been no changes in the 2022 Green Book that would affect the findings [1].

The Blue Book value of 9 years for the lifetime of R&D assets was checked to ensure it had not changed, which it had not.

6.3 Values Used in Current Analysis

The current analysis uses values of a 10% private sector ROI, 7% cost of capital and lifetime of R&D assets of 9 years as in the 2020 analysis.

7 Spillover and Social Rate of Return

7.1 Summary of the 2020 Report Findings

An estimate of spillover or social rate of return of 50% was used in the 2020 analysis, which was based upon values used by Sussex [2]. No new values for the UK were found from a literature search conducted in 2020. Spillover was assumed to occur in year five after the initial investment. The 2020 report concluded that the empirical evidence base for UK spillover and social return on biomedical R&D was weak.

7.2 Methods to Update the 2020 Report

The literature review in the 2020 report was updated to identify what empirical evidence on spillover and social return had been published since the start of 2020.

The searches were originally derived from a Health Economics Research Group (HERG) report [15], and were updated for the report in 2020. The same search methods were replicated as far as possible for this 2025 update, with searches limited to 2020 to 2025. The full search strategies are available in Appendix A, and the databases searched are shown in Table 7.1.

Search resources

Table 7.1: Databases searched

Resource	**Interface / URL**
Databases	
PubMed	https://www.ncbi.nlm.nih.gov/pubmed/
EconPapers	https://econpapers.repec.org/
Econlit	OvidSP
British Library main catalogue	https://bll01.primo.exlibrisgroup.com/discovery/search?vid=44BL_INST:BLL01&lang=en

After deduplication, abstracts were uploaded into Covidence with a single reviewer selecting studies for full text review and then final study selection. Studies were only included if they provided an empirical estimate of spillover or social rate of return.

7.3 Literature Search Results

The literature searches were run on 5 February 2025. 465 results were retrieved with 287 unique studies identified. Following abstract screening, 2 studies were assessed at full text for eligibility. None of the studies provided quantitative estimates of spillover or social rate of return.

7.4 Values Used in Current Analysis

The current analysis uses the same spillover value of 50% for private R&D expenditure as in the 2020 analysis. The 2020 analysis also identified a 30% spillover value for public funded R&D which was not used in the final calculation which we have used in the update. However, the continuing absence of empirical evidence for this parameter suggests it could be a priority for future specific econometric research to provide a more robust estimate.

8 Foreign Versus UK Ownership of Biomedical Companies

8.1 Summary of the 2020 Report Findings

A search of key websites including the ONS, Office for Life Sciences (OLS) and Association of British Pharmaceutical Industries (ABPI) was undertaken for the 2020 report. Data from the OLS showed that in 2018 foreign owners of life sciences companies accounted for 65% of the turnover and 52% of the employees in the sector in the UK. Statistics from 2017 showed 59% of companies in the life sciences sector (where known) were UK companies. ONS data from 2018 reported that foreign-owned companies were responsible for 53% of UK spend by pharmaceutical companies on research and development.

8.2 Methods to Update the 2020 Report

As was the case in the 2020 report, no literature search was undertaken. Rather, the following websites were searched using terms including ‘import’, ‘foreign’, ‘overseas’, ‘USA’ and ‘EU’:

- ONS.
- OLS.
- Association of British Healthcare Industries (ABHI).
- ABPI.
- Association of Medical Research Charities (AMRC).
- National Audit Office.
- Medical Research Council (MRC).

A Google search to identify any other publications that may hold this data was also performed using the strings:

- (Foreign OR overseas) AND (ownership OR R&D OR ‘Research and development’ OR employment) AND (UK OR British OR United Kingdom) AND (pharmaceutical OR life sciences).

Only information that provided statistical estimates of foreign ownership was considered relevant.

8.3 New Data Identified

The ONS produces the Business Enterprise R&D (BERD) datasets annually, with the latest data being for the year 2023[4]. This data showed a marked decrease in the percentage of R&D expenditure in the pharmaceutical sector by foreign owned companies from the 53% reported in 2018 to 37.1% in 2023.

The OLS produces official statistics on ownership, employment and turnover for the bioscience and health technology sector. The latest data is for the period 2021/2022[5]. Where ownership was known foreign-owned companies accounted for 38% of sites, 66.3% of turnover and 56.4% of all staff employed in life sciences in the UK. These are all slight increases compared to 2018.

Searches of the other websites and a wider google search of the did not produce any further estimates.

8.4 Values Used in Current Analysis

The percentage of R&D expenditure in the pharmaceutical sector by foreign-owned companies used in the current analysis was 37.1% (from 53% in the 2020 analysis). Values for turnover and employment from overseas-owned companies in the current analysis were higher than the 2020 analysis at 66.3% for turnover (from 65% in 2020) and 56.4% for employment (from 53% in 2020).

[4] https://www.ons.gov.uk/economy/governmentpublicsectorandtaxes/researchanddevelopmentexpenditure/datasets/businessenterpriseresearchanddevelopmentukdesignatedasofficialstatistics

[5] https://www.gov.uk/government/statistics/bioscience-and-health-technology-sector-statistics-2021-to-2022/bioscience-and-health-technology-sector-statistics-2021-to-2022#life-sciences-industry-segments

9 Impact of NIHR Funded Research on Employees, Staff Costs and National Output

9.1 Summary of the 2020 Report Findings

Applying ONS multipliers suggests that, since their inception, NIHR funding has enabled the BRCs and BRUs to generate:

- Direct output with a value of £1.14bn, together with indirect outputs, (as measured by type 1 input-output multipliers), equivalent to £0.65bn, giving a total economic impact of £1.79bn.
- Gross value added (GVA) of £0.98bn, together with associated indirect GVA of £0.57bn, giving a total GVA impact of £1.55bn.
- Payments to their staff of £0.98bn, together with associated indirect employee payments of £0.49bn, giving a boost to earnings across the economy of £1.47bn.
- Over 7,400 full-time equivalent (FTE) years of employment which generated employment opportunities for a further 5,788 FTEs, giving 13,190 FTE years of employment.

Applying the relevant type 1 multiplier suggested additional indirect national economic output associated with NIHR funding for BRCs/BRUs averaged about £0.57 for each £1 invested. The combined IRR, summing the economic and health gains from the NIHR investment, was 58%. This is well in excess of the annual discount rate set by HM Treasury of 3.5% in real terms.

Applying the same type 1 multiplier to the total funding received by BRCs and BRUs indicates they generated a total output valued at £7,861m, together with indirect outputs equivalent to £4,473m, giving a total economic impact of £12,334m.

There are several limitations including data for the early periods following the establishment of the BRCs and the ‘black box’ nature of the multiplier value.

9.2 Methods to Update the 2020 Report

The updated version of the HM Treasury Green Book [1] makes it clear that changes to GDP or GVA or the use of Keynesian style multipliers should not be used as part of an economic evaluation of Government funding or resource allocation. It specifically mentions that they should not be used as part of a spending review. As such, this section of the analysis has not been updated.

10 Regional Impact of BRC Funding

10.1 Summary of the 2020 Report Findings

Since 2007, the Oxford, Cambridge and London BRCs have been awarded over 75% of NIHR funding and been the most successful at leveraging funds from other sources. Hence these BRCs have received 85% of total funds.

All other regions have received a share of funds which is materially below their population share. This is particularly notable for the North West, Yorkshire and Humber and the West Midlands.

Welfare economics suggests that increasing funding to these areas could improve equity. Government policy to double R&D spend over the next five years offers the opportunity to 'level-up' these disadvantaged regions, consistent with other stated government priorities.

10.2 Methods to Update the 2020 Report

Regional analysis was updated using data provided by the NIHR from 2019/20 to 2023/24. In addition, the 2020 chapter on the Impact of NIHR Funded Research on Employees, Staff Costs and National contained information on staffing levels and sources of funding. As this chapter of the 2020 report had not been updated this information is presented in this chapter.

10.3 Findings

10.3.1 DHSC/NIHR Funding

A regional analysis of BRC and BRU investment from DHSC/NIHR and in total is set out in Table 10.1 for the years 2019/20 and 2023/24 and for the entire five-year period between those years. Total funding over the same period is provided in Table 10.2. The regional populations as of 2019/20 are also provided for comparison purposes.

Table 10.1: Regional analysis of investment from DHSC/NIHR received by BRCs and BRUs

Region	2019/20		2023/24		2019/20-2023/24		% of England population
	Funding	% of England funding	Funding	% of England funding	Funding	% of England funding	
East Midlands	£17.27m	10.6%	£21.21m	11.2%	£92.50m	8.2%	8.6%
East of England	£8.40m	5.1%	£10.98m	5.8%	£49.70m	4.4%	11.5%
London	£76.06m	46.5%	£46.03m	24.2%	£399.39m	35.6%	15.9%
North East	£1.18m	0.7%	£1.42m	0.7%	£9.68m	0.9%	4.7%
North West	£8.83m	5.4%	£15.02m	7.9%	£49.89m	4.4%	13.0%
South Central	£34.88m	21.3%	£61.17m	32.2%	£380.88m	34.0%	16.3%
South West	£11.11m	6.8%	£15.02m	7.9%	£87.67m	7.8%	10.0%
West Midlands	£1.93m	1.2%	£14.09m	7.4%	£26.64m	2.4%	10.5%
Yorkshire and Humber	£4.07m	2.5%	£5.00m	2.6%	£25.07m	2.2%	9.8%
England	**£163.73m**	**100.0%**	**£189.94m**	**100.0%**	**£1,121.42m**	**100.0%**	**100.0%**

Table 10.2: Regional analysis of total funds received by BRCs and BRUs

Region	2019/20		2023/24		2019/20-2023/24		% of England population
	Funding	% of England funding	Funding	% of England funding	Funding	% of England funding	
East Midlands	£66.04m	5.0%	£79.82m	7.1%	£347.61m	5.1%	8.6%
East of England	£86.41m	6.5%	£84.94m	7.6%	£488.08m	7.2%	11.5%
London	£781.72m	58.6%	£435.51m	38.8%	£3,553.60m	52.6%	15.9%
North East	£17.74m	1.3%	£27.54m	2.5%	£133.83m	2.0%	4.7%
North West	£66.40m	5.0%	£68.22m	6.1%	£293.30m	4.3%	13.0%
South Central	£259.76m	19.5%	£291.38m	25.9%	£1,504.81m	22.3%	16.3%
South West	£32.93m	2.5%	£49.32m	4.4%	£229.37m	3.4%	10.0%
West Midlands	£14.95m	1.1%	£71.65m	6.4%	£148.95m	2.2%	10.5%

Yorkshire and Humber	£7.90m	0.6%	£14.97m	1.3%	£58.31m	0.9%	9.8%
England	**£1,333.84m**	**100.0%**	**£1,123.35m**	**100.0%**	**£6,757.86m**	**100.0%**	**100.0%**

It remained the case over the five years from 2019/20 to 2023/24 that in terms of both DHSC/NIHR funding and total funding, London, South Central (Oxford and Southampton) and East of England (Cambridge) accounted for the majority of funding to DHSC/NIHR funding to BRCs/BRUs. 74.0% of DHSC/NIHR funding and 82.1% of total funding going to these regions. This was almost double the percentage of the population living in these regions (43.7%).

However, in the last year that data was available (2023/24), the percentage of DHSC/NIHR funding going to these regions was lower at 62.2% and total funding lower at 72.3%. This change in regional funding split is entirely due to a 44.3% reduction in total funding to the London region. This reduction in funding to London means that whilst annual funding from the DHSC/NIHR has risen by £26m (16.0%) and all other regions have seen increases in total funding between 2019/20 and 2023/24 (or in the case of the East of England a small decrease), total annual funding to BRCs/BRUs has fallen by £210m (15.8%) over the five-year period.

10.3.2 Total funding

When MRC funding is added to DHSC/NIHR funding, total government funding in each region can be compared to industry funding (Table 10.3). This is an important measure as it provides an indication of how much private funding government spending on BRCs and BRUs was able to leverage. On this measure the North East performed particularly well over the five years to 2023/24, generating £0.93 in funding for every £1 of government funding compared to a national average of £0.50 of private funding for every £1 of government funding.

Similarly, the North East outperforms all other regions in attracting non-NIHR funding (Table 10.4), with £13.83 of other funding (MRC, voluntary and private sector) for every £1 of NIHR funding. This compares with a national average of £6.03 for every £1 of NIHR funding. Despite the regional variation, it is clear that the BRCs and BRUs draw substantial funding from other sources, that may be leveraged due to the NIHR funding. It should be noted that drawing firm conclusions on leverage when looking at raw sector numbers in this way cannot account for whether the government funding truly leveraged private (or other) sector investment, or whether it merely provided a subsidy for investment that would have happened anyway.

Table 10.3: Ratio of industry funding to government funding to BRCs and BRUs (2019/20 to 2023/24)

Region	Industry funding	Govt funding	Industry:Govt
East Midlands	£56.49m	£193.57m	0.29
East of England	£65.92m	£221.78m	0.30
London	£706.12m	£1,102.46m	0.64
North East	£23.62m	£25.81m	0.92
North West	£57.63m	£79.30m	0.73
South Central	£339.98m	£747.98m	0.45
South West	£5.64m	£130.59m	0.04
West Midlands	£28.92m	£63.42m	0.46
Yorkshire and Humber	£12.90m	£34.85m	0.37
England	**£1,297.22m**	**£2,599.77m**	**0.50**

Table 10.4: Ratio of total (non NIHR funding) to NIHR funding to BRCs and BRUs (2019/20 to 2023/24)

Region	Non NIHR funding	NIHR funding	Non NIHR:NIHR
East Midlands	£347.61m	£92.50m	3.76
East of England	£488.08m	£49.70m	9.82
London	£3,553.60m	£399.39m	8.90
North East	£133.83m	£9.68m	13.83
North West	£293.30m	£49.89m	5.88
South Central	£1,504.81m	£380.88m	3.95
South West	£229.37m	£87.67m	2.62
West Midlands	£148.95m	£26.64m	5.59
Yorkshire and Humber	£58.31m	£25.07m	2.33
England	**£6,757.86m**	**£1,121.42m**	**6.03**

10.3.3 Regional staffing levels

Reflecting the change in funding to BRCs and BRUs between 2019/20 and 2023/24, the total number of FTE staff employed by BRCs and BRUs and total staff costs also fell nationally over the same period (Table 10.5). However, compared to falling funding levels which were driven by a substantial drop in funding to London, all but one region (the North West) saw reductions in FTE staff.

Table 10.5: Regional staffing levels in BRCs and BRUs (2019/20 and 2023/24)

Region	2019/20			2023/24		
	Total staff employed	FTEs	Total staff costs	Total staff employed	FTEs	Total staff costs
East Midlands	775	304	£5.15m	468	194	£7.53m
East of England	340	224	£16.78m	291	189	£18.94m
London	1932	1047	£60.56m	1440	668	£43.95m
North East	133	89	£2.63m	129	58	£1.71m
North West	349	121	£4.09m	443	172	£8.47m
South Central	743	437	£23.63m	966	403	£24.25m
South West	154	87	£3.63m	227	53	£2.91m
West Midlands	71	43	£1.91m	135	31	£4.04m
Yorkshire and Humber	147	67	£1.82m	243	57	£4.08m
England	**4644**	**2419**	**£120.21m**	**4342**	**1825**	**£115.88m**

11 Net Benefit on Marginal Spending on BRCs

11.1 Summary of the 2020 Report Findings

Using the model described in Figure 2.1, the annual IRR for funding provided to BRCs by NIHR was estimated at 29.2%. This included economic and health gains. It was judged conservative as some potential supply chain benefits are not captured.

11.2 Methods to Update the 2020 Report

The previous sections of this report have described how the values used to populate Figure 2.1 have either been confirmed to be the same as in the 2020 report or changed in the light of newer evidence. We have also refined our understanding of how the cash-flow calculation to estimate Figure 2.1 should be approached in several key areas which is discussed below for each model input.

11.3 Model Inputs

11.3.1 NIHR R&D investment and link to private R&D

The value used in the 2020 report was a £0.98 increase in private R&D for every £1 increase in NIHR funding. This was based upon applying the elasticity measure from the VECM of 0.68 to the ratio of total government expenditure to private expenditure on biomedical research in 2017.

Total direct public sector funding for biomedical research in 2022 was £2.35bn with indirect funding of £0.88bn, giving a total figure of £3.23bn with private sector investment estimated at £5.01bn[6]. Additional extra private sector investment for each additional £1 of NIHR funding is therefore estimated at £1.05 (0.68*(5.01/3.23)). This is a slight increase from the £0.98 figure from the 2020 report. The additional private sector investment generated from each pound of NIHR investment in the current analysis will have resulted in an increase in the net marginal benefit of NIHR funding compared with the 2020 report.

In the 2020 report, private sector investment was considered as a cost against cashflow. However, in this analysis we consider this should not be the case. The analysis is only interested in the marginal benefit of NIHR funding, with the calculation employed being dependent on estimating private

[6] https://hrcsonline.net/wpcontent/uploads/2024/09/UK_Health_Research_Analysis_Report_2022_web_v1-2-postpub.pdf. Total public sector funding was calculated by identifying and summing all public sector bodies and their funding levels from Appendix 2 of the report.

sector funding that would not have occurred without NIHR funding. The costs of this funding are not borne by society in the same way as NIHR funding, beyond the opportunity cost associated with private funding which is captured in the cost of capital (discussed in Section 11.3.3).

As such, this analysis differs from the 2020 report in that it only includes NIHR funding as a cost against which to calculate the Net Present Value (NPV) of NIHR funding. Further, the 2020 analysis did not present the NPV which was the primary outcome of the model in Figure 2.1 and instead presented an annual or internal return on investment (IRR). We consider that NPV with a benefit cost ratio (BCR) is a more appropriate metric to use, as it represents a return over a realistic time horizon. NPV can be turned into an equivalent annual return over the same period that the NPV was calculated, but this can be misleading as in reality the returns will be spread very unevenly across that period.

11.3.2 Foreign and UK funded investment

Foreign ownership was assumed to be 53% in the 2020 report with a value of 37.1% used in the current analysis. As more of the private sector investment is from UK companies in the current analysis, more of the financial returns from that investment will stay in the UK, thus increasing the net marginal benefit from NIHR funding.

11.3.3 UK private sector cost of capital, return and depreciation

The previous analysis used a cost of capital (the opportunity cost of private investment) of 7% per annum and a rate of return of 10% per annum. We have not altered these values in the current analysis, although the 2020 analysis just applied the 10% per annum rate of return in the calculation and did not adjust for the cost of capital. In this updated analysis, the rate of return has been adjusted by the cost of capital such that a cashflow equivalent to the rate of return minus the cost of capital enters the model (ie. 3%pa (10%-7%)). Depreciation of 11% was again applied but to the public and private sector spillover only, as suggested by the model in Figure 2.1.

All future cashflows are discounted at 3.5% per annum and health benefits at 1.5% per annum in line with Green Book guidance.

11.3.4 Spillover and social rate of return

In the 2020 analysis, a spillover value of 50% was used. However, the evidence at the time suggested that 50% should be applied to private R&D funding and 30% for government R&D funding and both discounted at 11% (the 2020 analysis did not appear to have discounted spillover). No new evidence was identified for this updated analysis and given the uncertainty in these values, analysis has been performed with and without the spillover included.

11.3.5 Health benefits

In the 2020 report, the health benefits in terms of QALY gains were not applied as part of the cashflow analysis but added on separately. In the updated analysis we have added in the 13%pa value of QALY gains (16%pa in the 2020 analysis) directly into the cashflow. Further, we have applied the QALY gains to all investment made in biomedical research regardless of whether it was public or leveraged private investment, and regardless of whether the private investment was from UK or foreign owned companies. This is because the QALY returns represent gains to UK patients regardless of the origin of the investment in biomedical research.

11.3.6 Time lags

In the 2020 analysis it was assumed that financial returns would start to be generated after 4 years, a value suggested by the literature at the time. However, this is not consistent with the reported time lags to develop new technologies to bring them to market in the updated review of literature. These lags could be 10 years or longer. In the updated analysis, we have therefore assumed that no financial returns occur for 10 years after initial funding was provided and similarly no health benefits occurred until that time point.

Spillover benefits were assumed to occur earlier, reflecting the increasing knowledge base even before products come to market. They were assumed to accrue after 4 years as was the case in the 2020 analysis.

The total time horizon considered has been extended to 20 years from 15 years in the 2020 analysis. Time horizons for investment are chosen to reflect the expectations of investors or the expected lifespan of returns from the investment. Given both of these are unknown, any time horizon chosen is necessarily arbitrary. However, patents tend to be for 20 years[7] which supports a time horizon of 20 years being reasonable.

11.3.7 Summary of model inputs

Table 11.1 summarises the model inputs for the current analysis compared to the 2020 analysis.

[7] https://www.drugpatentwatch.com/blog/how-long-do-drug-patents-last/?srsltid=AfmBOoqo_tVgpBfrRrYKgJdyPHGdpHfLsf4yAp8rR2kxJWCiWXh2LJoC

Table 11.1: Summary of model inputs

Model element	2020 value	Updated value
Increase in private funding for £1 increase in NIHR funding	£0.98	£1.05
Foreign ownership	53.0%	37.1%
Cost of capital (opportunity cost of private funding)	7% pa	7% pa
Return on private capital	10% pa	10% pa
Private sector return included in model	10% pa	3% pa (return on capital minus cost of capital)
Depreciation	11% pa	11% pa applied to spillover only
Spillover	50%	50% for private funding, 30% for public funding
Time lag before benefits arise	4 years	4 years for spillover, 10 years for commercial profit and health benefits
Health benefit return	16% pa	13% pa
Negative cash flow included in calculation	NIHR and private funding	NIHR funding only
Discount rate of future cash flows	No discounting	3.5% pa
Discount rate of future QALY benefits	No discounting	1.5% pa
Time horizon	15 years	20 years

Applying the model inputs in Table 11.1 gives cash flows over 20 years for a marginal increase in funding of £100 by the NIHR. These cash flows are summarised in Table 11.2.

Table 11.2: Cash flow model for NIHR funding

Year	NIHR funding	Private sector funding	Health benefit return (13%pa after 10 years)	Public sector spillover (30%pa after 5 years and depreciated at 11%pa from that point)	Private sector spillover (50%pa after 5 years and depreciated at 11%pa from that point)	Private sector return (3%pa after cost of capital and after 10 years)
0	£100.00	£105.00	-	-	-	-
1	-	-	-	-	-	-
2	-	-	-	-	-	-
3	-	-	-	-	-	-
4	-	-	-	-	-	-
5	-	-	-	£22.76	£39.82	-
6	-	-	-	£19.81	£34.66	-
7	-	-	-	£17.24	£30.17	-
8	-	-	-	£15.01	£26.26	-
9	-	-	-	£13.06	£22.86	-
10	-	-	£22.96	£11.37	£19.90	£1.40
11	-	-	£22.62	£9.90	£17.32	£1.36
12	-	-	£22.29	£8.61	£15.08	£1.31
13	-	-	£21.96	£7.50	£13.12	£1.27
14	-	-	£21.64	£6.53	£11.42	£1.22
15	-	-	£21.32	£5.68	£9.94	£1.18
16	-	-	£21.00	£4.95	£8.65	£1.14
17	-	-	£20.69	£4.30	£7.53	£1.10
18	-	-	£20.38	£3.75	£6.56	£1.07
19	-	-	£20.08	£3.26	£5.71	£1.03
20	-	-	£19.79	£2.84	£4.97	£1.00
Total	**£100.00**	**£105.00**	**£234.74**	**£156.56**	**£273.99**	**£13.09**

The modelling suggests that, excluding spillover, for a £100 increase in additional funding from the NIHR there would be £247.82 in discounted cashflows over 20 years giving a Net Present Value of £147.82. This gives a benefit cost ratio (BCR) of NIHR funding to biomedical research of 1.478 over 20 years, equivalent to an annualised return over 20 years of 4.7% per annum. Around 92% of this return is due to QALY gains generated from investment.

Including spillover, the discounted cashflows over 20 years would be £678.37 with a Net Present Value of the NIHR funding of £578.37. This would give a BCR of 5.783, equivalent to an annualised return over 20 years of 10.0% per annum.

11.3.8 Discussion

NIHR expenditure on biomedical research appears to provide a good return on investment. Updating the 2020 estimate suggests the annual rate of return from an increase in NIHR investment in BRCs is around 4.7%. Over 20 years this means that every £1 of NIHR funding will generate £2.47 in health benefits and private sector return. If spillover is included, the return increases to 10.0% with, over 20 years, every £1 of NIHR funding generating £5.78 in health benefits, private sector return and wider societal and private benefit.

The rates of return calculated in this report are lower than that estimated in the 2020 report, primarily due to lower spillover rates being used for public sector funding, the application of depreciation to spillover, the discounting of future cashflows and accounting for the cost of capital for private sector return. The approach taken in the current analysis is more transparent and still highlights potential substantial returns from NIHR funding, with BCRs well above 1 even when spillover is not taken into account. We consider that given the uncertainty around spillover (but its significant impact on estimated return) that the return with spillover should only be presented side by side with the return without spillover.

The limitations of the analysis largely remain as those in the 2020 report. Many of the values to populate the cashflow model are not known with confidence and so the actual return on NIHR funding remains uncertain. Given this we have used what we consider to be cautious assumptions where possible, to try to ensure the return presented is an under rather than over estimation. For example, we have estimated the private sector return after the cost of capital at 3% per annum after 10 years. This is likely to be an underestimate as it is based on a return above the cost of capital essential for all industries where the return, on average, is likely to occur well before the 10-year lag assumed in our calculation. Private investment that has longer waits for return will require higher returns over the cost of capital compared to those with shorter lengths of time before returns start to be generated.

12 Abbreviations

ABHI	Association of British Healthcare Industries
ABPI	Association of British Pharmaceutical Industries
AMRC	Association of Medical Research Charities
BERD	Business Enterprise R&D
BRC	Biomedical Research Centre
BRU	Biomedical Research Unit
BTKi	Bruton Tyrosine Kinase Inhibitor
CVD	Cardiovascular disease
DHSC	Department of Health and Social Care
DMT	Disease modifying therapy
EMA	European Medicines Agency
FDA	(US) Food and Drug Administration
HeFH	Heterozygous familial hypercholesterolemia
HTA	Health Technology Assessment
IND	Investigational New Drug Application
IRR	Internal rate of return
mRNA	Messenger RiboNucleic Acid
MRC	Medical Research Council
MSK	Musculoskeletal
NIHR	National Institute for Health and Care Research
OLS	Office for Life Sciences
ONS	Office for National Statistics
PCSK9	Proprotein Convertase Subtilisin/Kexin type 9
PREPARE	Partnership for Responsive Policy Analysis and Research
QALY	Quality-adjusted life year
RA	Rheumatoid arthritis
R&D	Research and development
RET	Rearranged during transfection
RNAi	Ribonucleic Acid interference
ROI	Return on investment
SUS	Sistema Único de Saúde
VECM	Vector error correction model
YHEC	York Health Economics Consortium

13 Appendix A

13.1 Search Methods for the Identification of Studies

13.1.1 Time lags between investment and new therapies

The searches from the Hanney review [3] were updated. The search methods used do not represent YHEC-developed de novo search methods. The aim of the research team was not to conduct an optimal search on this topic, but to update the Hanney searches using a methodology loosely based on, and adapted from, the methods reported by Hanney. The research team did not quality assure the original Hanney search methods, or quality assure the adaptation of those methods used for this search. No attempt was made to 'enhance' the Hanney et al search methods. This pragmatic approach was discussed and agreed within the research team.
The research team arrived at an estimate of the search strategy used by Hanney. When translated for use in PubMed however, the strategy retrieved record numbers that were far too high for the project context. The research team decided therefore to remove two terms from the Hanney et al strategy ("translational research" and "time factors"). This resulted in a targeted strategy which focused on records that explicitly included the terms "bench to bedside" or "time lag". In addition, plural forms of some terms were added to the strategy (it was judged that the authors may have included plural forms when they actually ran their searches, although they were not reported). No attempt was made to 'enhance' the Hanney strategy further.

The Hanney paper was published in 2015 and the search was updated by YHEC for the 2020 report. After discussion within the research team it was decided to restrict the searches for this update to studies published in English from 2020 to date, and to search only PubMed and Ovid Embase.

A.1: Source: PubMed
Interface / URL: https://www.ncbi.nlm.nih.gov/pubmed
Database coverage dates: Information not found
Search date: 03/02/2025
Retrieved records: 788
Search strategy:

("bench to bedside" OR "time lag" OR "time lags") AND (research OR development) AND ("medical device" OR "medical devices" OR "health intervention" OR "health interventions" OR pharmaceutical OR pharmaceuticals OR drug OR drugs OR "medical technology" OR "medical technologies") Filters: Publication date from 2020/12/31 to 2025/02/03; English

A.2: Source: Embase
Interface / URL: OvidSP
Database coverage dates: Embase 1974 to 2025 February 03
Search date: 04/02/25
Retrieved records: 833
Search strategy:

1 ((bench to bedside or time lag or time lags) and (research or development) and (medical device or medical devices or health intervention or health interventions or pharmaceutical or pharmaceuticals or drug or drugs or medical technology or medical technologies)).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word] (2460)
2 limit 1 to (english language and yr="2020-Current") (833)
3 conference abstract.pt. (5356225)
4 2 not 3 (734)
5 2 and 3 (99)
6 4 or 5 (833)

Note: The search terms were entered into the search interface with no field restrictions specified, as follows:

((bench to bedside OR time lag OR time lags) AND (research OR development) AND (medical device OR medical devices OR health intervention OR health interventions OR pharmaceutical OR pharmaceuticals OR drug OR drugs OR medical technology OR medical technologies))

Searching for a term without specifying a field in Advanced search, defaults to a 'multi-purpose' (.mp.) search.

13.1.2 Internal rates of return arising from the health gain of public sector investment measured in quality-adjusted life years (QALYs)

A MEDLINE (OvidSP) search strategy was designed to identify studies on rates of return and QALYs in both dementia (from 2000) and any type of biomedical research (from 2020).

The strategy comprised 3 concepts:

- dementia (search lines 1 to 16)
- biomedical research (search lines 17 to 30)
- rates of return / QALYs (search lines 31 to 54)

The concepts were combined as follows: (dementia AND biomedical research AND rates of return / QALYS from 2000 to date) OR (biomedical research AND rates of return / QALYS from 2020 to date).

The strategy excluded animal studies from MEDLINE using a standard algorithm (search line 56). The strategy also excluded some ineligible publication types which were unlikely to yield relevant study reports (editorials, news items and case reports) and records with the phrase 'case report' in the title (search line 57).

Reflecting the eligibility criteria, the strategy was restricted to studies published in the English language. The dementia search was also restricted to studies published from 2000 to date (search line 60), and the search for all biomedical research was restricted to studies published from 2020 onwards (search line 63).

Strategy limitations

The search strategy reflected the pragmatic nature of the project and timeline constraints. The strategy was not designed to be exhaustive, but aimed to target studies most likely to be relevant to the research question, whilst retrieving a volume of records manageable within the timescales and resources of the project. A number of pragmatic search approaches were used to achieve this. These included focusing subject headings for some search concepts where there was a high volume of results and including broader searches of the title field than for the keyword and abstract fields.

The final Ovid MEDLINE strategy was peer-reviewed before execution by a second Information Specialist. Peer review considered the appropriateness of the strategy for the review scope and eligibility criteria, inclusion of key search terms, errors in spelling, syntax and line combinations, and application of exclusions.

A.3: Source: MEDLINE ALL

Interface / URL: OvidSP

Database coverage dates: 1946 to February 24, 2025

Search date: 25/02/2025

Retrieved records: 1432 (all biomedical research from 2020) + 101 (dementia biomedical research only from 2000) – lines 60 and 64 outputted separately.

1 dementia/ (66818)
2 alzheimer disease/ (131323)
3 exp dementia, vascular/ (7913)
4 lewy body disease/ (4748)
5 exp frontotemporal lobar degeneration/ (6986)
6 (dementia* or amentia*).ti,ab,kf. (161661)
7 (predementia* or pseudodementia* or demention).ti,ab,kf. (727)
8 ((senile adj3 (confusion or psychos*)) or senilit*).ti,ab,kf. (1627)
9 (alzheimer* or alzeimer*).ti,ab,kf. (213869)
10 ((subcortical* or "sub cortical*") adj5 (encephalopath* or leukoencephalopath* or arteriosclero*)).ti,ab,kf. (1766)
11 (Binswanger* or CADASIL*).ti,ab,kf. (2262)
12 (((frontotemporal or frontal*) adj3 degenerat*) or FTD or FTLD or nonfluent aphasi* or non fluent aphasi*).ti,ab,kf. (10158)
13 ((pick* or PPA*) adj (disease* or syndrom* or disorder*)).ti,ab,kf. (4370)
14 (lewy* body or lewybody*).ti,ab,kf. (5779)
15 (cortical adj3 scleros*).ti,ab,kf. (426)
16 or/1-15 (342986)
17 exp *biomedical research/ or *research/ (288850)
18 Translational Research, Biomedical/ (13628)
19 exp *clinical studies as topic/ (64595)
20 ((biomedic* or bio-medic* or bioengineer* or bio-engineer* or bioscience* or bio-science* or bioscienti* or bio-scienti* or clinical* or epidemiolog* or experiment* or genom* or gene* or investigat* or medical* or science* or scienti* or stem cell* or translation*) and research*).ti. (82731)

21 ((biomedic* or bio-medic* or bioengineer* or bio-engineer* or bioscience* or bio-science* or bioscienti* or bio-scienti* or clinical* or epidemiolog* or experiment* or genom* or gene* or investigat* or medical* or science* or scienti* or stem cell* or translation*) and innovat*).ti. (6562)

22 (research* adj10 (biomedic* or bio-medic* or bioengineer* or bio-engineer* or bioscience* or bio-science* or bioscienti* or bio-scienti* or epidemiolog* or experiment* or genom* or gene* or investigat* or medical* or science* or scienti* or stem cell* or translation*) adj3 (center* or centre* or facilit* or laborator*)).ab,kf. (18790)

23 ((biomedic* or bio-medic* or bioengineer* or bio-engineer* or bioscience* or bio-science* or bioscienti* or bio-scienti* or epidemiolog* or experiment* or genom* or gene* or investigat* or medical* or science* or scienti* or stem cell* or translation*) adj10 (research adj3 (board* or council* or enterpris* or framework* or initiat* or inquir* or program* or project* or schem* or strateg*))).ab,kf. (25834)

24 ((biomedic* or bio-medic* or bioengineer* or bio-engineer* or bioscience* or bio-science* or bioscienti* or bio-scienti* or epidemiolog* or experiment* or genom* or gene* or investigat* or medical* or science* or scienti* or stem cell* or translation*) adj5 (research adj (fund* or grant*))).ab,kf. (1094)

25 (BRC or BMRC).ti,ab,kf. (1540)

26 (translation* adj1 (medicine* or science*)).ti,ab,kf. (6013)

27 (regenerat* adj1 (medicine* or research*)).ti,ab,kf. (30528)

28 (precision medicine* and research*).ti,ab,kf. (7599)

29 ("bench* to bed" or "bench* to beds" or "bench* to bedside*" or "bench* to clinic*" or "laborator* to bed" or "laborator* to beds" or "laborat* to bedside*" or "laborator* to clinic*" or "research to practice" or "research into practice").ti,ab,kf. (33268)

30 or/17-29 (521489)

31 "costs and cost analysis"/ (52197)

32 cost benefit analysis/ (97001)

33 exp health care costs/ (74606)

34 exp health expenditures/ (27346)

35 healthcare financing/ (1368)

36 (cost or costed or costing or costings or costs).ti. (142121)

37 ((research* or innovat*) adj5 (cost or costed or costing or costings or costs)).ab,kf. (11150)

38 (monetary or money or moneys or monied or moneyed).ti. (7293)

39 ((research* or innovat*) adj5 (monetary or money or moneys or monied or moneyed)).ab,kf. (606)

40 expenditur*.ti. (14178)

41 ((research* or innovat*) adj5 expend*).ab,kf. (985)

42 (spend or spending or spends or spent).ti. (9669)

43 ((research* or innovat*) adj5 (spend or spending or spends or spent)).ab,kf. (1249)

44 financ*.ti. (25798)

45 ((research or innovat*) adj5 financ*).ab,kf. (3763)

46 ((investment* or investor* or invest or invests or invested or investing) adj6 return*).ti,ab,kf. (4616)

47 ((investment* or investor* or invest or invests or invested or investing) and (roi or rois)).ti,ab,kf. (596)
48 quality-adjusted life years/ (17478)
49 (qaly* or qualy* or quality adjusted life year*).ti,ab,kf. (21949)
50 or/31-49 (349126)
51 exp models, economic/ (16750)
52 ((economic* or econometric* or pharmacoeconomic* or cost or costs or costing or budget*) adj6 model*).ti,ab,kf. (42188)
53 ((economic evaluation* or economic analys* or cost-effectiv* or cost-benefi* or cost-consequen* or cost-utilit* or cost-minim* or budget impact*) and (agent-based or cohort model* or decision analy* or decision-based or decision-making or decision-model* or decision-support* or decision theor* or decision tree* or disease model* or event-based or markov or mcmc or microsimulation* or monte carlo or partitioned survival or semimarkov or simulation* or state-transition* or stochastic or time-to-event*)).ti,ab,kf. (31426)
54 or/51-53 (73055)
55 50 or 54 (381129)
56 exp animals/ not humans/ (5309750)
57 (news or editorial or case reports).pt. or case report.ti. (3462591)
58 16 and 30 and 55 (127)
59 58 not (56 or 57) (120)
60 limit 59 to (english language and yr="2000 -Current") (101)
61 30 and 55 (11910)
62 61 not (56 or 57) (10927)
63 limit 62 to (english language and yr="2020 -Current") (1458)
64 63 not 60 (1432)

A.4: Source: Embase

Interface / URL: OvidSP
Database coverage dates: 1974 to February 25, 2025
Search date: 26/02/2025
Retrieved records: 1708 (all biomedical research from 2020) + 162 (dementia biomedical research only from 2000) – lines 61 and 65 outputted separately.

1 dementia/ (162741)
2 alzheimer disease/ or binswanger encephalopathy/ or cadasil/ (278236)
3 diffuse lewy body disease/ (13179)
4 multiinfarct dementia/ (15811)
5 exp frontotemporal dementia/ or mixed dementia/ or exp senile dementia/ (28234)
6 (dementia* or amentia*).ti,ab,kf,dq. (230784)
7 (predementia* or pseudodementia* or demention).ti,ab,kf,dq. (1108)
8 ((senile adj3 (confusion or psychos*)) or senilit*).ti,ab,kf,dq. (1074)
9 (alzheimer* or alzeimer*).ti,ab,kf,dq. (287110)

10 ((subcortical* or "sub cortical*") adj5 (encephalopath* or leukoencephalopath* or arteriosclero*)).ti,ab,kf,dq. (2454)

11 (Binswanger* or CADASIL*).ti,ab,kf,dq. (3336)

12 (((frontotemporal or frontal*) adj3 degenerat*) or FTD or FTLD or nonfluent aphasi* or non fluent aphasi*).ti,ab,kf,dq. (17171)

13 ((pick* or PPA*) adj (disease* or syndrom* or disorder*)).ti,ab,kf,dq. (5540)

14 (lewy* body or lewybody*).ti,ab,kf,dq. (9214)

15 (cortical adj3 scleros*).ti,ab,kf,dq. (691)

16 or/1-15 (515511)

17 *medical research/ or *research/ (106879)

18 translational research/ (24574)

19 *clinical study/ (50520)

20 ((biomedic* or bio-medic* or bioengineer* or bio-engineer* or bioscience* or bio-science* or bioscienti* or bio-scienti* or clinical* or epidemiolog* or experiment* or genom* or gene* or investigat* or medical* or science* or scienti* or stem cell* or translation*) and research*).ti. (94249)

21 ((biomedic* or bio-medic* or bioengineer* or bio-engineer* or bioscience* or bio-science* or bioscienti* or bio-scienti* or clinical* or epidemiolog* or experiment* or genom* or gene* or investigat* or medical* or science* or scienti* or stem cell* or translation*) and innovat*).ti. (8300)

22 (research* adj10 (biomedic* or bio-medic* or bioengineer* or bio-engineer* or bioscience* or bio-science* or bioscienti* or bio-scienti* or epidemiolog* or experiment* or genom* or gene* or investigat* or medical* or science* or scienti* or stem cell* or translation*) adj3 (center* or centre* or facilit* or laborator*)).ab,kf,dq. (30954)

23 ((biomedic* or bio-medic* or bioengineer* or bio-engineer* or bioscience* or bio-science* or bioscienti* or bio-scienti* or epidemiolog* or experiment* or genom* or gene* or investigat* or medical* or science* or scienti* or stem cell* or translation*) adj10 (research adj3 (board* or council* or enterpris* or framework* or initiat* or inquir* or program* or project* or schem* or strateg*))).ab,kf,dq. (37033)

24 ((biomedic* or bio-medic* or bioengineer* or bio-engineer* or bioscience* or bio-science* or bioscienti* or bio-scienti* or epidemiolog* or experiment* or genom* or gene* or investigat* or medical* or science* or scienti* or stem cell* or translation*) adj5 (research adj (fund* or grant*))).ab,kf,dq. (10049)

25 (BRC or BMRC).ti,ab,kf,dq. (2107)

26 (translation* adj1 (medicine* or science*)).ti,ab,kf,dq. (8492)

27 (regenerat* adj1 (medicine* or research*)).ti,ab,kf,dq. (37015)

28 (precision medicine* and research*).ti,ab,kf,dq. (9825)

29 ("bench* to bed" or "bench* to beds" or "bench* to bedside*" or "bench* to clinic*" or "laborator* to bed" or "laborator* to beds" or "laborat* to bedside*" or "laborator* to clinic*" or "research to practice" or "research into practice").ti,ab,kf,dq. (45103)

30 or/17-29 (422915)

31 "cost"/ (64954)

32 exp "cost benefit analysis"/ (98498)

33 exp "health care cost"/ (363933)

34 (cost or costed or costing or costings or costs).ti. (192279)
35 ((research* or innovat*) adj5 (cost or costed or costing or costings or costs)).ab,kf,dq. (15237)
36 (monetary or money or moneys or monied or moneyed).ti. (7870)
37 ((research* or innovat*) adj5 (monetary or money or moneys or monied or moneyed)).ab,kf,dq. (744)
38 expenditur*.ti. (16824)
39 ((research* or innovat*) adj5 expend*).ab,kf,dq. (1224)
40 (spend or spending or spends or spent).ti. (11197)
41 ((research* or innovat*) adj5 (spend or spending or spends or spent)).ab,kf,dq. (1641)
42 financ*.ti. (28425)
43 ((research or innovat*) adj5 financ*).ab,kf,dq. (10269)
44 ((investment* or investor* or invest or invests or invested or investing) adj6 return*).ti,ab,kf,dq. (5639)
45 ((investment* or investor* or invest or invests or invested or investing) and (roi or rois)).ti,ab,kf,dq. (869)
46 quality adjusted life year/ (39663)
47 (qaly* or qualy* or quality adjusted life year*).ti,ab,kf,dq. (36824)
48 or/31-47 (663646)
49 exp economic model/ (4771)
50 ((economic* or econometric* or pharmacoeconomic* or cost or costs or costing or budget*) adj6 model*).ti,ab,kf,dq. (61251)
51 ((economic evaluation* or economic analys* or cost-effectiv* or cost-benefi* or cost-consequen* or cost-utilit* or cost-minim* or budget impact*) and (agent-based or cohort model* or decision analy* or decision-based or decision-making or decision-model* or decision-support* or decision theor* or decision tree* or disease model* or event-based or markov or mcmc or microsimulation* or monte carlo or partitioned survival or semimarkov or simulation* or state-transition* or stochastic or time-to-event*)).ti,ab,kf,dq. (49448)
52 or/49-51 (94802)
53 48 or 52 (699753)
54 (animal/ or animal experiment/ or animal model/ or animal tissue/ or nonhuman/) not exp human/ (7143938)
55 editorial.pt. or case report.ti. (1252819)
56 conference abstract.pt. (5385596)
57 preprint.pt. (166411)
58 or/54-57 (13510392)
59 16 and 30 and 53 (232)
60 59 not 58 (176)
61 limit 60 to (english language and yr="2000 -Current") (162)
62 30 and 53 (13520)
63 62 not 58 (8829)
64 limit 63 to (english language and yr="2020 -Current") (1765)
65 64 not 61 (1708)

A.5: Source: EconLit

Interface / URL: OvidSP

Database coverage dates: 1886 to February 13, 2025

Search date: 26/02/2025

Retrieved records: 114 (all biomedical research from 2020) + 3 (dementia biomedical research only from 2000) – lines 40 and 42 outputted separately.

1 (dementia* or amentia*).af. (179)
2 (predementia* or pseudodementia* or demention).af. (0)
3 ((senile adj3 (confusion or psychos*)) or senilit*).af. (5)
4 (alzheimer* or alzeimer*).af. (171)
5 ((subcortical* or "sub cortical*") adj5 (encephalopath* or leukoencephalopath* or arteriosclero*)).af. (0)
6 (((frontotemporal or frontal*) adj3 degenerat*) or FTD or FTLD or nonfluent aphasi* or non fluent aphasi*).af. (11)
7 ((pick* or PPA*) adj (disease* or syndrom* or disorder*)).af. (0)
8 (cortical adj3 scleros*).af. (0)
9 (Binswanger* or CADASIL*).af. (203)
10 (lewy* body or lewybody*).af. (0)
11 or/1-10 (518)
12 ((biomedic* or bio-medic* or bioengineer* or bio-engineer* or bioscience* or bio-science* or bioscienti* or bio-scienti* or clinical* or epidemiolog* or experiment* or genom* or gene* or investigat* or medical* or science* or scienti* or stem cell* or translation*) and research*).ti. (1833)
13 ((biomedic* or bio-medic* or bioengineer* or bio-engineer* or bioscience* or bio-science* or bioscienti* or bio-scienti* or clinical* or epidemiolog* or experiment* or genom* or gene* or investigat* or medical* or science* or scienti* or stem cell* or translation*) and innovat*).ti. (1389)
14 (research* adj10 (biomedic* or bio-medic* or bioengineer* or bio-engineer* or bioscience* or bio-science* or bioscienti* or bio-scienti* or epidemiolog* or experiment* or genom* or gene* or investigat* or medical* or science* or scienti* or stem cell* or translation*) adj3 (center* or centre* or facilit* or laborator*)).ab. (620)
15 ((biomedic* or bio-medic* or bioengineer* or bio-engineer* or bioscience* or bio-science* or bioscienti* or bio-scienti* or epidemiolog* or experiment* or genom* or gene* or investigat* or medical* or science* or scienti* or stem cell* or translation*) adj10 (research adj3 (board* or council* or enterpris* or framework* or initiat* or inquir* or program* or project* or schem* or strateg*))).ab. (948)
16 ((biomedic* or bio-medic* or bioengineer* or bio-engineer* or bioscience* or bio-science* or bioscienti* or bio-scienti* or epidemiolog* or experiment* or genom* or gene* or investigat* or medical* or science* or scienti* or stem cell* or translation*) adj5 (research adj (fund* or grant*))).ab. (46)
17 (BRC or BMRC).af. (17)
18 (translation* adj1 (medicine* or science*)).af. (17)
19 (regenerat* adj1 (medicine* or research*)).af. (22)
20 (precision medicine* and research*).af. (33)

21 ("bench* to bed" or "bench* to beds" or "bench* to bedside*" or "bench* to clinic*" or "laborator* to bed" or "laborator* to beds" or "laborat* to bedside*" or "laborator* to clinic*" or "research to practice" or "research into practice").ti,ab. (941)
22 or/12-21 (5609)
23 (cost or costed or costing or costings or costs).ti. (39521)
24 ((research* or innovat*) adj5 (cost or costed or costing or costings or costs)).ab. (2661)
25 (monetary or money or moneys or monied or moneyed).ti. (48124)
26 ((research* or innovat*) adj5 (monetary or money or moneys or monied or moneyed)).ab. (1064)
27 expenditur*.ti. (9556)
28 ((research* or innovat*) adj5 expend*).ab. (1197)
29 (spend or spending or spends or spent).ti. (5882)
30 ((research* or innovat*) adj5 (spend or spending or spends or spent)).ab. (624)
31 financ*.ti. (87922)
32 ((research or innovat*) adj5 financ*).ab. (7103)
33 ((investment* or investor* or invest or invests or invested or investing) adj6 return*).af. (9685)
34 ((investment* or investor* or invest or invests or invested or investing) and (roi or rois)).af. (144)
35 (qaly* or qualy* or quality adjusted life year*).af. (807)
36 ((economic* or econometric* or pharmacoeconomic* or cost or costs or costing or budget*) adj6 model*).af. (65508)
37 ((economic evaluation* or economic analys* or cost-effectiv* or cost-benefi* or cost-consequen* or cost-utilit* or cost-minim* or budget impact*) and (agent-based or cohort model* or decision analy* or decision-based or decision-making or decision-model* or decision-support* or decision theor* or decision tree* or disease model* or event-based or markov or mcmc or microsimulation* or monte carlo or partitioned survival or semimarkov or simulation* or state-transition* or stochastic or time-to-event*)).af. (4261)
38 or/23-37 (260547)
39 22 and 38 (536)
40 limit 39 to yr="2020 -Current" (114)
41 11 and 22 (4)
42 limit 41 to yr="2000 -Current" (3)

13.1.3 Spillover and social rate of return

For the 2020 report, the initial aim of the research team was to carry out an update of the searches related to research spillover conducted to inform the 2008 report by HERG [15] using the same search methods as were used by the authors. The search methods used are described in Annex to Chapter Six: Literature review on R&D spillovers. The research team examined the search methods as reported in this Annex. The research team judged that it was not possible to be certain of the exact search methods used. It was therefore not possible to reproduce the HERG searches as reported. In the absence of reproducible search methodology, the research team considered alternative approaches to updating the HERG searches. One approach considered was for YHEC to develop de novo search methodology. However, within the context of project aims, resources and timelines it was decided that this approach was not appropriate. Within the project context, it was decided that the research team would make an informed estimate of the search methods used by

HERG, based on an interpretation of the reported methods, and adapt as appropriate to the project context.

The search methods used do not represent YHEC-developed de novo search methods. The aim of the research team was not to conduct an optimal search on this topic, but to update the HERG searches using a methodology loosely based on, and adapted from, the methods reported by HERG. The research team did not quality assure the original HERG search methods, or quality assure the adaptation of those methods used for this search. No attempt was made to 'enhance' the HERG search methods. This pragmatic approach was discussed and agreed within the research team.

For this update, we reproduced the literature search as far as possible from the 2020 report. However, a full search of the British Library Catalogue was not possible, as the British Library was still not fully operational in February 2025, following a cyber-attack. Searches of this resource were therefore only conducted for 2020 to April 2023. The only facets of the catalogue that could be searched for this update were: printed books, printed journals and freely available online content.

A.6: Source: PubMed

Interface / URL: https://www.ncbi.nlm.nih.gov/pubmed
Database coverage dates: Information not found
Search date: 04/02/2025
Retrieved records: 219
Search strategy:

medical AND ("R&D" OR research) AND (spillover OR spillovers OR spill-over OR spill-overs OR externalities OR synergies OR "rate of return" OR "rates of return") Filters: Publication date from 2020/12/31 to 2025/02/04; English

A.7: Source: Econlit

Interface / URL: OvidSP
Database coverage dates: Econlit 1886 to January 30, 2025
Search date: 04/02/2025
Retrieved records: 24
Search strategy:

1 (medical and (R&D or "R & D" or research) and (spillover or spillovers or spill-over or spill-overs or externalities or synergies or rate of return or rates of return)).mp. [mp=heading words, abstract, title, country as subject] (69)
2 limit 1 to (yr="2020 -Current" and english) (24)

Note: The search terms were entered into the search interface with no field restrictions specified, as follows:

(medical and (R&D or "R & D" or research) and (spillover or spillovers or spill-over or spill-overs or externalities or synergies or rate of return or rates of return))

Searching for a term without specifying a field in Advanced search, defaults to a 'multi-purpose' (.mp.) search

A.8: Source: EconPapers

Interface / URL: https://econpapers.repec.org/
Database coverage dates: Information not found
Search date: 04/02/2025
Retrieved records: 170
Search strategy:

The advanced search at the following URL was used: https://econpapers.repec.org/scripts/search.pf

medical AND ("R&D" OR "R & D" OR research) AND (spillover OR spillovers OR "spill-over" OR "spill-overs" OR externalities OR synergies OR "rate of return" OR "rates of return")

The 'Sort by' option of 'Date modified' was used to sort results in date order. The 'Date is Creation/revision' 'of item' was selected.

622 documents were retrieved.

Records for studies with a 'created / revised date' before 2020 were excluded. 'Register author' returned results (i.e. a result called 'Registered author:[name]') were excluded - these results contain author details.

The remaining results (170) were copied into a Word document. Abstracts were located via the EconPapers record and copied into the Word document.

A.9: Source: British Library main catalogue

Interface / URL:
https://bll01.primo.exlibrisgroup.com/discovery/search?vid=44BL_INST:BLL01&lang=en
Database coverage dates: Information not found
Search date: 05/02/2025
Retrieved records: 52
Search strategy:

The catalogue at this URL was searched, this was the only catalogue available at the BL on 05/02/2025:
https://bll01.primo.exlibrisgroup.com/discovery/search?vid=44BL_INST:BLL01&lang=en

The following searches were conducted separately as per the 2020 search.

Results were displayed in date order (newest first). All results with a search date of 2020 to date were added to the ‘My Favourites’ area. All added records were downloaded into EndNote.

medical AND research AND spillover = 0 added (from 7)
medical AND research AND spillovers = 0 added (from 3)
medical AND research AND spill-over = 1 added (from 1)
medical AND research AND spill-overs = 1 added (from 1)
medical AND externalities = 4 added (from 16)
medical AND research AND synergies = 46 added (from 165)
medical AND research AND "rate of return" = 0 added (from 3)
medical AND research AND "rates of return" = 0 added (from 0)

medical AND R&D AND spillover = 0 added (from 2)
medical AND R&D AND spillovers = 0 results returned
medical AND R&D AND spill-over = 1 duplicate result (from 1)
medical AND R&D AND spill-overs = 0 results returned
medical AND R&D AND synergies = 0 added (from 1)
medical AND R&D AND "rate of return" = 0 results returned
medical AND R&D AND "rates of return" = 0 results returned
medical AND "R & D" AND spillover = 0 added (from 2)
medical AND "R & D" AND spillovers = 0 results returned
medical AND "R & D" AND spill-over = 1 duplicate result (from 1)
medical AND "R & D" AND spill-overs = 0 results returned
medical AND "R & D" AND synergies = 0 added (from 1)
medical AND "R & D" AND "rate of return" = 0 results returned
medical AND "R & D" AND "rates of return" = 0 results returned

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