

The value of industry clinical trials to the UK

Interim report

A report for the Association of the British
Pharmaceutical Industry

September 2024



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Industry clinical trials deliver significant value to the UK economy, the NHS, and the UK's research and development base

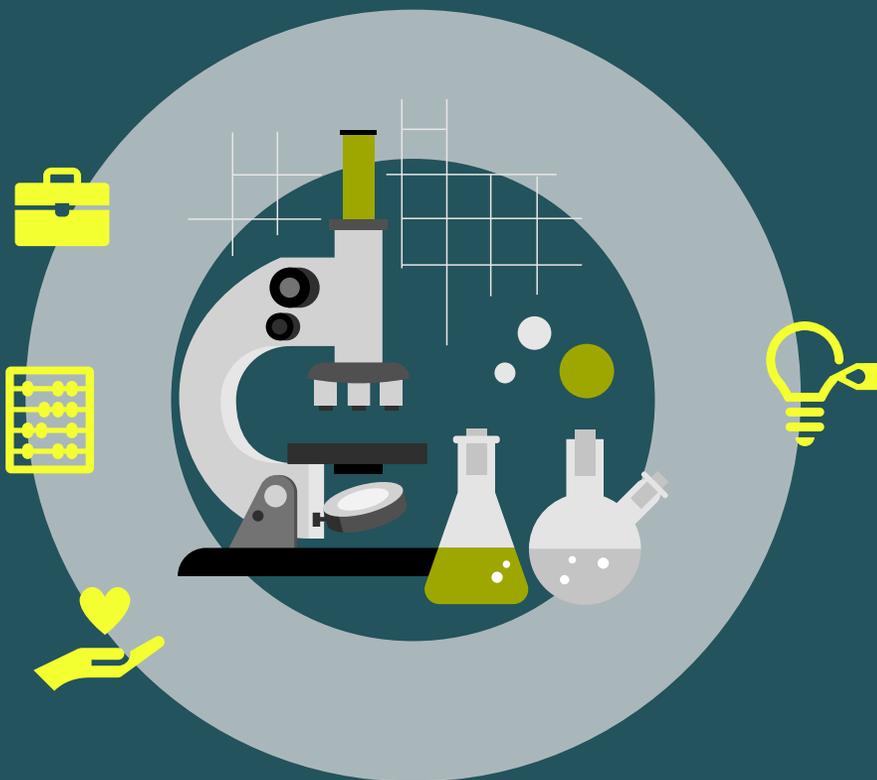
In 2022:

Industry clinical trials contributed **£7.4 billion** of gross value added (GVA) to the UK economy and supported a total of **65,000 jobs**.

Generated **£1.2 billion** of revenue for the NHS and supported **13,000 NHS jobs**.

£0.9 billion of GVA was generated by the contribution of industry clinical trials to improved patient outcomes in research-active hospitals compared to research-inactive hospitals.

These health improvements are estimated to prevent **3 million sick days**.



Over the past 5 years:

Industry contributed to almost **5,000** research papers between 2019 and 2023.

11% of these papers were highly cited, compared to an EU benchmark of 5.7%.

These papers supported **283** patent applications.

Restoring the UK's capacity to deliver industry clinical trials would significantly advance the government's NHS and economic growth missions

Increasing UK industry clinical trial activity by 40% (comparable to 2017 levels) would generate:



£3 billion of additional GVA for the UK economy.

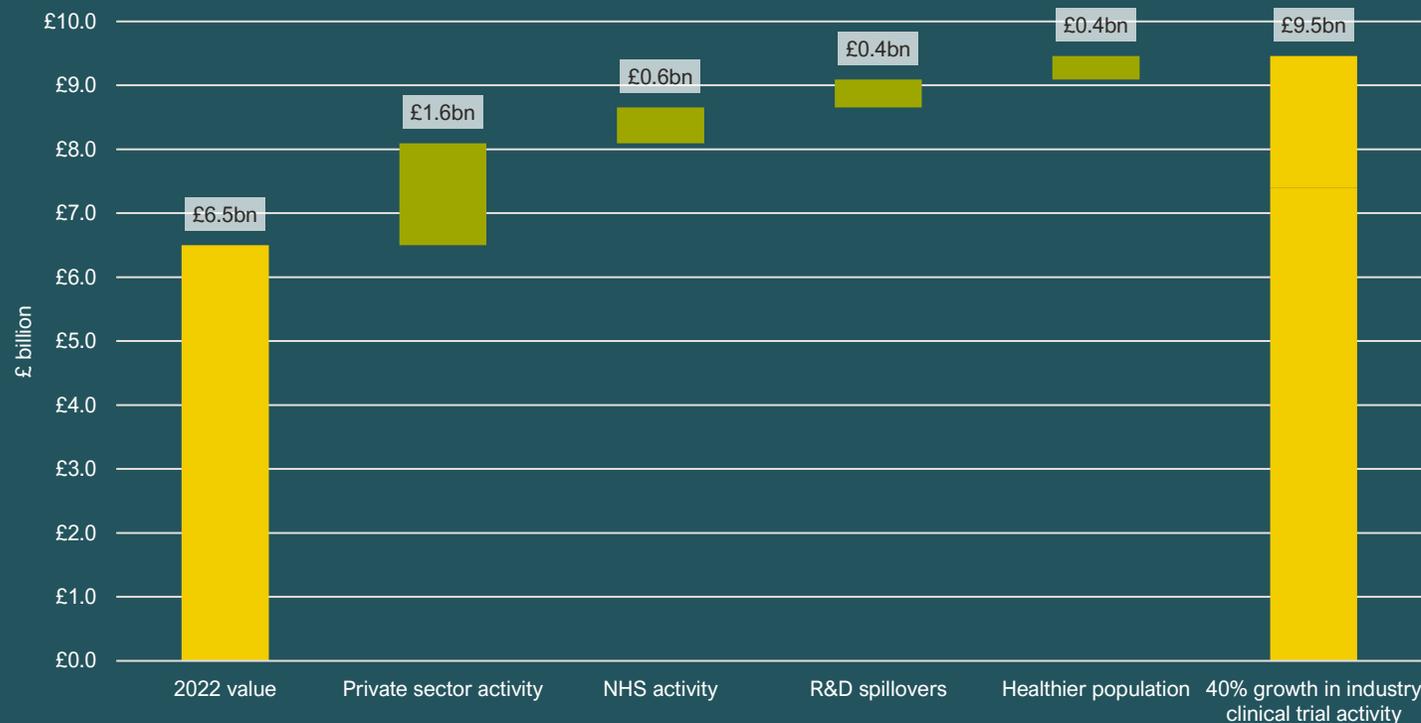


26,000 additional jobs, **5,000** of which are in the NHS.



1.1 million additional avoided sick days from improved quality of care, leading to a healthier population.

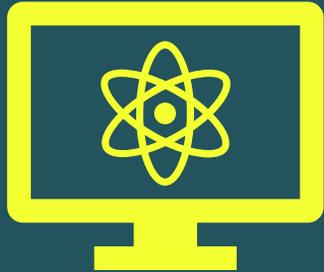
Additional GVA impact of increasing industry clinical trial activity by 40%



1. Introduction

“Rebuilding and innovating within the UK’s clinical trials sector is an essential part of the UK’s wider health, scientific, and economic strategy.”

Lord O’Shaughnessy review (2023)



Clinical trials are an essential part of the research and development (R&D) of new healthcare innovations including medicines and vaccines. These innovations help to improve patient outcomes, which in turn enable people to lead healthy and fulfilling lives. Not only do these health benefits have a profound impact on individual patients and their loved ones, but they are also a key part of supporting a healthy population enabling UK productivity and wellbeing.

Industry clinical trials are a key contributor to the UK’s economic growth. They support jobs and skills development across the supply chain and contribute to the attractiveness of the UK for global R&D investment. For the NHS, they are a valuable source of revenue as well as a source of industry-funded treatment.

However, there has been a recent decline in the number of industry clinical trials initiated in the UK, which fell from a peak of 690 in 2015 to 394 in 2021. While there are some signs of recent recovery, with 411 trials initiated in the UK in 2022, this is still far below the 2015 peak.¹ Investing in capacity today to accelerate this recovery will generate significant long-term financial and patient benefits, helping to advance the government’s missions for health and economic growth.

Frontier Economics was commissioned by the Association of the British Pharmaceutical Industry (ABPI) to explore the value of commercial clinical trials to the UK. This work explored benefits to UK patient outcomes, R&D, the NHS, and the UK economy.

Industry clinical trials

The Department for Health and Social Care (DHSC) defines three broad categories of clinical trials:²

- Industry clinical trials (also known as commercial contract studies) are sponsored and fully funded by the life sciences industry.
- Commercial collaborative studies are typically funded, either wholly or in part, by the life sciences industry and sponsored by a combination of industry and non-commercial organisations.
- Non-commercial studies are sponsored and wholly funded by one or more non-commercial organisations, including medical research charities, universities, and public funders.

In 2022, 411 industry clinical trials were initiated in the UK, and 42,088 participants were recruited into industry clinical trials in 2022/23. While this is an increase compared to 2021, it is still well below 2017/18 levels when 58,048 participants were recruited onto industry clinical trials in the UK.¹ Looking at the UK's attractiveness as a destination for industry clinical research, in 2021 the UK ranked 4th, 6th, and 10th for the global share of phase 1, phase 2, and phase 3 trials respectively.

The ABPI commissioned Frontier Economics to assess the value of industry clinical trials to UK society. This paper explores two questions:

1. What is the current value of industry clinical trials to UK society?
2. What are the potential future impacts of growth in UK clinical trial activity?

This study built on existing work that highlights the importance of industry clinical trials to the UK and the benefits associated with strengthening the UK's global position including:

- The impact and value assessment of the National Institute for Health and Care Research (NIHR).³
- The recent assessment of benefits associated with investment into access and uptake of innovative medicines as part of the Government's Life Sciences Vision.⁴
- The Lord O'Shaughnessy Review which set out recommendations on how industry clinical trials can support UK health, growth, and investment opportunities.⁵

This study focused on phase 1, 2, and 3 industry clinical trials, which are described in the figure below. Phase 4 trials, which study the effects of new treatments in the wider population after approval, are out of scope.



Acknowledgements

We thank the NIHR for its input and support with this analysis.

If you use this document in your own research and/or writing, it should be cited as: Frontier Economics (2024). 'The value of industry clinical trials, interim report' commissioned by The Association of the British Pharmaceutical Industry.

Impact framework and approach

A logic model was developed to support the identification of the benefits of delivering industry clinical trials in the UK. This identified four key benefits:



Benefits to the economy

The overall economic contribution of industry clinical trials, measured in GVA and full-time equivalent (FTE) employment. Wider productivity benefits from a healthier population arising from improved patient care in research-active hospitals compared to research-inactive hospitals were also considered.



Benefits to the NHS

Revenue from commercial income payments for the delivery of trials.



Benefits to the R&D base

Enabling UK-led clinical research publications, strengthening the UK's global scientific leadership and attractiveness as a destination for R&D and investment.



Benefits to patients

Potential health improvements for patients participating in clinical trials.

This interim report focuses on benefits to the UK economy, the NHS, and UK R&D. It will be followed by a full report in the Autumn that assesses the benefits to patients and any further UK R&D impacts.

This study used a mixed-methods approach, bringing together evidence generated through several methods to conduct a quantitative and qualitative assessment of impacts. It has drawn on publicly available data as well as data provided by the NIHR.

This study has some limitations:

- Some assumptions have been drawn from previous work carried out for the NIHR.³ These include assumptions on payroll as a share of expenditure in NHS Trusts, which is used to estimate the number of NHS clinical research jobs enabled by industry clinical trials. Data sources have been specified in the technical appendix.
- Data on average per-patient payments in 2022/23 has been provided by the NIHR. This value represents the average across all industry clinical trials (commercial studies) supported by the NIHR Clinical Research Network. However, per-patient payments will vary significantly across individual studies to reflect factors such as specialty, trial, duration, study type, and product type.

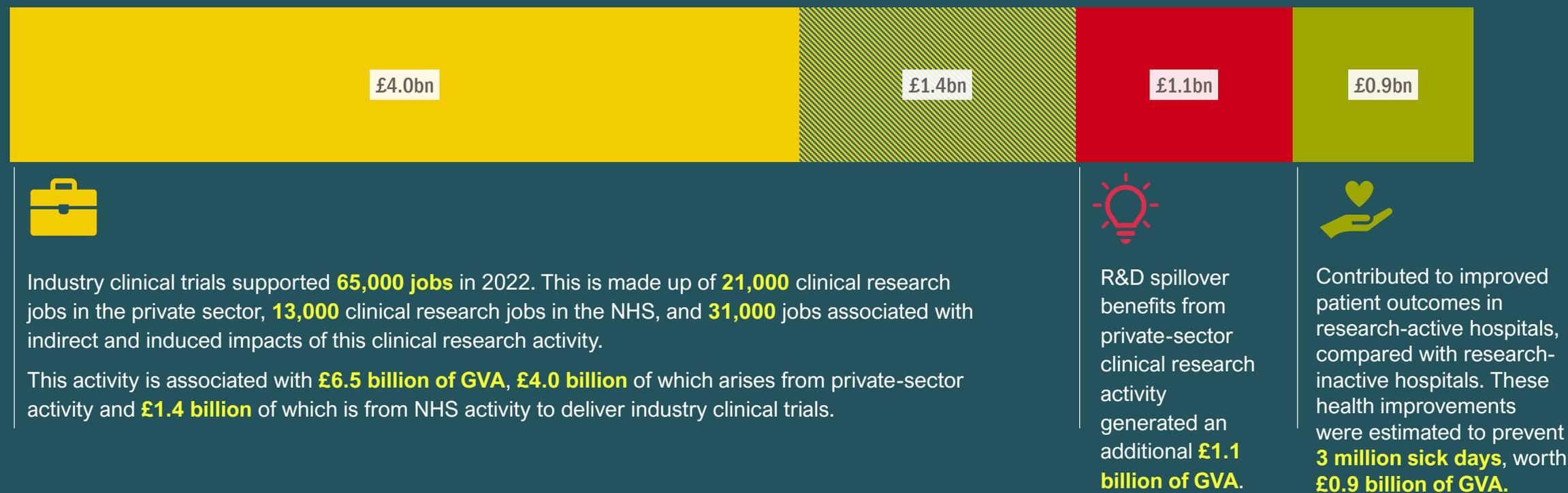
It is also important to recognise that realisation of some benefits will rely on activities of several other organisations, for example the NHS, the Medicines and Healthcare products Regulation Agency (MHRA), and the National Institute for Health and Care Excellence (NICE) and may be impacted by external factors. It has not been possible to carry out detailed attribution of impacts.

Full details on the data and approach can be found in the technical appendix.

2. Benefits to the UK economy

Despite the decline in recent years, industry clinical trials contributed £7.4 billion of GVA in 2022

While the UK remains a strong player in the global clinical trial market, the number of trials initiated in the UK and the number of patients recruited have been declining since 2015. In 2022, 411 industry clinical trials were initiated in the UK, compared to the peak of 690 in 2015. Nonetheless, these industry clinical trials continue to bring numerous benefits, including creation of high-quality jobs, knowledge and skills spillovers and better healthcare outcomes.



Contribution to UK productivity and employment

This report looks at three ways in which industry clinical trials contribute to UK GVA:

- **Direct, indirect, and induced effects** measure the impact of industry investment into the UK to carry out clinical trial activity. Direct effects measure the impact of higher final demand for clinical research. This will also lead to an increase in demand on their suppliers (indirect impact). Direct and indirect impacts lead to an increase in the level of household income, some of which will be re-spent on goods and services (induced impact).
- **Spillover effects of R&D.** R&D is well known for generating ‘spillover effects’ where knowledge, products, and processes created during research activity can be used by other companies. This helps to spread the benefits of innovation beyond the organisation originally carrying out the research, and further contributes to the growth of the wider economy.
- **Impacts of a healthier population.** Evidence shows that NHS Trusts that are engaged in research activities have better patient outcomes,⁹ which has productivity impacts such as reduced absenteeism.

The remainder of this section looks at each of these in turn.

Direct, indirect, and induced effects of clinical research activity

The life sciences industry plays a key role in the UK economy. Based on Office for National Statistics (ONS) payroll data for 2022 (the most recent year available), industry clinical trial activity generated **an estimated £5.4 billion GVA through direct, indirect, and induced benefits and supported 65,000 jobs.**

This does not include the GVA impact of spillover benefits or contribution to a

healthier population.

The industry directly employed an estimated 21,000 people in the UK to deliver clinical trials in 2022, contributing £1.9 billion to the UK economy (direct impact).

This increases to £3.2 billion and 36,000 jobs once additional activity across the supply chain to deliver this research activity (indirect impact) is accounted for. Finally, including the impacts of spending by employees (induced impact) increase this to reach a total of £4.0 billion of GVA and 42,000 jobs from private-sector activity.

In addition to the contribution of private-sector activity set out above, industry contracts NHS providers to deliver clinical trials, paying them a per-patient payment for doing so. This supports around 13,000 jobs in the NHS. There is a greater range of uncertainty around this estimate as it uses historical data on wage costs, which may have changed in relation to per-patient payments. When indirect and induced effects are included, revenue generated by industry clinical trials supported 23,000 jobs and £1.4 billion of GVA.*

Spillover effects

Evidence suggests the spillover benefits of R&D could be in the range of 20% to 37% of private returns (benefits that accrue to the business making R&D investments).⁶⁻⁸ A conservative estimate of 20% has been applied on private-sector industry clinical trial expenditure, which was reported to be £5.5 billion in the ONS Business enterprise research and development dataset (BERD) resulting in **£1.1 billion of spillover benefits** (see page 31, technical appendix for further detail) in addition to the £5.4 billion of private returns (direct, indirect, and induced effects).

* NHS employment impacts presented here are the same as those discussed on page 16 and should therefore not be aggregated, as this would lead to double-counting.

Impact of a healthier population

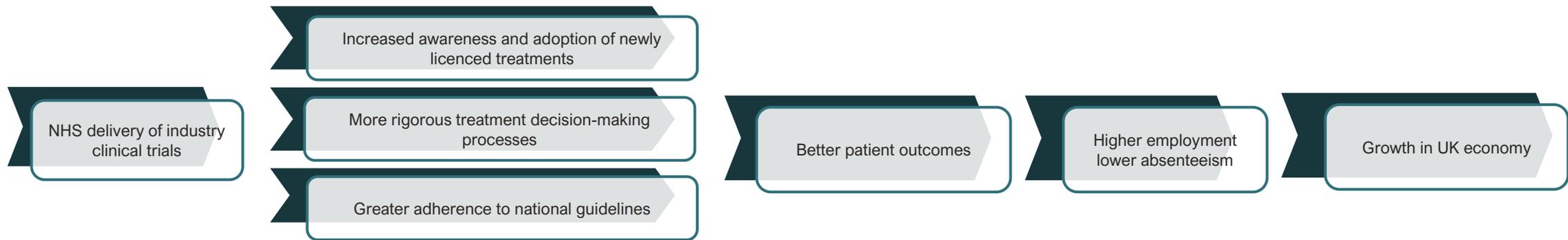
Evidence shows that NHS Trusts that are engaged in research activities have better patient outcomes.⁹ This includes lower mortality rates,¹⁰ shorter hospital stays,¹¹ and improved patient-care experiences.¹² These benefits are not confined to large hospitals but are evident across all NHS hospitals engaged in research¹³. This is a key beneficial side-effect of clinical research, with industry clinical trials making up 44% of all interventional studies in 2022/23.¹⁴

Consultants who participate in clinical research have a greater awareness and adoption of new treatments once they have been licenced¹⁵ and the influence of research-active consultants often extends to their peers, promoting a culture of innovation.¹⁶ This means that hospitals active in research are often quicker to adopt newly licenced and approved treatments.¹⁷⁻¹⁸

Clinical research participation also fosters collaboration between hospital staff and national experts, leading to dissemination of information that enhances medical care quality. It encourages adherence to clinical guidelines^{12, 16, 19} and can lead to more rigorous treatment decision-making processes.¹³ These impacts result in improved outcomes for patients treated in NHS Trusts that participate in clinical research. Not only does this benefit individual patient wellbeing, but it also supports a healthier population and UK productivity (see figure below).

“Hospital consultants who take part in research studies are more likely to promote the uptake of innovative therapies or devices once they have been licenced, improving access for all patients. NHS bodies that carry out research tend, on average, to provide better health outcomes for their patients. Encouraging more research must be a priority for those bodies charged with improving the nation’s health.”

Lord O’Shaughnessy Review



Health has a major effect on a person's ability to work. Generally, people in good health require fewer absences from work and have higher productivity per hour worked. Ill health can also indirectly affect a person's employment, as they may have to take absences to care for others.

New treatments can also improve quality of life for patients undergoing treatment, increasing their ability to stay in employment and reducing absenteeism. Previous work carried out for the ABPI estimates that increasing uptake of just four innovative medicine classes would lead to an estimated £17.9 billion productivity gain for the UK.⁴

Research participation is one way to increase uptake of innovative medicines. Chen and Goldman examined the relationship between new treatments and gains in labour productivity across multiple conditions.²⁰ They found that, on average, new treatments led to a 30% increase in work productivity. In the absence of new treatments, hours worked per person would have fallen by 7 hours a week.

The same approach was used to estimate population-wide productivity impacts. This was combined with findings on the proportion of NHS Trusts that are research-active* and the increased likelihood of consultants who participate in research to prescribe new treatments once they were licenced (see technical appendix for detailed approach).¹⁸

Faster uptake of new treatments in research-active hospitals was estimated to enable 6.3 million avoided sick days in 2022. Attributing 44% to industry clinical trials based on their share of interventional clinical trials leads to an **estimated 3 million avoided sick days in 2022, equivalent to £0.9 billion of GVA.**

Case study: Improved colorectal cancer outcomes in research-active NHS Trusts

Oncology is a major area of clinical research and accounted for almost half of industry clinical trials initiated in the UK in 2022.³¹ It is also a major cost to the UK economy. Previous estimates suggest that preventable cancers cost the UK £40 billion a year in lost productivity.²¹

Downing et al (2016)¹³ compares 5-year survival rates for colorectal cancer patients treated in research-active (those that had ≥16% of patients enrolled in interventional trials for at least 1 of the 8-year study period) and research-inactive NHS Trusts (those that did not have ≥16% of patients enrolled in interventional trials in any of the 8 years observed).

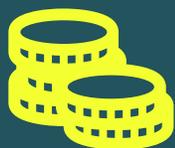
It found that 5-year survival rates were around 5% higher in NHS Trusts that met the criteria to be research-active in at least 1 year, and around 10% higher in those that met the criteria for at least 4 of the 8 years observed.

2,181 colorectal cancer patients diagnosed in 2022 were estimated to have benefited from improved care in research-active hospitals, leading to £1.2 million of productivity benefits per year for that patient cohort.

Without industry clinical trials, which made up 44% of all interventional trials in 2022/23,¹⁴ the number of opportunities for NHS Trusts to participate in clinical research would be lower, potentially reducing the proportion of patients treated in research-active NHS Trusts. Attributing 44% of the £1.2 million of productivity benefits from improved patient care in research-active hospitals would lead to a **GVA benefit of £0.5 million attributed to industry clinical trials.**

* The term research-active corresponds with those classified as 'high participation' in Downing et al (2016),¹³ defined as NHS Trusts where at least 16% new colorectal cancer patients were entered into research studies.

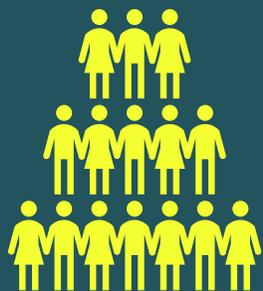
2. Benefits to the NHS



In 2022/23, 42,088 patients were recruited to industry clinical trials, leading to **£1.2 billion** of income for the NHS.



In addition, there are cost savings associated with industry-funded provision of care for patients enrolled on clinical trials, which are not included in this report.



In 2022, industry clinical trials supported **13,000** jobs in the NHS, helping to address the clinical research workforce shortage and increasing job satisfaction among NHS staff.

The value of industry clinical trials to the NHS

Delivering industry clinical trials in the UK benefits the NHS in several ways:

- **Commercial revenue.** Industry often contracts NHS providers to deliver clinical trials, giving them a per-patient payment for doing so.
- **Avoided treatment costs.** Industry clinical trial sponsors will provide pharmaceutical products free of charge for trial participants.
- **Strengthening the clinical research workforce.** Commercial revenue received by NHS Trusts for delivering industry clinical trials consists of three components: direct costs, overheads, and a capacity build charge. Both direct costs and the capacity build charge fund the NHS clinical research workforce.

Commercial revenues

Industry sponsored trials are typically delivered by NHS staff on NHS premises. These NHS Trusts receive an income for delivering this activity that covers direct staff costs, overhead costs, and a capacity build charge. The capacity build charge is intended to build sustainable research and innovation capacity, including clinical research workforce, for the benefit of all research partners. This income is referred to as a 'per-patient payment'.

Based on data shared by the NIHR, the average per-patient payment in 2022/23 across commercial studies sponsored by the NIHR Clinical Research Network (CRN) was £26,311 (£28,808 once adjusted for inflation to 2024 prices). This is a significant increase compared to the average per-patient payment values in

the previous analysis for NIHR (£9,189 in 2018/19 prices, £11,458 in 2024 prices), and this per-patient figure will vary significantly from trial to trial.

In 2022/23, 42,088 patients were recruited to industry clinical trials, leading to **£1.2 billion of income for the NHS for trials initiated in 2022/23.**

Avoided treatment costs

In addition to providing a revenue stream to the NHS, industry clinical trials also lead to avoided treatment costs. Industry trials that involve replacing standard treatment with new pharmaceutical products lead to a direct cost saving for the NHS. Furthermore, in some trials, industry will also fund treatment on the 'control arm' - that is, patients who receive normal standard of care during the trial. This offers an additional saving to the NHS.

While the value of avoided treatment costs have not been quantified in this study, previous work carried out for the NIHR estimated that 31% of industry trials involved replacing standard treatment with new pharmaceutical products, resulting in £28.6 million of treatment cost savings to the NHS in 2018/19.³

The avoided treatment costs for the NHS in 2022 depend on the mix of clinical trials and changes in treatment costs since 2018/19.

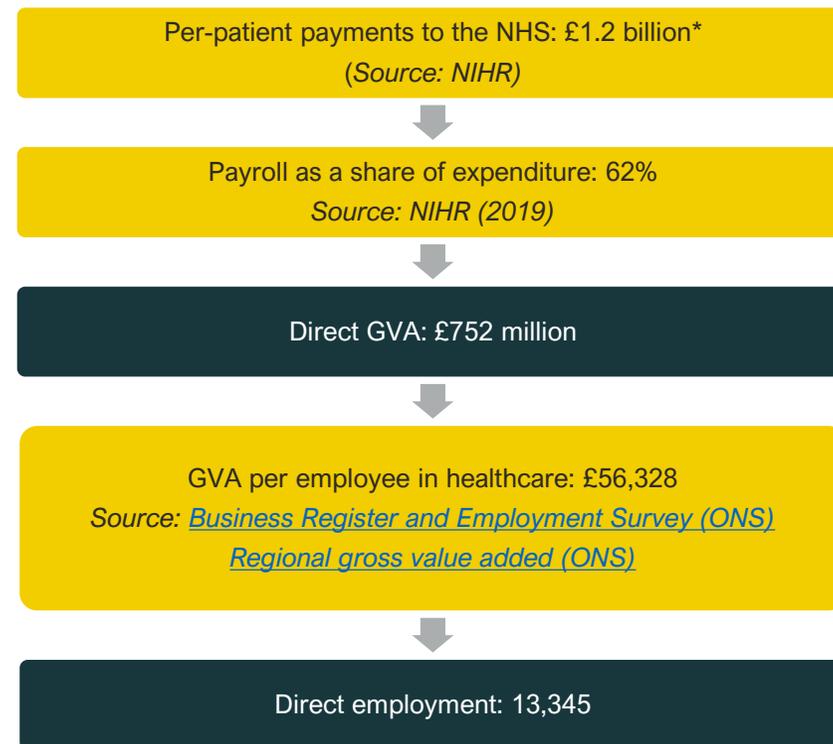
Clinical research workforce

The UK has an international reputation for delivering high-quality clinical research and scientific leadership. This plays a key role in attracting global industry to invest in the UK. Delivery of these studies is possible because of leading clinical academics based within the NHS, supported by a clinical research workforce, most of whom are also embedded within the NHS.

However, the UK is facing shortages across the research workforce,²⁴ and rates of clinical research engagement are lower in the UK than both the EU and the US.²⁵ Both government²⁶ and wider stakeholders²⁷ have called for greater investment in this area.

Participation in research raises job satisfaction among clinicians. Surveys of medical graduates have consistently showed that over 40% of graduates look for posts in the NHS that include an element of research, and a survey of senior UK doctors found that more dedicated time for research was considered desirable.²⁸

Clinical trials are one of the most common ways in which clinical academics participate in research.²⁹ Our analysis estimates that industry clinical trial activity directly supports around **13,000 FTEs in the NHS** in 2022, noting that there is some uncertainty around this estimate as it uses historical data on wage costs, which may have changed over time.



*£ figures expressed in 2024 prices using the Consumer Prices Index including owner occupiers' housing costs (CPIH). CPIH is the lead inflation index used by the government as it is the most comprehensive measure of inflation.

3. Benefits to the UK's research and development base

Industry contributed to approximately 5,000 papers over the past 5 years, either through funding or authorship, 11% of which were highly cited. These went on to support 283 patent applications.



4,841 academic publications.

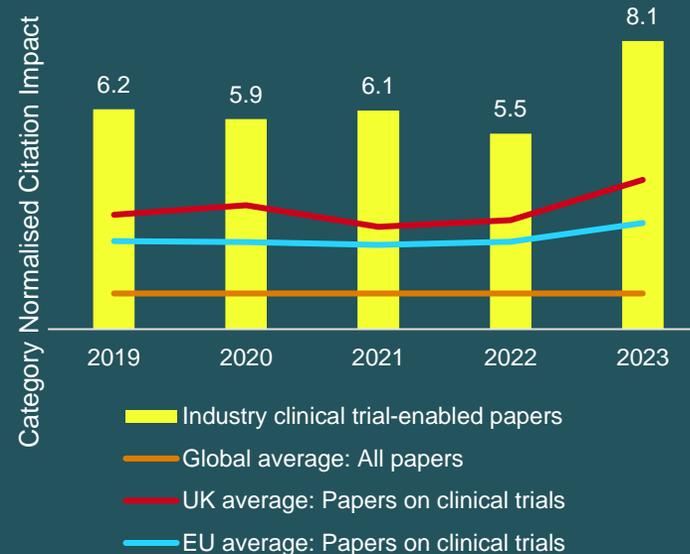


Cited by 283 patent applications.

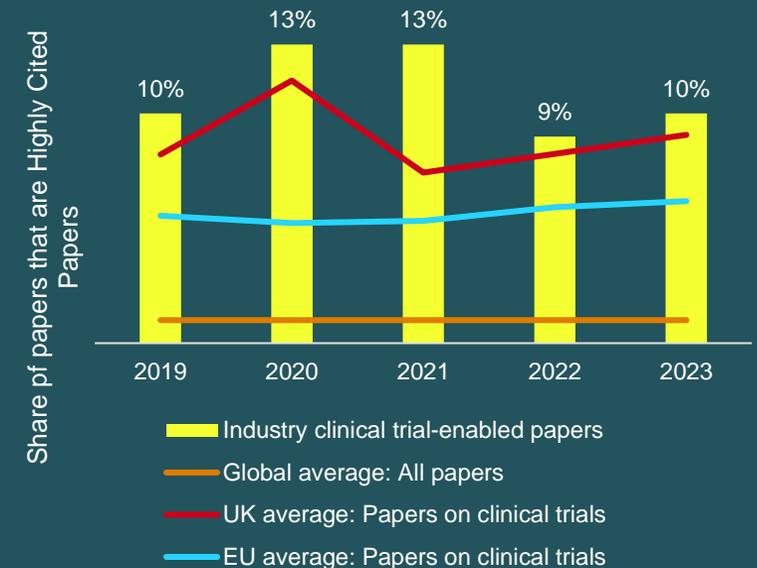


40% of publications were collaborative between industry and hospitals or the Department for Health and Social Care.

On average these papers were cited **over 6x** the global average, demonstrating their high impact.



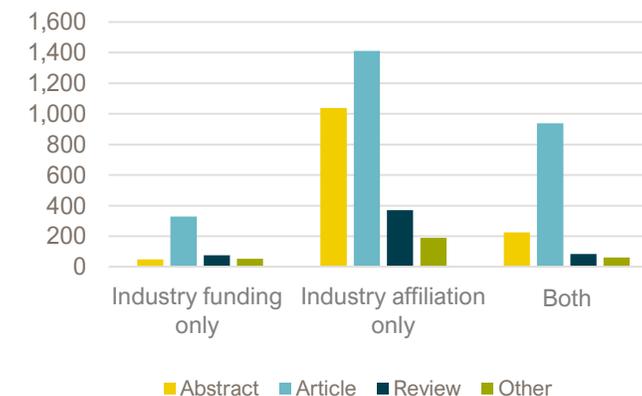
11% of papers were in the top 1% most cited papers published in the field that year.



Impact on UK research publications

Industry clinical trials produce world-class research and help to maintain the UK's position as a global leader in clinical research. Clarivate carried out a bibliometric analysis of publications arising from industry clinical trials, the potential spillover benefits of this research into commercial activities via patents, and future collaborative research via collaboration analysis. A dataset was constructed consisting of UK documents indexed in the Web of Science™ published between 2019 and 2023 that were related to clinical trials and were either funded or authored by the pharmaceutical industry. It was not possible to identify the underlying funding structure of the clinical trial itself, which means that papers assessed in this section could cover both industry clinical trials and commercial collaborative studies. Around 27% of publications were produced by authors with an industry affiliation while also acknowledging industry funding. The majority of publications (62%) were produced by authors with an industry affiliation. Another 10% were publications that acknowledge industry funding without being authored by researchers with an industry affiliation.

Document types by industry involvement

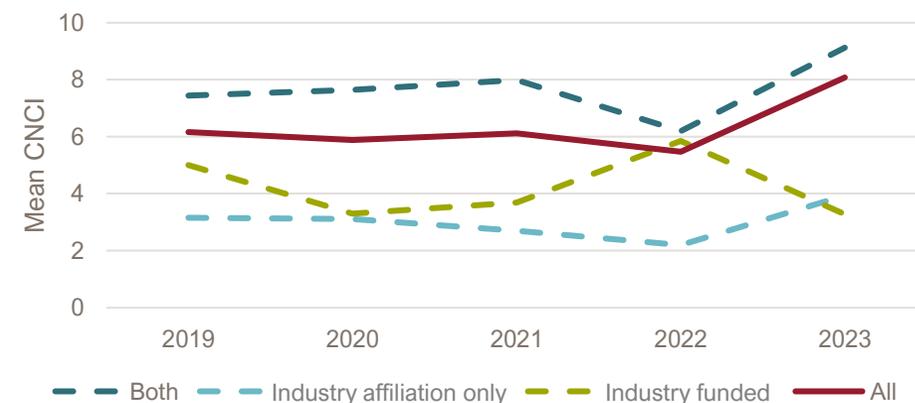


Citation impact

Citations are a common measure of research impact. For this analysis, Clarivate looked at two citation-related metrics: Category Normalised Citation Impact (CNCI) and Highly Cited Papers (HCPs). CNCI is a measure of a publication's scholarly influence as indicated by the volume of citations (adjusted for year and field), and HCP represent the top 1% most cited papers within their respective field, year, and document type. Publications with industry contribution performed well above the global average in both metrics:

- **The average CNCI was 6.2, well above the global baseline (for all papers) of 1. This average was also higher than the average CNCI for all UK papers on clinical trials (3.36) and the average CNCI for all EU papers on clinical trials (2.54).**
- **On average, 11% were categorised as HCPs meaning they were in the top 1% most cited papers in their field. In comparison, 8.9% of all UK papers discussing clinical trials and 5.7% of all EU papers discussing clinical trials were HCPs.**

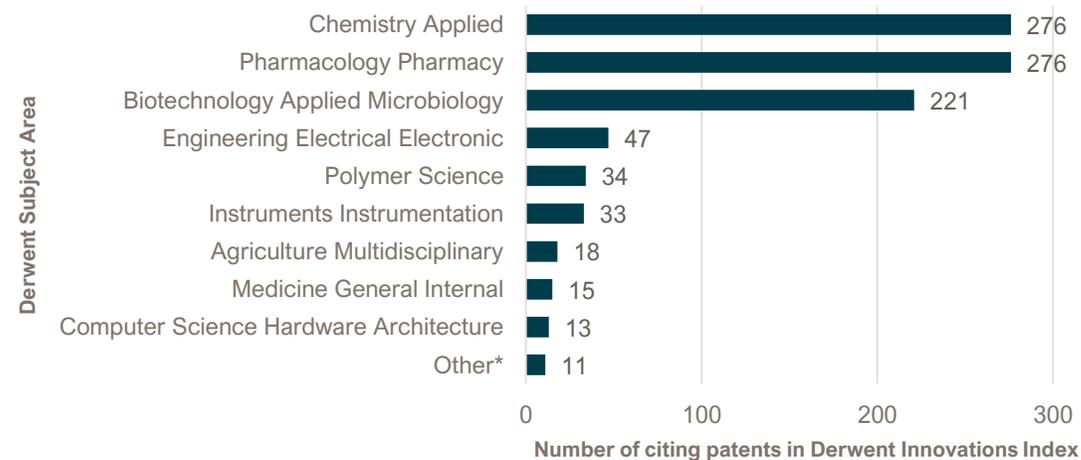
Mean Category Normalized Citation Impact (CNCI), by industry collaboration type, 2019-2023



Patent citations

R&D activity generates spillover benefits. These are benefits that accrue to organisations beyond the company carrying out the research activity. This is a major driver of economic growth arising from R&D investment. In 2022, the industry invested £5.5 million in clinical trial R&D, generating £1.1 billion in spillover benefits.

Spin-offs (companies whose business is based on products or technology initially developed in a parent company, university, or research organisation) are one way in which these spillover effects are generated and are a key part of economic growth. Patents are one indicator of spin-off activity. Identifying instances where industry clinical trial publications have been cited in patent submissions demonstrates the impact that this activity has in supporting economic growth. Collectively, the set of clinical trial publications that had industry input received a total of 330 citations from patent literature. A total of **283 patents in the Derwent Innovations Index™** were found to contain references to the set of publications related to industry clinical trials.

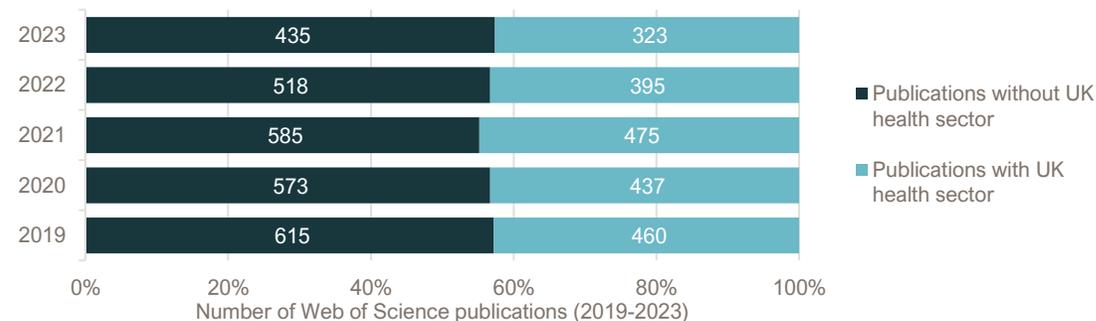


* Other is made up of subject areas with fewer than 5 citing patents: Nuclear Science Technology (4), Engineering Chemical (4), Optics (1), Imaging Science Photographic Technology (1), Food science technology (1)

Collaboration

Affiliation data was used to understand the degree to which industry contributions to R&D support collaboration with the NHS and DHSC. The results showed that collaboration with the UK health sector is common on research publications with industry contribution. Overall, **over 40% of considered publications featured an affiliation with a UK health sector organisation**. Throughout the analysis period, this has also remained stable on an annual basis.

Collaboration with the UK health sector



Restoring the UK's capacity to deliver industry clinical trials would significantly advance the government's NHS and economic growth missions

Increasing UK industry clinical trial activity by 40% (comparable to 2017 levels) would generate:



£3 billion of additional GVA for the UK economy.

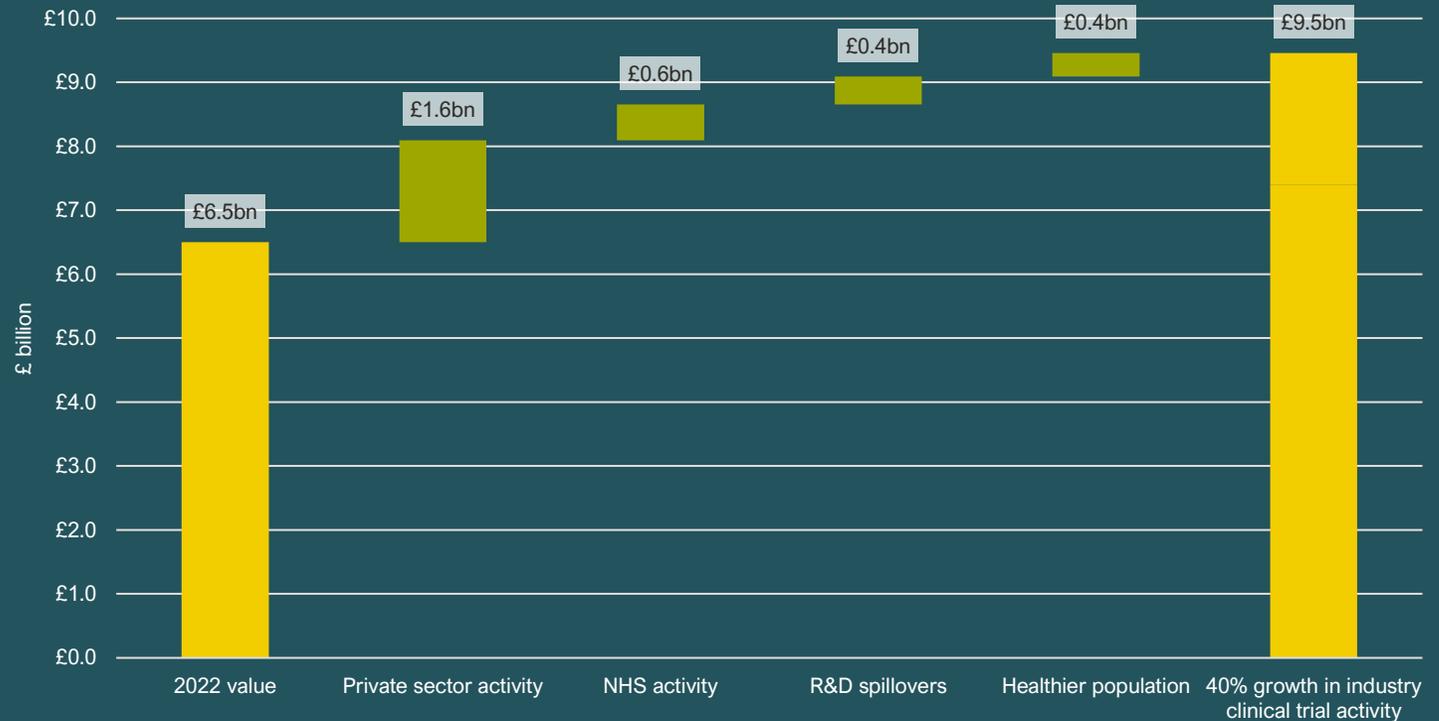


26,000 additional jobs, **5,000** of which are in the NHS.



1.1 million additional avoided sick days from improved quality of care, leading to a healthier population.

Additional GVA impact of increasing industry clinical trial activity by 40%



What's the opportunity?

While the UK remains active in the global clinical trial market, both the number of industry clinical trials initiated in the UK and number of participants recruited have been declining since 2017.³⁰ Frontier Economics investigated the opportunities available to the UK if investments in its capacity for industry clinical research enabled a 40% increase in industry clinical trial activity (that is, a rise comparable to 2017 levels).

The economic opportunity

Assuming that the average cost of industry clinical trials (in 2024 prices) remains the same, growth in the number of patients recruited (and trials initiated assuming average patients per trial remains the same) would lead to an **additional £3 billion of GVA for the UK**, made up of:

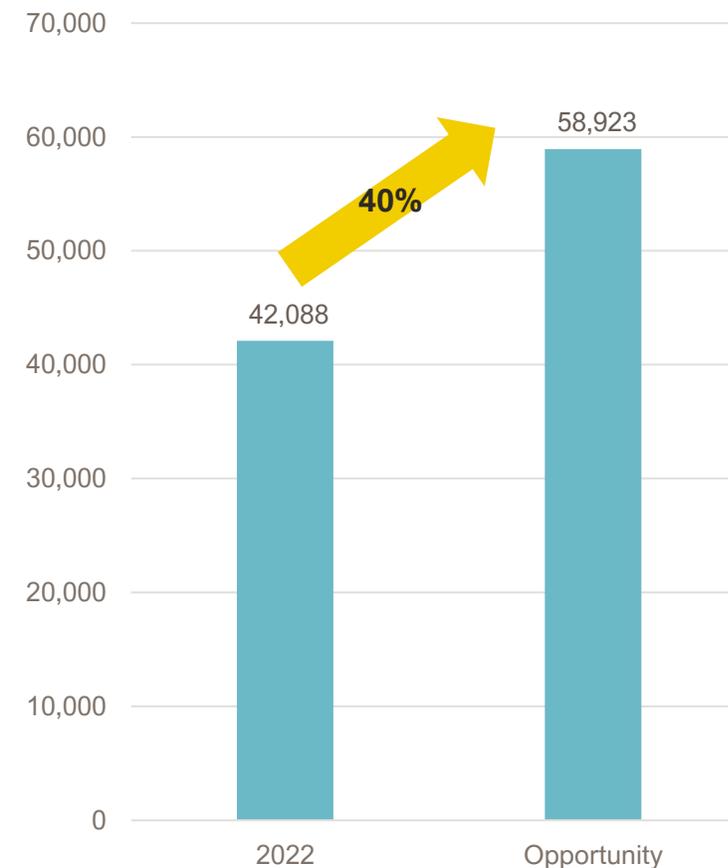
- £1.6 billion generated from the direct, indirect, and induced effects of additional people employed in industry.
- £0.6 billion generated from the direct, indirect, and induced effects of additional NHS clinical research activity (this estimate is more uncertain and is excluded from the lower range of the estimate above).
- £0.4 billion created by R&D spillovers.
- £0.4 billion attributed impact from avoided sick days due to improved quality of care in hospitals that participate in research, equivalent to 1.1 million additional avoided sick days.

This growth in the clinical research sector would create 26,000 additional jobs, 5,000 of which are in the NHS.

Opportunity for the NHS

This additional industry clinical trial activity would generate **£485 million of commercial revenue for the NHS**, enabling **5,000 additional NHS jobs**. Growth in industry clinical trial recruitment would also increase the number of patients receiving industry-funded treatments, leading to additional cost savings for the NHS over and above this revenue.

Participants recruited to industry clinical trials



Endnotes

- 1 ABPI (2023). Getting back on track: Restoring the UK's global position in industry clinical trials. [Getting back on track: Restoring the UK's global position in industry clinical trials \(abpi.org.uk\)](https://www.abpi.org.uk)
- 2 DHSC (2024). UK Clinical Research Delivery Key Performance Indicators Report. [UK Clinical Research Delivery Key Performance Indicators Report + appendix - June 2024.pdf - Google Drive](#)
- 3 NIHR (2019). NIHR Clinical Research Network: Impact and Value Assessment. [Impact and Value Report | NIHR](#)
- 4 PwC (2022). Transforming lives, raising productivity. [PwC - Transforming lives, raising productivity \(abpi.org.uk\)](#)
- 5 DHSC, OLS, DSIT (2023). Commercial clinical trials in the UK: the Lord O'Shaughnessy review - final report. [Commercial clinical trials in the UK: the Lord O'Shaughnessy review - final report - GOV.UK \(www.gov.uk\)](#)
- 6 Frontier Economics (2023). Rate of return to investment in R&D. [rate-of-return.pdf \(frontier-economics.com\)](#)
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- 10 Ozdemir et al (2015). Research Activity and the Association with Mortality. <https://doi.org/10.1371/journal.pone.0118253>
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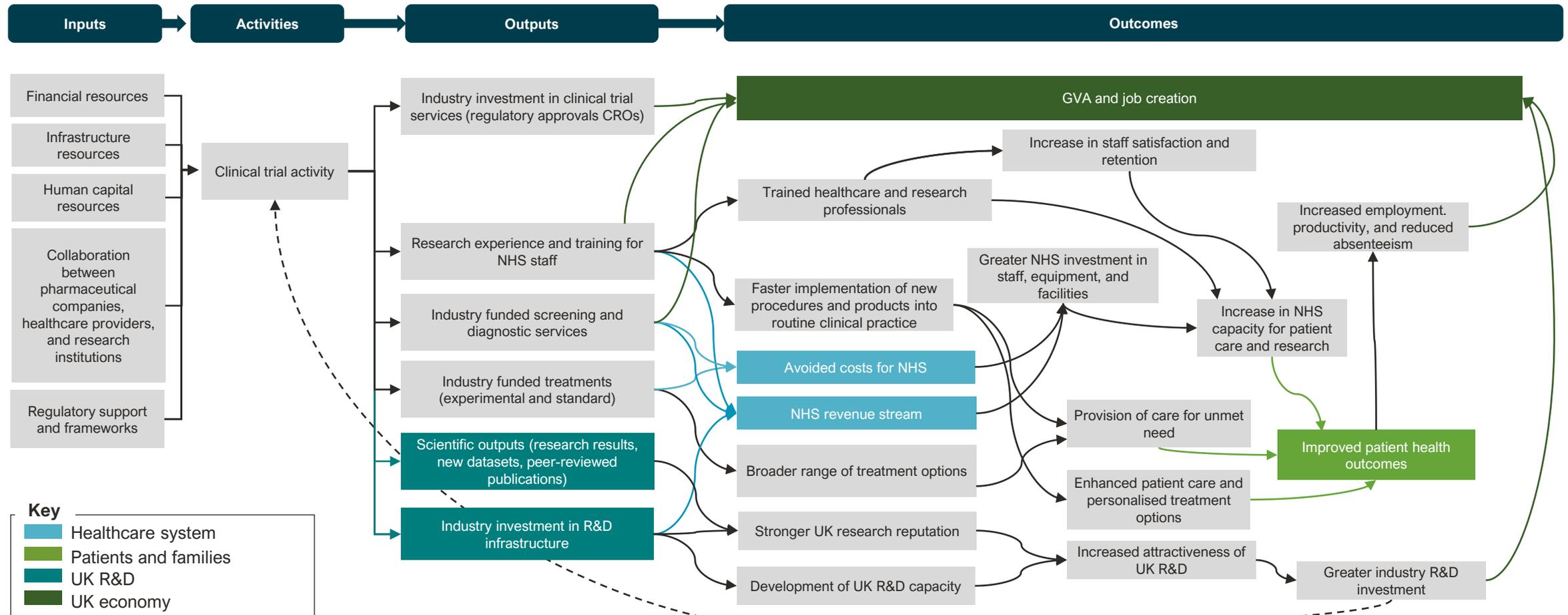
Technical appendix

Glossary

| | |
|---|---|
| ABPI | The Association of the British Pharmaceutical Industry |
| Category Normalised Citation Impact (CNCI) | Citation rates vary between research fields and with time. Consequently, analyses must take both publication field and year into account. In addition, the type of publication will also influence the citation count. For this reason, only citation counts of papers (as defined below) are used in calculations of citation impact. The standard normalisation factor is the world average of citations per paper for the year and subject category in which the paper was published. This normalisation is referred to as 'rebasings' the citation count. A CNCI value of more than 1.0 indicates performance higher than the world average for the relevant publication field, year, and document type. |
| Citation count | The citation count is the number of times that a citation has been recorded for a given publication since it was published. Not all citations are necessarily recorded since not all publications are indexed. The material indexed by Clarivate, however, is estimated to attract about 95% of global citations. |
| Citation impact | Citations per paper is an index of academic or research impact (as compared with economic or social impact). For a single paper, raw citation impact is the same as its citation count. For a set of papers, it is calculated by dividing the sum of citations by the total number of papers in any given dataset. Impact can be calculated for papers within a specific research field such as clinical neurology, or for a specific institution or group of institutions, or a specific country. Citation count declines in the most recent years of any time period as papers have had less time to accumulate citations (papers published in 2007 will typically have more citations than papers published in 2010). |
| Clinical trial sponsor | The organisation that has overall responsibility for running the clinical trial. This can be different from the organisation that funds the research. |
| Commercial collaborative studies | Commercial collaborative studies are typically funded, either wholly or in part, by the life sciences industry and sponsored by a combination of industry and non-commercial organisations. |
| GVA (direct, indirect, and induced) | Gross value added (GVA) measures the contribution of a specific sector to the overall economy. GVA impacts are often split into direct, indirect, and induced impacts. Direct impacts refers to changes in the value of goods and services produced by that industry. Indirect impacts refer to changes in the use of inputs across their supply chain. Together, direct and indirect impacts will impact the level of household income of employees, some of which will be re-spent on buying products. This known as the induced impact. |
| Industry clinical trials | Industry clinical trials (also known as commercial contract studies) are sponsored and fully funded by the life sciences industry. |
| Publications | A collection of research outputs regardless of document type, as indexed in the Web of Science™. In addition to articles and reviews, publications can cover a wide range of document types such as books, conference proceedings, editorial material, bibliographies, meeting abstracts, etc. While these are all relevant forms of scholarly communication, only articles and reviews (that is, papers) are considered in citation analyses. |
| Papers | A subset of publications consisting of 'articles' and 'reviews' only. Articles are reports of original research published in a peer-reviewed journal and/or presented at a symposium. Reviews are renewed studies of previous research, such as literature reviews and meta-analyses. Papers are the primary means of scholarly communication and considered the most informative for citation analysis. All citation-related results in this report (except patent citations) are therefore based on papers only. |
| Highly Cited Papers (HCPs) | Highly Cited Papers are papers that are recognised as having a greater impact than other papers published in a similar year and field. For a paper to be considered highly cited it must be in the top 1% in terms of citation frequency, considering the field and year of publication. High citation rates have shown to be correlated with other qualitative research performance evaluations, such as peer reviews. |
| Non-commercial studies | Non-commercial studies are sponsored and wholly funded by one or more non-commercial organisations, including medical research charities, universities, and public funders. |
| Web of Science subject categories | Journals are assigned to one or more categories, and every article within that journal is subsequently assigned to that category. Journals in the Web of Science Core Collection can be assigned to up to six categories, which are selected on the basis of a range of criteria including journal subject matter and scope, author and editorial board affiliations, funding agencies providing grant support, cited references as well as citing and cited reference relationships, journal sponsors, and categorisations in other bibliographic databases. The selection procedures for the journals included in the citation databases as well as the scope of each subject category are documented here: http://mjl.clarivate.com/ . |

Logic model

A logic model was developed to support the identification of potential benefits of delivering industry clinical trials in the UK. This underpins the impact framework.



Overview of impact estimation approach

A mixed-methods approach was applied for estimating the benefits of industry clinical trials to the UK. This brought together evidence generated via several approaches:

- Rapid evidence review of existing published literature.
- Scale of existing estimates of the impact of industry clinical trials to reflect changes in trial activity.
- Analysis of key impact metrics such as NHS commercial revenues.
- Economic impact assessment, using multipliers to estimate the direct, indirect, induced, and spillover economic benefits of clinical trial activity.
- Health economics productivity modelling.
- Bibliometric analysis using a curated database of relevant publications indexed in the Web of Science™.
- What if analysis which scales up modelled benefits based on a theoretical scenario: an increase in clinical trial activity of 40% compared to 2022 levels.

The table below sets out the approaches used to generate evidence for each type of impact in this work:

| Benefit area | Benefit type | Approach |
|--------------|---|--|
| UK economy | Direct, indirect, and induced benefits from private-sector activity | Economic impact assessment (income approach) |
| | Direct, indirect, and induced benefits from NHS activity | Economic impact assessment (income approach) |
| | Spillover effects from private-sector activity | Economic impact assessment (income approach) |
| | Impact of a healthier population | Rapid evidence review Health economics productivity modelling (avoided sick days) Case study (colorectal cancer) |
| NHS | Commercial revenue of industry clinical trials | Analysis of key impact metrics |
| | NHS clinical research workforce | Economic impact assessment (income approach) |
| UK R&D base | Volume and impact of industry clinical trial-enabled research | Bibliometric analysis |

Benefits to the UK economy: Approach

Direct, indirect, and induced benefits from private-sector activity

An ‘income approach’ was used to measure Gross Value Added. This assumes that the total payroll cost corresponds to the value added, plus associated profit margin (some of the value added is captured by the owners as profit (item D)).

This amount was further scaled to account for the fact that only a subset of pharmaceutical R&D is in trials (B), there will be trials involving medical devices that are not captured in the pharmaceutical industry total (C), as well as inflation (E). This gives ‘direct’ GVA of £1.93 billion. The proportion of clinical trials that are concerned with medical devices was provided by NIHR based on their 2023/24 clinical trial portfolio.

Multipliers were then applied to account for:

- Indirect GVA from activity and output supported in the supply chain.
- Induced GVA as direct and indirect employees spend their money elsewhere in the economy.

This gives total GVA of £3.99 billion.

Employment follows the structure as the GVA calculation.

R&D employment was measured using ONS BERD and the same scaling factors were applied to account for the share of clinical studies in R&D and uplift for medical devices. Note that the 48.4% R&D spend share was used as no comparable employment statistic is available. Thus, it is implicitly assumed that clinical trials have the same GVA per employee as other types of pharmaceutical R&D. Multipliers were then applied to account for indirect and induced employment. This gives total employment of 42,300.

| Item | | Value | Source |
|--|-----|----------------|-------------------------|
| Payroll costs in pharmaceutical R&D (2022) | (A) | £3,116m | ONS BERD (2022) |
| Proportion of pharmaceutical R&D spent on clinical studies* | (B) | 48.4% | PhRMA survey (2023) |
| Uplift for proportion of clinical trials involving medical devices | (C) | 13% | NIHR |
| Profit margin | (D) | 2% | Deloitte (2018) |
| Inflation to scale 2022 estimates to 2024 prices | (E) | 9.5% | ONS CPIH |
| Direct GVA | (F) | £1,934m | $A*B*(1+C)*(1+D)*(1+E)$ |
| Type 1 GVA multiplier parameter | (G) | 0.67 | ONS (2020) |
| Type 2 GVA multiplier parameter** | (H) | 0.39 | Scottish Govt+ONS(2020) |
| Indirect GVA | (I) | £1,304m | (F)*(G) |
| Induced GVA | (J) | £746m | (F)*(H) |
| Total GVA | (K) | £3,994m | (F)+(I)+(J) |

*The proportion of pharmaceutical spend on R&D on clinical studies is based on phase 1/2/3 trials. Phase 4 trials represent a further 11.5%

**Type 2 multipliers are reported by the Scottish Govt but not ONS. The ratio of Type 2 to Type 1 reported by Scottish Govt is applied to the ONS Type 1 multiplier to give a Type 2 estimate

| Item | | Value | Source |
|--|-----|---------------|-------------------------|
| Employment in pharmaceutical R&D | (A) | 38,000 | ONS BERD (2022) |
| Proportion of pharmaceutical R&D spent on clinical studies | (B) | 48.4% | PhRMA survey (2023) |
| Uplift for proportion of clinical trials involving medical devices | (C) | 13% | NIHR |
| Direct employment | (D) | 21,100 | $A*B*(1+C)$ |
| Type 1 Employment cost multiplier parameter | (E) | 0.70 | ONS (2020) |
| Type 2 Employment multiplier parameter | (F) | 0.30 | ONS+Scottish Govt(2020) |
| Indirect employment | (G) | 14,700 | (D)*(E) |
| Induced employment | (H) | 6,400 | (D)*(F) |
| Total employment | (I) | 42,300 | (D)+(G)+(H) |

Benefits to the UK economy: Approach

Direct, indirect, and induced benefits from private-sector activity: Comparison with previous estimates

The estimates of direct, indirect, and induced benefits from private-sector industry clinical trial activity are considerably larger than previous estimates calculated for the NIHR (£1.5 billion GVA and 23,000 employees in 2018/19) despite adopting the same overarching approach. Partly, this reflects differences in scope (UK-wide rather than England-only, all commercial activity rather than just CRN-supported) as well as inflation. However, the key driver is the substantial increase in R&D activity shown in BERD. There has been a recent revision to the BERD methodology that has significantly increased estimates, principally involving estimates for small firms.

If this revision has materially impacted estimates, there would be large jumps as the methodology changes. Unfortunately, it is not possible to explore this systematically, as the available data points vary over time, with revised estimates for 2020 and 2021 only recorded down to the level of an aggregated ‘chemicals and pharmaceuticals’ category, and payroll costs not reported for 2020 or 2021. As can be seen in the table to the right there is no change in employment for the ‘chemicals and pharmaceuticals’ group with the revision change, while expenditure sees a 20% increase. However, there are substantial increases in 2021 and 2022, all of which points to significant growth. This is also consistent with pharmaceutical employment growth from 30k in 2020 under the old methodology to 38k in 2022, a 27% increase.

Payroll costs for 2020 are not available on the revised basis but comparing 2020 on the old methodology with 2022 on the new methodology, there is a 47% increase. This would suggest GVA per employee rose 16% over the period, which exceed inflation. This is also corroborated by other information on pay, with the Annual Survey of Hours and Earnings dataset (ASHE) showing a 43% increase in annual pay (from £43,000 in 2020 to £61,000 in 2022).

ONS BERD data

| | 2014 | 2015 | 2016 | 2020 (old) | 2020 (revised) | 2021 | 2022 |
|-------------------------------|--------|--------|--------|------------|----------------|--------|--------|
| Employment ('000s) | | | | | | | |
| All sectors | 192 | 206 | 210 | 283 | 629 | 712 | 652 |
| Chemicals | 8 | 8 | 10 | 9 | | | 8 |
| Pharmaceuticals | 24 | 24 | 24 | 30 | | | 38 |
| Chemicals and pharmaceuticals | 32 | 32 | 34 | 39 | 38 | 39 | 46 |
| Expenditure (£m) | | | | | | | |
| All sectors | 19,935 | 20,885 | 22,224 | 26,937 | 43,995 | 46,929 | 49,942 |
| Chemicals | 682 | 826 | 1,020 | 814 | | | 861 |
| Pharmaceuticals | 3,924 | 4,178 | 4,122 | 5,017 | | | 8,961 |
| Chemicals and pharmaceuticals | 4,606 | 5,004 | 5,142 | 5,831 | 7,083 | 8,200 | 9,822 |
| Payroll costs (£m) | | | | | | | |
| All sectors | 9,489 | 10,238 | 10,504 | 13,657 | | | 27,770 |
| Chemicals | 319 | 401 | 469 | 362 | | | 464 |
| Pharmaceuticals | 1,676 | 1,796 | 1,761 | 2,114 | | | 3,116 |
| Chemicals and pharmaceuticals | 1,995 | 2,197 | 2,230 | 2,476 | | | 3,580 |

Benefits to the UK economy: Approach

Direct, indirect, and induced benefits from NHS activity

Commercial revenues to the NHS was used as the basis for this calculation (see page 33). Estimates from prior analysis of NHS Trust data was applied, which found that staff costs make up 62% of total clinical research costs.* Using the same GVA income approach as previously, this suggests the commercial research activity carried out in the NHS has a direct GVA of £752 million. Multipliers were then applied, which brings the total GVA up to £1,403 million.

The direct GVA estimate was then converted into a corresponding direct employment figure by applying ONS GVA per employee estimates for SIC code 86. This gives direct employment of 13,300 workers (FTE). Employment multipliers are then applied, which brings the total up to 22,500.

**The proportion of pharmaceutical spend on R&D on clinical studies is based on phase 1/2/3 trials. Phase 4 trials represent a further 11.5% but are out of scope for this work.*

***Type 2 multipliers are reported by the Scottish Govt but not ONS. The ratio of Type 2 to Type 1 reported by Scottish Govt is applied to the ONS Type 1 multiplier to give a Type 2 estimate.*

| Item | | Value | Source |
|---|------------|----------------|----------------------------|
| <i>GVA calculation</i> | | | |
| Total value of payments | (A) | £1,212m | |
| Payroll as share of expenditure in NHS Trust | (B) | 62% | KPMG (2019) |
| Direct GVA | (C) | £752m | (B)*(C) |
| Type 1 GVA multiplier parameter SIC 86 | (D) | 0.50 | ONS (2020) |
| Type 2 GVA multiplier parameter SIC 86 | (E) | 0.37 | ONS + Scottish Govt (2020) |
| Indirect GVA | (F) | £372m | (C)*(D) |
| Induced GVA | (G) | £279m | (C)*(E) |
| Total GVA | (H) | £1,403m | (C)+(G)+(H) |
| <i>Employment calculation</i> | | | |
| GVA per employee SIC 86 (2022 prices) | (I) | £51,128 | ONS |
| Inflation from 2022 to 202 | (J) | 10.2% | ONS |
| GVA per employee SIC 86 (2024 prices) | (K) | £56,328 | (I)*(J) |
| Direct employment | (L) | 13,345 | (C)/(K) |
| Type 1 employment multiplier parameter SIC 86 | (M) | 0.40 | Scottish Govt(2020) |
| Type 2 employment multiplier parameter SIC 86 | (N) | 0.28 | ONS + Scottish Govt(2020) |
| Indirect employment | (O) | 5,300 | (L)*(M) |
| Induced employment | (P) | 3,800 | (L)*(N) |
| Total employment | (Q) | 22,500 | (L)+(O)+(P) |

Benefits to the UK economy: Approach

Economic spillovers

As with other forms of R&D, clinical trials give rise to the creation of knowledge that can be used by other firms and open up new areas of treatment that other firms can become active in. They also stimulate activity in a productive sector of the economy and employ a skilled workforce who can benefit other firms when they move jobs, either within or outside the sector. All of this means that the 'social' economic return of clinical research may be wider than the private economic return to the firm undertaking the R&D.

Using the same BERD data used for the commercial GVA calculation, annual R&D investment is £5.5 billion (2024 prices). This comes from taking the £9.0 billion pharmaceutical figure from BERD and applying the 48.4% clinical trials share, 13% medical device uplift, and adjusting for inflation.

A broad literature has estimated the rate of return on R&D and the spillovers. A previous meta-analysis ([Frontier Economics](#)) finds central estimates of a private rate of return to R&D of 20% and a social rate of return of 40%, with the difference between the two interpreted as the spillover.

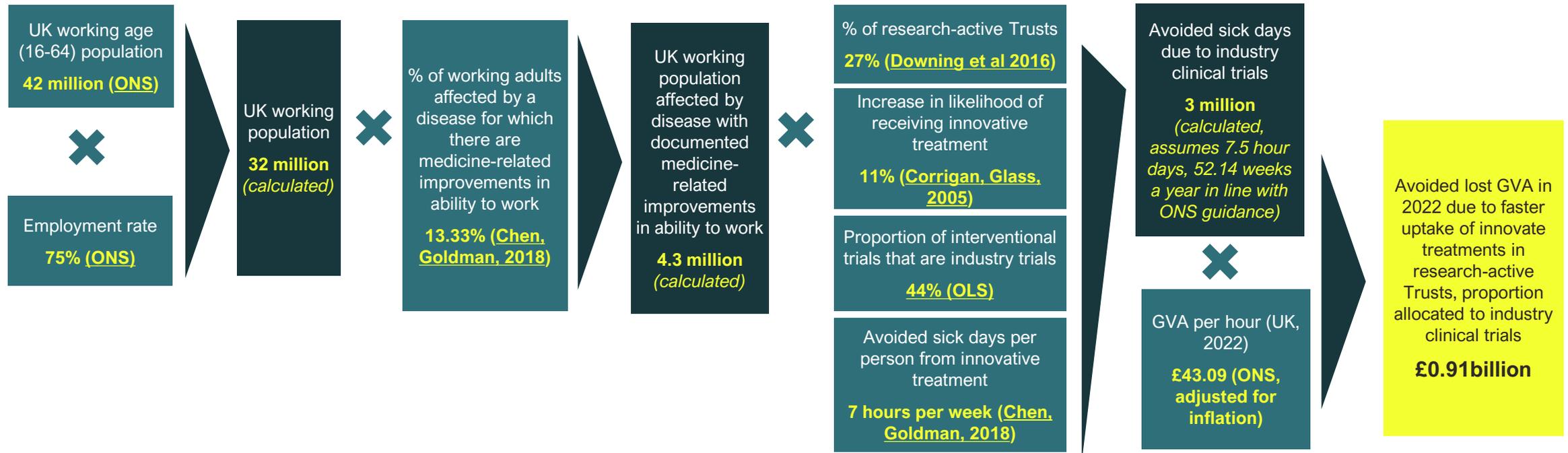
A report by York University for [NIHR](#) focuses on R&D in the biomedical industry and reaches a consensus spillover figure of 30%. This includes a result from Garau and Sussex (2007), which finds the rate of return generated by investment in R&D by two UK private-sector pharmaceutical companies in the UK was 51%, of which 14% was captured by the investing firm, 26% was captured by other firms in the same sector, and 11% was captured in other non-pharmaceutical sectors of the UK economy.

Applying the 20% spillover parameter would suggest spillovers in the order of £1.1 billion.

Benefits to the UK economy: Approach

Avoided absenteeism

Evidence has been drawn from the rapid evidence review to estimate the attributable impact of industry clinical trials to improved patient outcomes from hospitals with research participation, and the impact this has on UK GVA via avoided sick days. The approach used by Chen and Goldman²⁰ was used to estimate the population-wide productivity impacts of new treatments. They found that in the absence of new treatments, hours worked per person would have fallen by 7 hours a week. Evidence from Corrigan and Glass¹⁸ found that at 18 months after launch, 23% of consultants that participated in clinical research had prescribed the new treatment compared to 12% of consultants who did not. Finally, evidence from Downing et al (2016)¹³ was used to estimate the proportion of NHS Trusts that are 'research-active' to reach an estimate of avoided sick days due to hospital participation in research. 44% of this was attributed to industry clinical trials based on the proportion of interventional trials in 2022 that were industry clinical trials.



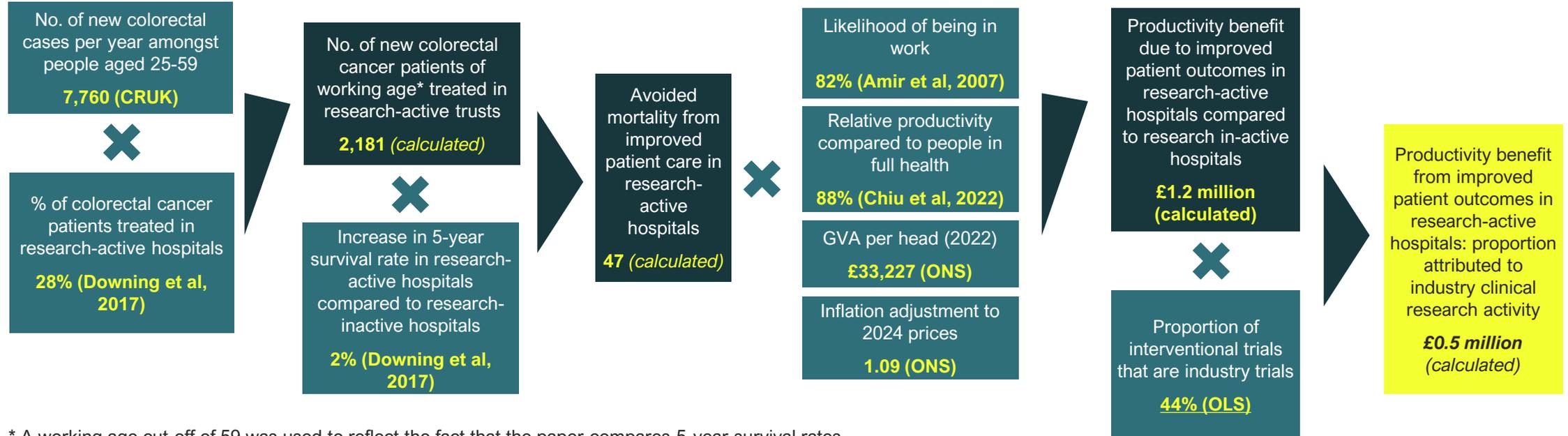
This study quantifies potential GVA benefits from avoided absenteeism. However, this is likely to be only a subset of the total productivity benefits associated with industry clinical trials and their role in accelerating the uptake of innovative treatments. Other benefits that have not been quantified include:

- Benefits of avoided mortality from other disease areas aside from colorectal cancer.
- Increase in productivity per hour worked associated with improved health outcomes.
- Increase in GVA due to higher labour force participation. For example, research into the use of radiation therapy for breast cancer found that it reduced the risk of being on welfare by 33-41%.²²
- Increase in GVA from reducing absenteeism of carers. For example, taking a multi-pronged approach to treating coronary heart disease increases family income by 4% compared to 3% for the patient.²³

Benefits to the UK economy: Approach

Case study: Improved patient outcomes for colorectal care

Research by Downing et al (2016)¹³ has shown that surgical colorectal cancer patients treated in hospitals with high research participation have better outcomes. The study looked at average outcomes across all patients treated with major resection, not just those that were participating in clinical trials at the time. It found that being treated in Trusts with high participation in interventional clinical research is independently associated with better outcomes, and this effect applies across all NHS Trusts that provide care for patients with colorectal cancer. Findings from this research have been used to estimate the productivity impacts associated with improved patient outcomes. A proportion of these benefits was attributed to industry clinical trials based on their share of interventional trials in 2022/23 to reflect the role that industry trials play in creating opportunities for hospitals to participate in clinical research.



* A working age cut-off of 59 was used to reflect the fact that the paper compares 5-year survival rates

Benefits to the NHS: Approach

Commercial revenues

Commercial revenues were calculated using an average per-patient payment provided by the NIHR.

The average amount paid to the NHS by commercial studies supported by the NIHR CRN (excluding other parts of the NIHR) in 2022/23 was £851 million. The NIHR advised us that this was based on expected recruitment of 32,328 people, leading to an average per patient payment of £26,311. This is a significant increase compared to the average per-patient payment values in the previous analysis for NIHR (£9,189 in 2018/19 prices, £11,458 in 2024 prices).

This was inflated to 2024 prices using CPIH to reach an average per-patient payment of £28,808.

This was then multiplied against a total of 42,088 patients recruited to industry clinical trials in 2022/23 to give a total NHS commercial revenue estimate of £1.2 billion in 2024 prices.

This approach has some limitations:

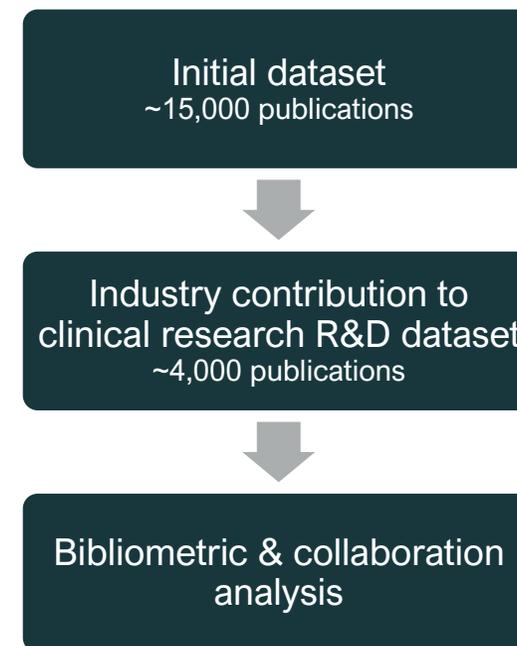
- Average NIHR per-payment payments have been applied to the devolved authorities.
- Data on average per-patient payments in 2022/23 has been provided by NIHR. This value represents the average across all industry clinical trials (commercial studies) supported by the NIHR Clinical Research Network. However, per-patient payments will vary significantly across individual studies to reflect factors such as specialty, trial, duration, study type, and product type.

| Item | | Value | Source |
|---|-----|----------------|--------|
| Per-patient payment for NIHR CRN commercial trials in 2022/23, 2022/23 prices | (A) | £26,311 | NIHR |
| Inflation | (B) | 1.095 | ONS |
| Per-patient payment, 2024 prices | (C) | £28,808 | A*B |
| Number of patients recruited to industry trials in 2022, UK | (D) | 42,088 | ABPI |
| Estimated UK commercial revenues | (E) | £1,212,450,303 | C*D |

Benefits to the UK R&D base: Approach

The following approach was used to carry out the bibliometric analysis for benefits to UK R&D:

1. **Identification of academic publications related to clinical trials.**
 - a. Extraction of publications discussing clinical trials with a UK affiliation and published between 2019-2023 from the Web of Science database
 - b. Relevant publications were selected based on their titles and Medical Subject Headings (MeSH terms)
2. **Identification of publications related to clinical trials and with a link to industry.**
 - a. Within the initial dataset, publications with a link to industry were identified based on either the affiliations of their authors or funding acknowledgements
 - b. Manual checks were conducted to confirm the resulting publications are related to clinical trials that are run or funded by industry. False positives were excluded.
3. **Bibliometric analysis to assess the research performance of UK industry clinical trial publications.**
 - a. Number of papers, average citation impact, Highly Cited Papers, citations from patents
 - b. Disaggregation of the results by year of publication and subject category (with a focus on oncology and rare diseases)
4. **Collaboration analysis based on co-authors listed on the identified publications.**
 - a. Levels of international collaboration between the UK and other countries
 - b. Collaboration with the NHS and DHSC (including NIHR and NHS trusts)
 - c. Identification of key collaboration partners and recurring collaborative partnerships over time



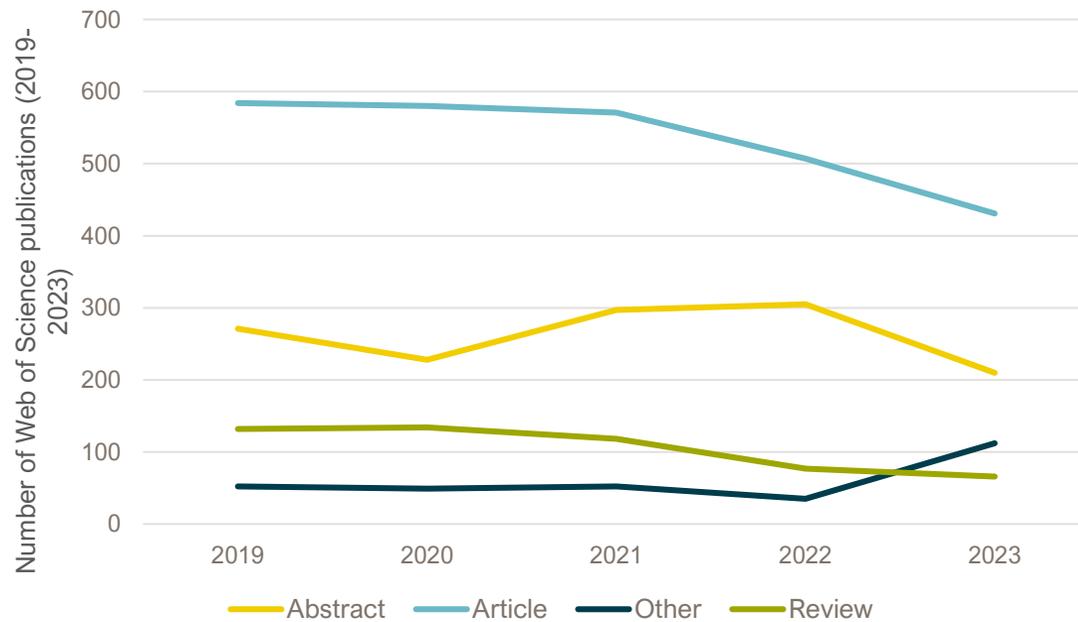
The main limitation with this analysis is that papers were included where there is a link to industry based either on author affiliation or funding acknowledgements. It has not been possible to identify whether the specific clinical trial discussed was funded wholly or in part by industry. There is therefore a risk that some of these papers may reference collaborative trials or non-commercial trials. Throughout this work, this has been reflected by presenting the results of the analysis in terms of industry contributions to R&D.

As part of the collaboration analysis, recurring partnerships were identified. Recurring partnerships were defined as pairs of organisations that have co-authored two or more publications. In total, the set of publications related to industry clinical trials include over 297,000 partnerships. Approximately 26% of these are instances where the collaborating organisations co-authored two or more publications together.

Trend analysis

Considering the number of publications per year, a slight downward trend can be observed, particularly in the number of journal articles and reviews published. The relative uptick in 2023 of the number of 'other' document types is largely driven by the publication of early-access materials. It is possible that this reflects a displacement of clinical research activity in favour of other kinds of research following the COVID-19 pandemic.

Annual number of publications

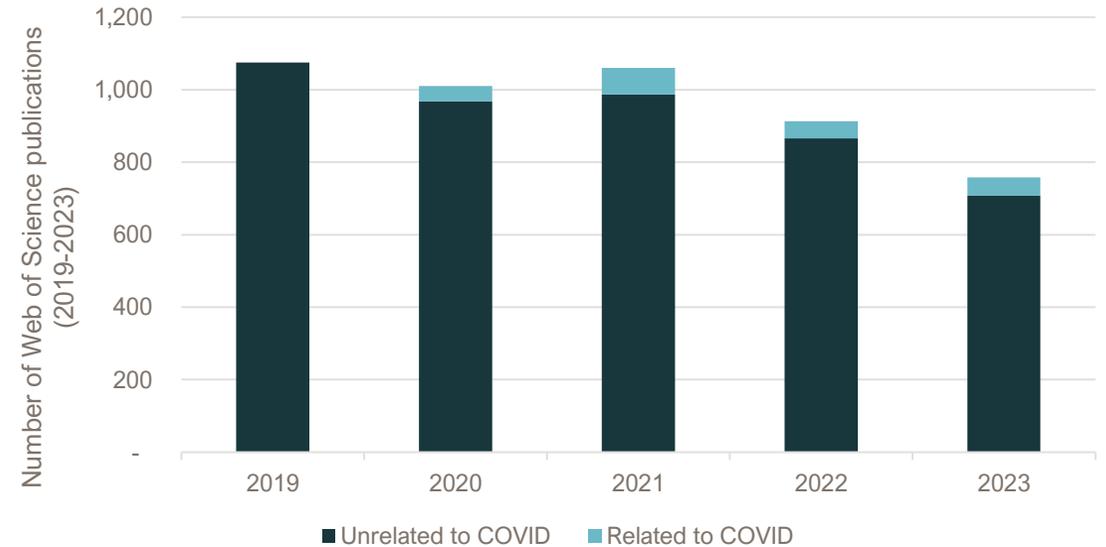


Effects of COVID-19

From the total set of publications, the vast majority are unrelated to COVID-19. Approximately 4% (212) of the publications was found to be related to COVID-19. These publications are spread relatively evenly across the years 2020 to 2023 with most appearing in 2021 (34%).

However, the downward trend in publications shown below may be due to reduced numbers of clinical trials during the pandemic (2022 and 2021), accounting for the lag between clinical trial activity and associated publications.

COVID-related publications





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