

# THE ACADEMY OF MEDICAL SCIENCES

Estimate of the economic costs and literature review of the benefits of dedicated research time for Hospital Consultants in the NHS

Final Report

NICK HEX, Associate Director  
CAMERON COLLINS, Research Consultant  
ANNE WEBB, Associate Information Specialist

11 October 2019

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# Executive Summary

## 1. INTRODUCTION

The Academy of Medical Sciences (the Academy) commissioned York Health Economics Consortium (YHEC) to undertake an economic analysis of costs and a review of benefits relating to the concept of dedicated research time in the NHS. Consideration of dedicated research time for clinical staff working in the NHS is part of a wider project being undertaken by the Academy on 'Enhancing the NHS-academia interface'.

The objectives of the study were to undertake:

- An estimate of the opportunity cost of providing Consultants with 20% dedicated research time.
- A pragmatic literature review into the potential benefits, or lack thereof, of dedicated research time.

If the literature review had identified any specific evidence of benefits that could be robustly quantified and attributed to dedicated research time, then a return on investment analysis would be carried out, based on the costs estimated.

## 2. METHODS

Following consultation with key stakeholders, the main components of the opportunity cost estimate were:

- Consideration of the baseline position in terms of existing dedicated research time.
- The opportunity cost of the activities foregone if time is freed up to provided dedicated research time for Consultants.
- Any direct costs incurred by NHS Trusts as a result of this commitment.

A review protocol was developed to inform the literature review and this was provided to the Academy for consultation. Search strategies and terms were developed and searches were undertaken in biomedical databases using OvidSP and also in grey literature sources. These were supplemented by literature provided by the Academy and also by snowballing of references from literature reviewed. A total of 28 eligible papers were identified through these techniques.

### 3. RESULTS

From a review of existing guidelines and other literature it is apparent that although the Consultant Contract provides for 'supporting clinical activities', which could include dedicated time for research, in reality most Consultants do not have time to carry out research on top of their requirement to provide direct clinical care. The exception is for Consultant Clinical Academics whose contracts allow for 0.5 whole time equivalent (WTE) academic activities. It was, therefore, assumed that to provide 20% of Consultants with 20% of dedicated research time would require backfilling of an equivalent amount of time for direct clinical care.

The cost estimate was made on the basis that an average Teaching Hospital Trust has around 415 Consultants and an average District General Hospital Trust has around 182 Consultants. In an average week the provision of 20% of Consultants with 20% of dedicated research time would require 166 Programmed Activities (PAs), which are 4 hour periods of activity, in a Teaching Hospital Trust and 72 PAs in a District General Hospital Trust.

Applying an average Consultant cost per PA of £432, this would suggest an estimated weekly cost of £71,712 for Teaching Hospital Trusts and £31,450 for District General Hospital Trusts to provide dedicated research time. Assuming an annual average working year of 42 weeks, the annual cost for a Teaching Hospital Trust would be £3.01 million and for a District General Hospital Trust it would be £1.32 million. For the proposed pilot of 5 Teaching Hospital Trusts and 5 District General Hospital Trusts the overall cost would be £21.7 million (£15.1 million and £6.6 million respectively).

This cost estimate is based on the assumption that all backfilled time will be met by other Consultants on rotation. However, if locum Consultants are required to backfill some of the time then there will be additional costs. If the additional premium for locum Consultants is around 15% and all of the backfill requirements were fulfilled by locums then the overall cost of the pilot would be £25 million per year.

The database literature review generated 14 references that met the inclusion criteria. There was some evidence of a link between dedicated research time and improved job satisfaction. Two of the papers described dedicated research time as an important factor in either career progression or success in their role. Only one paper, a US study, reported on the potential for dedicated research time to attract research funding. One paper also referred to research time providing potential for Consultants to effect better outcomes for patients in the field of stroke. There were also a number of papers that explored the concept of dedicated research time being an important factor in the success of research programmes.

The search terms used for the grey literature search were broader and a number of different study themes emerged. Four papers found an association between research activity and better patient outcomes including improved mortality rates and better cancer survival rates, although these were not specifically attributed to the provision of dedicated research time. There is also a body of research around the economic impact of medical research.

Five papers were identified that estimated rates of return on investment in public sector health research. One report by the National Institute for Health Research found that, alongside the value clinical research generates for the UK economy, NHS Trusts in England benefitted by up to £192 million per year in increased revenue from life science company investment and pharmaceutical cost savings.

Other grey literature studies examined the impact of dedicated research time on job satisfaction and on the success of research programmes.

#### **4. DISCUSSION AND CONCLUSIONS**

The potential opportunity cost to the NHS of providing dedicated research time to Consultants could be offset by benefits but this cannot be quantified in any meaningful way using the evidence found from this study.

The opportunity cost of providing 20% of Consultants with 20% dedicated research time was estimated at around £3 million per year for Teaching Hospital Trusts and £1.3 million per year for District General Hospital Trusts and there may be additional direct costs associated with this activity.

The literature review found evidence that dedicated research time is associated with successful research programmes and improved job satisfaction and the potential for better employee retention. From the grey literature, it was found that publicly funded research programmes provide economic benefits in the form of improved patient outcomes and wider societal benefits but no evidence was found that demonstrated the role of dedicated research time in generating those benefits.

The potential benefits identified are important in the context of high vacancy rates among medical staff in the NHS and the cost of using agency locum staff. Staff stability rates (the percentage of staff remaining in their roles) for NHS staff reduced from 89% to 85% between 2010/11 and 2017/18. Between April and June 2019, there were almost 10,000 medical and dental full time equivalent staff vacancies in England. The overall cost of agency staff to the NHS was £480 million in 2018. In September 2018 7% of spending on medical staff in England was for agency staff.

It is recommended that the pilot study examines the actual cost of providing dedicated research time to clinicians and also attempts to capture evidence around some of the benefit metrics identified and their link to dedicated research time.

# Section 1: Introduction

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## 1.1 BACKGROUND

The Academy of Medical Sciences (the Academy) commissioned York Health Economics Consortium (YHEC) to undertake an economic analysis of costs and a review of benefits relating to the concept of dedicated research time in the NHS. The impact of dedicated research time for clinical staff working in the NHS is part of a wider project being undertaken by the Academy on 'Enhancing the NHS-academia interface'.

The aim of this analysis is to provide evidence to support an emerging recommendation from the project. This relates to the suggestion that a three-year pilot should be carried where 20% of Consultants in five large teaching NHS Trusts and five district general hospital Trusts across the UK have 20% of their time dedicated to research. Seven of the pilot sites will be in England with one also in each of the devolved administrations.

The idea for the recommendation has been tested with stakeholders who have suggested that this may lead to a number of benefits, such as improvements in recruitment and retention and increased investment by private sector organisations, such as pharmaceutical and device companies.

## 1.2 OBJECTIVES

In discussions between YHEC and the Academy it was been recognised that the short timescale and budget constraints for this analysis and review mean that it would be potentially difficult to generate robust data to support the type of metrics that could be used to measure any potential benefits for this recommendation. Therefore, a shorter and more discrete approach has been taken involving:

- An estimate of the opportunity cost of providing Consultants with 20% dedicated research time.
- A pragmatic literature review into the potential benefits, or lack thereof, of dedicated research time.

YHEC suggested that if the literature review identified any specific evidence of benefits that could be robustly quantified and attributed to dedicated research time, then a return on investment analysis could be carried out, based on the costs estimated.

## Section 2: Methods

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### 2.1 OPPORTUNITY COST

In order to estimate the cost of providing Consultants with 20% dedicated research time an economic cost framework was established, providing an outline of the proposed main components of the estimate. The main components were:

- Baseline data. In order to estimate the incremental cost of providing dedicated research time in the NHS, it was essential that current practice was appropriately defined.
- Opportunity cost. The opportunity cost of an intervention is what is foregone as a consequence of adopting a new intervention. Therefore, it was necessary to identify the Consultant's activities foregone when 20% of their time will be dedicated to research.
- Direct cost. The direct additional expenditure incurred by both the teaching NHS Trusts and district general hospital Trusts.

Interviews were carried out with 5 key stakeholders, including Academy President, Professor Sir Robert Lechler. Views were provided on the components to be included in the cost estimate, as well as some thoughts on the likely benefits of dedicated research time for Consultants.

The main concepts the respondents reported as being worth considering in the cost estimate were:

- Locum or agency costs of backfilling dedicated research time.
- Infrastructure costs including growth in Research and Development admin.
- Consultant salary ranges.

Some of the suggested benefits included:

- Improvements in staff satisfaction leading to reduced burnout and improved staff retention.
- Improved research outputs, potentially leading to benefits for patients.
- Potential commercial gain through links to industry as a result of additional research funding.

## **2.2 LITERATURE REVIEW**

The approach to the literature review was informed by the principles of rigour, transparency and replicability in reviewing embodied in Centre for Reviews and Dissemination (CRD) guidance for systematic reviews<sup>1</sup> and the Cochrane Collaboration Handbook<sup>2</sup>, with pragmatic limits placed on the types of literature searched, the number of databases searched, and the inclusion of English language records only. This enabled the identification of specific and potential data sources for benefits and costs.

### **2.2.1 Eligibility criteria**

The studies considered eligible for this review needed meet the following eligibility criteria.

#### **2.2.1.1 Population**

Studies were eligible for inclusion in this review if they reported on the medical professional or medical staff (doctors and Consultants).

#### **2.2.1.2 Intervention**

Studies reporting on the use of any dedicated research time or designated time to undertake research activity were eligible.

#### **2.2.1.3 Outcome**

Studies were eligible for inclusion in this review if they reported on benefits of the intervention and also if the intervention had no benefits, primarily in relation to:

- Improvements in recruitment, retention job satisfaction of doctors.
- Increased investment by private sector pharmaceutical and device companies and economics.
- Patient outcomes i.e. quality of life, mortality, survival, quality of care.

### **2.2.2 Study design**

Any study design that met the eligibility criteria was eligible for inclusion in the review. This included systematic reviews, economics studies, cohort studies, prospective, retrospective and follow-up studies and reports such as those identified in the Grey Literature. Higher level evidence was sought where possible. Studies published as abstracts, conference presentations and media items were considered although they rarely provide adequate data.

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<sup>1</sup> Centre for Reviews and Dissemination. Systematic Reviews: CRD's guidance for undertaking reviews in health care. York: University of York; 2009.

<sup>2</sup> Higgins JPT, Green S (editors). Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0 [updated March 2011]. The Cochrane Collaboration, 2011. (Available from [www.cochrane-handbook.org](http://www.cochrane-handbook.org).)

### 2.2.3 Limits

The search was restricted to English-language studies only and studies from the past 10 years were considered. The searches were conducted with and without a UK filter. Limits are summarised in Table 2.1.

**Table 2.1 Literature search limits**

	<b>Eligible studies</b>	<b>Ineligible studies</b>
Population	Medical staff (doctors and consultants)	Non-medical staff e.g. nurses, AHP's etc.
Interventions	Dedicated research time for conducting research activity	Studies referring to research experimental design only to undertake a clinical study. Studies not mentioning medical personnel undertaking research activity
Outcomes	Benefits (or any lack of benefit): improvement in recruitment and retention, job satisfaction, investment Quality of life, length of stay, patient outcomes, quality of patient care	
Study design	Systematic Reviews, economic study, clinical trials/trials, cohort studies, prospective, retrospective and follow-up studies reports	
Limits	Evidence in English Evidence available as full text e.g. journal articles, reports, theses	Evidence in languages other than English

### 2.2.4 Search Strategy

A draft search strategy was designed to identify studies reporting on the outcomes of research activity and is presented in Appendix A. The strategy was designed for MEDLINE (OvidSP) and comprises the following concepts:

1. Medical consultants OR doctors
2. Research activity OR research project OR scholarship OR scholarly activity
3. Protected time
4. Outcomes/Benefits:  
recruitment OR retention OR job satisfaction  
OR economic OR return on investment OR cost-benefit OR private sector  
investment OR pharmaceutical company OR device company
5. Outcomes/Benefits:  
Quality of life OR quality of care OR mortality OR survival OR length of stay

The search concepts were combined as follows:

1. (Medical consultants OR doctors) AND
2. (Research activity OR research project OR scholarship OR scholarly activity) AND
3. (protected time) AND
3. (recruitment OR retention OR job satisfaction OR economic OR return on investment OR cost-benefit OR private sector investment OR pharmaceutical company OR device company)

OR

1. (Medical consultants OR doctors) AND
2. (Research activity OR research project OR scholarship OR scholarly activity) AND
3. (protected time) AND
4. Quality of life OR quality of care OR mortality OR survival OR length of stay

The search terms were identified through scanning background literature, browsing database thesauri and suggestions from steering group members. The terms include synonyms / alternative terms / associated terms. The strategy was devised using a combination of subject indexing terms and free text search terms in the title, abstract and keyword heading word fields. The search strategy designed to identify approximately 300 records in the MEDLINE database. Table 2.2 details the search terms used.

The literature search was conducted in MEDLINE, Epub Ahead of Print, In-Process & Other Non-Indexed Citations, MEDLINE Daily, using the OVIDSP interface. The results of the searches were screened to identify studies that meet the inclusion criteria.

### **2.2.5 Record processing**

The results of the bibliographic database searches were transferred into an EndNote library and were then de-duplicated using several algorithms. Obviously irrelevant records which may have been retrieved, such as animal studies, were removed. The first stage of the review removed records which included ineligible study design features or reported ineligible outcomes. Record selection was then carried out from the title and abstract.

Electronic or paper copies of potentially relevant full papers were obtained through local access routes, the internet and steering group members. These studies were assessed in detail for relevance to the review's inclusion criteria the final selection of studies to inform the review was made.

## 2.2.6 Grey literature

In addition to the searches of bibliographic databases a number of supplementary search activities were conducted. These activities were designed to complement the bibliographic database searches and aimed to identify additional eligible publications that were not identified by the database searches, for example studies and publications not included in these databases or additional evidence provided by steering group members. These included pragmatic searches for “grey literature” which were held in a variety of databases and websites.

The NICE Evidence website provides access to selected evidence in health, social care and public health. It was searched to find potential papers of relevance using the broad search term “consultant research time” for a number of selected organisations.

References were also provided by staff at the Academy for review. Reference searches were also made by ‘snowballing’ references from papers found in the database and grey literature searches.

## 2.2.7 Studies included and excluded

The number of studies identified by the search and excluded at various stages are reported in Table 2.2.

**Table 2.2 Literature search results**

Resource	Number of records identified
OvidSP MEDLINE(R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily	300
Grey literature	14
Excluded based on title and abstract	286
Studies included for description in report	28

The evidence extracted from the selected studies was summarised and is presented in Section 3 of the report.

## Section 3: Results

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### 3.1 COST ESTIMATE

#### 3.1.1 Baseline assumptions

Consultant job plans are prospective, professional agreements setting out the duties, responsibilities, accountabilities and objectives of the Consultant and the support and resources provided by the employer for the coming year.<sup>3</sup> The 2003 Consultant Contract specifies that job plans should include appropriate personal objectives setting out what the Consultant will be seeking to achieve during the annual period that they cover in terms of output and outcome measures.

All duties undertaken by Consultants are expressed as Programmed Activities (PAs). A PA is a period of activity, typically equivalent to 4 hours' work. A full-time Consultant will normally be contracted for a total of 10 PAs per week. These may be categorised into direct clinical care, supporting professional activities (SPAs), additional responsibilities, external duties, and academic activities.

Additional or extra PAs can be agreed upon within the Consultant's contract and these are typically used to deal with peaks of activity or other short-term pressures. However, as these are regarded as a temporary short-term measure, this analysis has assumed that standard Consultants will be contracted to 10 PAs per week.

Direct clinical care is work that directly relates to the prevention, diagnosis or treatment of illness within the NHS. Supporting professional activities are activities that underpin direct clinical care and may include, continuing professional development, formal teaching and participation in training. Typically, the Consultant Contract currently provides for a weekly split of 7.5 PAs of direct clinical care to 2.5 PAs of supporting professional activities.

In interviews with key stakeholders it was reported that a 9 to 1 PA split between direct clinical care and supporting professional activities was more typical of current practice. This opinion is supported in literature, with The Academy of Medical Royal Colleges estimating that Consultants require between 1 and 1.5 PAs per week for supporting professional activities as the minimum time required to meet the needs of continuing professional development.

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<sup>3</sup>[https://www.nhsemployers.org/~media/Employers/Publications/Guide\\_to\\_consultant\\_job\\_planning.pdf](https://www.nhsemployers.org/~media/Employers/Publications/Guide_to_consultant_job_planning.pdf).

Comments from interview respondents also indicated that external duties and additional responsibilities were irregular objectives for Consultants and that only Consultants with more senior roles, such as Clinical or Medical Directors would assign PAs to these objectives.

Consultant Clinical Academics are Consultants employed by a Medical or Dental School, or by a research organisation (typically Universities). The Clinical Academic Consultant's job differs from that of other Consultants because of their contractual commitment to undertake both clinical (NHS duties) and academic activities.<sup>4</sup> These commitments require equal priority, and thus demand a combined job plan merging the separate responsibilities. The 2003 Consultant Contract specified a standard of 5 PAs for clinical work and 5 PAs for academic work for Clinical Academic Consultants.<sup>5</sup>

On the basis of opinion from interviews and desk based research, the following has been assumed:

- Consultants other than Consultant Clinical Academics do not receive adequate time for research so provision of 20% dedicated research time will require a 20% opportunity cost to backfill the time that would have been spent on clinical work instead.
- It has been assumed for this analysis that standard Consultants will spend 9 PA's conducting DCC and 1 SPA, with the SPA covering continuing professional development. Where a Consultant adopts a contract of 20% dedicated research time from a total of a 10 PA working week, 2 PA's would be displaced from DCC.
- Consultant Clinical Academics already have 50% dedicated time so will not require additional opportunity cost for backfill. In Teaching Hospitals, the additional 20% of Consultants being provided with 20% dedicated research time will be non-Clinical Academic Consultants.
- The weighted average number of Consultants in a Teaching Hospital is 415 and in a District General Hospital there are 182.<sup>6</sup>

### 3.1.2 Cost Calculation

Table 3.1 illustrates the additional number of PAs generated per week that can be dedicated to research if 20% of Consultants are given 20% dedicated research time.

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<sup>4</sup> [https://www.nhsemployers.org/-/media/Employers/Documents/Pay-and-reward/job\\_planning\\_clinical\\_academics\\_010308\\_aw.pdf?la=en&hash=7C7FAD85D0EA7C0E6ED8478E527E4D05291590F4](https://www.nhsemployers.org/-/media/Employers/Documents/Pay-and-reward/job_planning_clinical_academics_010308_aw.pdf?la=en&hash=7C7FAD85D0EA7C0E6ED8478E527E4D05291590F4)

<sup>5</sup> British Medical Association. (2010). *Intergrated Job Planning for Clinical Academic Consultants and Senior Academic GPs in England (February 2010)*. [www.bma.org.uk](http://www.bma.org.uk)

<sup>6</sup> <https://digital.nhs.uk/data-and-information/publications/statistical/nhs-workforce-statistics/may-2019>

**Table 3.1: Illustration of weekly split of PAs, before and after application of dedicated research time to 20% of Consultants in Teaching and Other NHS Trusts**

Current Pathway		Number of Consultants	Split and number of PAs		
			DCCs	SPAs	Research Time
Teaching Hospitals	Standard Consultant	415	3735	415	0
	Dedicated Time Consultant	0	0	0	0
NHS Trusts (Other)	Standard Consultant	182	1638	182	0
	Dedicated Time Consultant	0	0	0	0
New Pathway		Number of Consultants	DCCs	SPAs	Research Time
Teaching Hospitals	Standard Consultant	332	2988	332	0
	Dedicated Time Consultant	83	581	83	166
NHS Trusts (Other)	Standard Consultant	146	1310	146	0
	Dedicated Time Consultant	36	255	36	73

Table 3.2 illustrates the assumed costs per hour and PA for Consultant time. The costs were sourced from the Personal Social Services Research Unit for 2018 (PSSRU)<sup>7</sup>. Cost per hour of a Consultant (medical) is calculated from the relevant wages, on costs and overheads. The average salary for a Consultant was determined from the mean annual basic pay per FTE as reported in the NHS Staff Earnings Estimates. As locum Consultants may be supplied by private agencies, cost for a locum Consultant was estimated as a 15% premium to a standard Consultant cost. This value was varied through sensitivity analysis.

**Table 3.2: Assumed average costs for standard Consultant and locum Consultant.**

Resource	Cost per hour	Cost per PA (4 hours per PA)
Consultant (medical)	£108	£432
Locum Consultant (15% premium)	£124	£497

<sup>7</sup> <https://www.pssru.ac.uk/pub/uc/uc2018/hospital-based-health-care-staff.pdf>

Based on the incremental costs and activity described in Tables 1 and 2, it is estimated that 18 FTE Consultants will be required to fill the additional 166 PAs dedicated to research in Teaching Hospital Trusts and 8 FTE Consultants will be required to fill the additional 73 PAs dedicated to research in District General Hospital Trusts every week.

Assuming that the backfill is met fully with FTE standard Consultants, the incremental weekly cost of providing 20% of Consultants with 20% of dedicated research time is estimated at £71,712 in a Teaching Hospital Trust and £31,450 in a District General Hospital Trust. Assuming an average working year of 42 weeks, the annual cost of providing 20% of Consultants with 20% of dedicated research time is estimated at £3.01m in a Teaching Hospital and £1.32m in a District General Hospital Trust.

Tables 3.3, 3.4 and 3.5 present one-way and two-way deterministic sensitivity analysis showing the additional annual cost incurred when the percentage of backfill met by locum Consultants changes alone, and in combination with variation to the percentage of additional costs of locums.

Table 3.3 illustrates the additional cost if varying amounts of backfill had to be provided by locum Consultants, assuming their cost to be 15% higher than standard Consultants.

**Table 3.3: Change in net annual cost for varying levels of locum Consultant backfill in an NHS Teaching Hospital and an NHS General District Hospitals.**

Percentage of backfill met by locum consultants	NHS Teaching Hospitals	NHS District General Hospitals
0%	£0	£0
10%	£45,179	£19,813
20%	£90,357	£39,626
30%	£135,536	£59,440
40%	£180,714	£79,253
50%	£225,893	£99,066
60%	£271,071	£118,879
70%	£316,250	£138,693
80%	£361,428	£158,506
90%	£406,607	£178,319
100%	£451,786	£198,132

Tables 3.4 and 3.5 illustrate the impact if the additional locum premium was higher or lower than 15% in a range of scenarios for both types of hospital Trust.

**Table 3.4: Change in net annual cost for varying levels of locum Consultant backfill and cost of locum Consultants in an NHS Teaching Hospital.**

<b>Percentage of backfill met by locum consultants</b>					
<b>Additional percentage cost of locum consultants</b>	<b>0%</b>	<b>25%</b>	<b>50%</b>	<b>75%</b>	<b>100%</b>
0%	£0	£0	£0	£0	£0
10%	£0	£75,298	£150,595	£225,893	£301,190
<b>15%</b>	<b>£0</b>	<b>£112,947</b>	<b>£225,893</b>	<b>£338,840</b>	<b>£451,786</b>
20%	£0	£150,595	£301,190	£451,786	£602,381
30%	£0	£225,893	£451,786	£677,678	£903,571
40%	£0	£301,190	£602,381	£903,571	£1,204,762
50%	£0	£376,488	£752,976	£1,129,464	£1,505,952

**Table 3.5: Change in net annual cost for varying levels of locum Consultant backfill and cost of locum Consultants in an NHS General District Hospital.**

<b>Percentage of backfill met by locum consultants</b>					
<b>Additional percentage cost of locum consultants</b>	<b>0%</b>	<b>25%</b>	<b>50%</b>	<b>75%</b>	<b>100%</b>
0%	£0	£0	£0	£0	£0
10%	£0	£33,022	£66,044	£99,066	£132,088
<b>15%</b>	<b>£0</b>	<b>£49,533</b>	<b>£99,066</b>	<b>£148,599</b>	<b>£198,132</b>
20%	£0	£66,044	£132,088	£198,132	£264,177
30%	£0	£99,066	£198,132	£297,199	£396,265
40%	£0	£132,088	£264,177	£396,265	£528,353
50%	£0	£165,110	£330,221	£495,331	£660,442

No additional costs have been assumed such as any additional Research and Development requirements or infrastructure costs. It was not possible to estimate an additional unit cost of potential additional costs incurred, although it is acknowledged that some additional cost would be likely.

The estimated annual cost to provide this dedicated research time to 5 Teaching Hospitals and 5 District General Hospitals is estimated at approximately £15.1 million for the Teaching Hospital Trusts and £6.6 million for the District General Hospital Trusts. This equates to £21.7 million per year for the pilot sites.

If all of the backfill had to be met by locum Consultants, at a 15% higher cost than standard Consultants, the additional cost per year for a Teaching Hospital would be around £450,000 and for a District General Hospital Trust the additional cost would be around £200,000. This would mean the overall cost for the pilot sites would increase to approximately £25 million per year.

## **3.2 LITERATURE REVIEW**

### **3.2.1 Database search**

The title review reduced the number of results to 28 with potential relevance. A review of abstracts reduced the number of studies to be assessed in more detail to 14. The main results are summarised by theme in the following section. The two main themes related to the importance of dedicated research time and job satisfaction, and also in relation to the success of research programmes. Only one study was found with any reference to dedicated research time and, respectively, the ability to attract research funding and improved clinical outcomes.

None of the studies reviewed produced data that were quantifiable for the purpose of developing a return on investment estimate in relation to dedicated research time. A number of studies were of lesser relevance, either because they did not involve the Consultant profession or because they were only reporting qualitative data.

#### **3.2.1.1 Dedicated research time and job satisfaction**

In a paper provided by the Academy (Rees and Bracewell, 2019), the authors argue that increasing the academic component of medical posts may help retain doctors in practice by providing experience and support in an area of medical practice.

Twa et al (2017) reviewed the determinants of satisfaction with physician scientist training among Canadian MD/PhD students and found that dedicated research time was strongly associated with career progression and training satisfaction. They found that this could reduce programme attrition.

Lambert et al (2015) carried out a survey of UK-trained doctors. One of their findings was that more dedicated time for research and less service work was a key suggestion for making clinical academic medicine more attractive.

Dale et al (2015) carried out a cross-sectional study on the GP workforce in England and found that dedicated time for education and training were rated as important, along with incentive payments and increased pay in addressing the workforce crisis. While not related to Consultants specifically these findings demonstrate the value of dedicated research time across clinical professions.

Watson et al (2015) studied the factors involved in developing successful paediatric surgeon-scientists in the US. 60% of surgeons receiving major NIH funding had significant dedicated research time and financial support. They found that institutional commitment to dedicated research time was considered to be an important factor in facilitating the success of paediatric surgeon-scientists, as well as mentorship and perseverance.

Schofield et al (2009) surveyed Consultants in Scotland who reported that their involvement in educational activities was virtually universal but that they perceived a need for more time to devote to these activities than that allocated in job plans.

McManus et al (2008) found that general practices which participate in research are larger and located in more deprived areas than non-research active practices. They found that research in research active practices is likely to be generalizable to the wider primary care community.

### **3.2.1.2 Dedicated research time and the ability to attract research funding**

Rosati et al (2017) reported that among US cardiothoracic surgeons dedicated time for research was associated with a higher number of ongoing publications and an ability to attract research funding. 87% of surgeons with National Institutes of Health (NIH) funding had a history of dedicated time for research compared to only 71% for those without NIH funding ( $p < 0.001$ ).

### **3.2.1.3 Dedicated research time and improvement in clinical outcomes**

Wira et al (2018) established a link between dedicated clinical time in neurological education and the potential for better intervention outcomes such as the ability to recognise and manage acute strokes, the management of intracerebral haemorrhage and the ability to interpret images in the field of stroke.

### **3.2.1.4 Dedicated research time as a success factor in research programmes**

Ersek et al (2019) explored the critical aspects of a sustainable clinical research programme and concluded that dedicated physician time was one of the crucial factors in ensuring a healthy programme.

Christou et al (2016) carried out qualitative research on the role of institutional support in facilitating independent research careers in the US. They asked junior and senior respondents about optimal levels of dedicated time and found senior respondents placed a higher premium on this than junior respondents.

Mayo and Rockey (2015) reviewed the outcomes from a training programme for gastroenterology trainees in the US. One of the components of the programme was 'dedicated protected time' as well as a dedicated research curriculum, programme support, mentorship and oversight and accountability and tracking of accomplishments. The effect of the programme was to increase the proportion of trainees remaining in academic medicine from 14% to 51%.

Hiscock et al (2014) surveyed doctors in Victoria, Australia and found that 50% identified dedicated research time as a critical enabler of research.

Mahmoud et al (2011) surveyed medical specialists in Nigeria who reported that securing funding and finding time were the major constraints on conducting research.

Barnsteiner et al (2010) reviewed evidence-based practice in the nursing model at the Hospital of the University of Pennsylvania. The success of the model depended on time allocation for staff to participate in scholarly activities.

Lown et al (2009) explored perceptions of medical education fellowship graduates on their skills and participation in learning communities. One of the common themes reported as an essential element of faculty fellowships in medical education was dedicated time.

### **3.2.2 Grey literature search**

From the grey literature searches carried out, along with snowballing of references and papers provided by the Academy an additional 14 papers were identified with some relevance to the impact of the provision of dedicated research time.

None of the findings from the searches for papers from the Royal Colleges of General Practitioners, Radiologists or Emergency Medicine produced any papers with useable data or evidence. The same was true for searches for publications by the King's Fund, Nuffield Trust and Wellcome Trust.

#### **3.2.2.1 Dedicated research time and improvement in clinical outcomes**

Three relevant papers were found from a review of references included in a statement on research on the Royal College of Physicians website.<sup>8</sup>

Ozdemir et al (2015), found an association between research active Trusts and lower risk-adjusted mortality for acute admissions, which persisted after adjustment for staffing and other structural factors.

Jonker and Fisher (2018) carried out a retrospective cross-sectional study of clinical trial activity and both mortality rates and Care Quality Commission ratings. They found a correlation between increased research and reduced deaths, as well as a statistically significant association between trail activity and improved CQC ratings. The correlations were driven by interventional rather than observational research.

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<sup>8</sup> <https://www.rcplondon.ac.uk/guidelines-policy/delivering-research-all-expectations-and-aspirations-nhs-england>

Downing et al (2016) tested the hypothesis that high, sustained hospital-level participation in interventional clinical trials improves outcomes for patients, using colorectal cancer as an example. Patients treated in Trusts with high research participation in their year of diagnosis had lower postoperative mortality ( $p < 0.001$ ) and improved survival ( $p < 0.001$ ) after adjustment for casemix and hospital variables. The effects were increased with sustained research participation.

Another paper provided by the Academy (Boaz et al, 2015) reported a literature review that reported current evidence suggesting that there is an association between the engagement of individuals and healthcare organisations in research and improvements in healthcare performance. The paper concluded that these effects may depend on the context in which they operate.

### **3.2.2.2 Dedicated research time and improved economic outcomes**

Two relevant papers on the importance of dedicated research time to improving economic outcomes were either provided by the Academy or found through snowballing of references from other studies.

A report by Brunel University, the Office of Health Economics and RAND Europe (2008) used a methodology to estimate the economic returns to medical research, comprising health gains net of the health care costs of delivering them and gross domestic product (GDP) gains to the UK national income. The health gains were measured in terms of quality-adjusted life years (QALYs), using an NICE threshold mid-point value of £25,000 per QALY, and related to two disease areas: cardiovascular disease (CVD) and mental health. The research benefits were attributed to the UK rather than worldwide research.

The benefit estimates were combined with cost data to compute an internal rate of return (IRR). For CVD the researchers attributed a QALY gain of £69 billion over a 20 year period from 1985 to 2005, compared with an incremental cost of £16 billion. The IRR for health gains alone was estimated to be 9% and the best estimate of the associated GDP gain was 30%, giving an overall IRR of 39%. For mental health the net health IRR was slightly lower at 7% and with the addition of a 30% GDP gain, the overall IRR was estimated at 37%. The researchers stressed the limitations of the analysis and emphasised the need for extreme caution in using the estimated rates of return.

The Academy provided a more recent report by RAND Europe (2018) which estimates the returns from general research and innovation investment, across the economy, to be between 20% to 30%. The report also focused on the findings by Sussex et al (2016) that public sector investment in biomedical and health research is associated with an addition 83% to 107% equivalent investment from private sector research income.

A paper by Grant and Buxton (2018) assessed the economic returns from medical research in the UK. This provides an impact on the macro scale, indicating that the rates of return, measured in terms of additional health gain that UK research has provided is in the range of 7% to 10% per annum. The authors carried out a bottom up analysis of the impact on specific clinical areas by tracing forwards from research the benefits that arise. The metrics used were monetised health gains and the broader impact on UK gross domestic product (GDP). An associated paper by Glover et al (2018) separately reported an IRR of 7% for musculoskeletal disease related research.

The National Institute for Health Research (NIHR) published a report it commissioned by KPMG into the benefits to the UK economy of clinical research. The report found that during 2014/15 the NIHR Clinical Research Network supported clinical research activity that generated £2.4 billion in gross value added, a measure of the value of goods and services produced in a sector of the economy. They also found that NHS Trusts in England received an estimated £176 million in revenue from life sciences companies for patients recruited into commercial clinical research studies, with a further £16 million in reduced costs due to pharmaceutical cost savings.

The NIHR also participated in a case study, reported by Smith et al (2019), which used an input-output model to estimate the impact of the Oxford Biomedical Research Centre (OxBRC) on income and job creation following the initial NIHR investment. The estimated return on investment in biomedical research within the OxBRC was 46% through income and job creation alone. The authors also estimated multiplicative employment effects following a marginal investment in the OxBRC of £98m during the period 2007-2017, resulting in an estimated additional 196 full time equivalent positions being created within the local economy, alongside direct employment within OxBRC.

### **3.2.2.3 Dedicated research time as a success factor in research programmes**

Two papers found through snowballing techniques using papers drawn from the grey literature examined increased research output as a result of dedicated research time.

Papasavas et al (2013), found that the institution of a mandatory research programme requirement resulted in a threefold increase in scientific presentations in surgical residency.

Beckman et al (2009) found that, within a clinical education research group who were given 63 days of dedicated research time, there was an increase in presentations, peer-reviewed publications and collaborative projects.

## Section 4: Discussion and Conclusions

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### 4.1 ANALYSIS OF BENEFITS DESCRIBED IN LITERATURE

The database literature review generated 14 references that met the inclusion criteria. There was some evidence of a link between dedicated research time and improved job satisfaction. Two of the papers described dedicated research time as an important factor in either career progression or success in their role. Only one paper, a US study, reported on the potential for dedicated research time to attract research funding. One paper also referred to research time providing potential for Consultants to effect better outcomes for patients in the field of stroke. There were also a number of papers that explored the concept of dedicated research time being an important factor in the success of research programmes.

The search terms used for the grey literature search were broader and a number of different study themes emerged. Four papers found an association between research activity and better patient outcomes including improved mortality rates and better cancer survival rates, although these were not specifically attributed to the provision of dedicated research time. There is also a body of research around the economic impact of medical research. Five papers were identified that estimated rates of return on investment in public sector health research. One report by the National Institute for Health Research found that, alongside the value clinical research generates for the UK economy, NHS Trusts in England benefitted by up to £192 million per year in increased revenue from life science company investment and pharmaceutical cost savings.

Other grey literature studies examined the impact of dedicated research time on job satisfaction and on the success of research programmes.

### 4.2 LIMITATIONS OF THE STUDY

The study was limited in time and resource and as a result a number of assumptions had to be made to generate the opportunity cost estimate. As part of the pilot study, a more detailed examination could be made of the potential costs of providing dedicated research time, including estimates of any direct costs to NHS Trusts such as additional research and development costs.

The literature review was constrained by time and was pragmatic in nature. A more systematic review may have generated additional results but there is no guarantee that more useable evidence would have been found.

### 4.3 CONCLUSIONS

The potential opportunity cost to the NHS of providing dedicated research time to Consultants could be offset by benefits but this cannot be quantified in any meaningful way using the evidence found from this study.

The opportunity cost of providing 20% of Consultants with 20% dedicated research time was estimated at around £3 million per year for Teaching Hospital Trusts and £1.3 million per year for District General Hospital Trusts and there may be additional direct costs associated with this activity.

The literature review found evidence that dedicated research time is associated with successful research programmes and improved job satisfaction and the potential for better employee retention. From the grey literature, it was found that publicly funded research programmes provide economic benefits in the form of improved patient outcomes and wider societal benefits but no evidence was found that demonstrated the role of dedicated research time in generating those benefits.

The potential benefits identified are important in the context of high vacancy rates among medical staff in the NHS and the cost of using agency locum staff. Staff stability rates (the percentage of staff remaining in their roles) for NHS staff reduced from 89% to 85% between 2010/11 and 2017/18.<sup>9</sup> Between April and June 2019, there were almost 10,000 medical and dental full time equivalent staff vacancies in England.<sup>10</sup> The overall cost of agency staff to the NHS was £480 million in 2018<sup>11</sup>. In September 2018 7% of spending on medical staff in England was for agency staff<sup>12</sup>.

It is recommended that the pilot study examines the actual cost of providing dedicated research time to clinicians and also attempts to capture evidence around some of the benefit metrics identified and their link to dedicated research time. The key metrics to consider are job satisfaction; the ability to attract research funding; improvement in clinical outcomes; the success of research programmes; and improved economic outcomes.

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<sup>9</sup> Buchan J, Charlesworth A, Gershlick B, Seccombe I. A critical moment: NHS staffing trends, retention and attrition. The Health Foundation. 2019.

<sup>10</sup> <https://digital.nhs.uk/data-and-information/publications/statistical/nhs-vacancies-survey/february-2015---june-2019-provisional-experimental-statistics>

<sup>11</sup> <https://www.england.nhs.uk/2018/08/nhs-could-free-480m-limiting-use-temporary-staffing-agencies/>

<sup>12</sup> BMJ 2019;364:l297

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## **Appendix A: Literature Search Strategy**

## Ovid MEDLINE(R) Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily and Ovid MEDLINE(R) 1946 to Present

1. (doctor\* or consultant\*).ab,ti.
2. exp Physicians/ or physician\*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
3. (medicine or medical or medic\*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
4. 1 and 3
5. 2 or 4
6. Consultants/
7. 3 and 6
8. 5 or 7
9. ((research adj2 activ\*) or (research adj2 project\*)).mp. or (research adj2 productiv\*).ab,ti. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
10. scholarship.mp. or exp "Fellowships and Scholarships"/
11. exp Research/ or research.mp.
12. biomedical research.mp. or exp Biomedical Research/
13. clinical research.mp.
14. medical research.mp.
15. surgical research.mp.
16. professional research.mp.
17. biomedical research.mp.
18. 13 or 14 or 15 or 16 or 17
19. 9 or 10 or 11 or 12 or 18
20. (protect\* adj2 time).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
21. (time adj2 allow\*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
22. (designate\* adj2 time).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
23. (allocat\* adj2 time).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
24. (time adj2 away).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
25. (time adj2 out).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
26. (dedicate\* adj2 time).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
27. 20 or 21 or 22 or 23 or 24 or 25 or 26
28. (((economic\$ or cost\$) adj3 model\$) or (monte carlo or markov)).ab,hw,sh,ti.

29. ((econom\$ or cost or costs or costing or price or pricing) adj3 (analysis or analyses or evaluation\$1 or study or studies)).ab,hw,sh,ti.
30. ((economic\$ or cost) adj3 (effect\$ or utilit\$ or benefit\$ or consequence\$ or outcome\$1 or minimi\$)).ab,hw,sh,ti.
31. ((economic\$ or cost or costs or value) adj4 (decision\$1 or threshold\$)).ab,hw,sh,ti.
32. (value adj2 (money or monetary)).ab,hw,sh,ti.
33. (return on investment or ROI).ab,hw,sh,ti.
34. budget impact\$.ab,hw,sh,ti.
35. (decision\$ adj2 (tree\$ or analy\$ or model\$)).ab,hw,sh,ti.
36. (resource\$1 adj4 (use\$1 or usage or utilit\$ or utilis\$ or utiliz\$)).ab,hw,sh,ti.
37. exp Cost-Benefit Analysis/  
38. models, economic/  
39. Economics/  
40. 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39
41. ((financ\* or fund\* or mone\*) adj2 invest\*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
42. investment.mp. or exp Investments/  
43. (drug adj compan\*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
44. (drug adj industr\*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
45. drug industry.mp. or exp Drug Industry/  
46. (pharma\* adj compan\*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
47. (pharma adj industr\*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
48. exp Cost-Benefit Analysis/ or cost\*.mp.  
49. (private adj2 invest\*).ab,ti.  
50. (device adj (industr\* or company)).ab,ti.  
51. exp Private Sector/  
52. exp Cost-Benefit Analysis/ or benefit.mp.  
53. return on investment.mp.  
54. exp Economics/ or economics.mp.  
55. exp "Costs and Cost Analysis"/
56. (increas\* adj2 investment\*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
57. ((increas\* or improv\*) adj2 fund\*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
58. 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51 or 52 or 53 or 54 or 55 or 56 or 57
59. intellectual property.mp. or exp Intellectual Property/  
60. patents.mp. or exp Patent/  
61. commercial\*.mp.  
62. 59 or 60 or 61
63. (staff adj turnover).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]

64. exp Personnel Turnover/  
65. (staff adj retention).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]  
66. (staff adj (retention or retain\* or recruit\*)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]  
67. exp Personnel Selection/  
68. (Person\* adj (motivat\* or engage\* or satisf\*)).ab,ti.  
69. job satisfaction.mp. or exp Job Satisfaction/  
70. work engagement.mp. or exp Work Engagement/  
71. Contract Services/  
72. (locum\* or backfill\*).mp.  
73. (temp\* adj staff\*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]  
74. 63 or 64 or 65 or 66 or 67 or 68 or 69 or 70 or 71 or 72 or 73  
75. (quality adjusted or adjusted life year\$).ab,hw,sh,ti.  
76. (qaly\$ or qald\$ or qale\$ or qtime\$).ab,hw,sh,ti.  
77. (illness state\$1 or health state\$1).ab,hw,sh,ti.  
78. (eq-5d or eq5d or eq-5 or eq5 or euro qual or euroqual or euro qual5d or euroqual5d or euro qol or euroqol or euro qol5d or euroqol5d or euro quol or euroquol or euro quol5d or euroquol5d or eur qol or eurqol or eur qol5d or eur qol5d or eur?qul or eur?qul5d or euro\$ quality of life or european qol).ab,hw,sh,ti.  
79. exp "Quality of Life"/  
80. exp quality-adjusted life years/  
81. exp Mortality/ or mortality.mp.  
82. Survival Rate/  
83. surviv\*.mp.  
84. (survival or survivorship).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]  
85. exp Morbidity/  
86. morbidity.mp.  
87. exp "Quality of Health Care"/ or quality.mp. or exp Quality Improvement/  
88. (wellbeing or "well being").mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]  
89. "length of stay".mp. or exp "Length of Stay"/  
90. (quality adj2 care).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]  
91. ((patient or health\*) adj2 (outcome\* or benefit\* or improv\*)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]  
92. 75 or 76 or 77 or 78 or 79 or 80 or 81 or 82 or 83 or 84 or 85 or 86 or 87 or 88 or 89 or 90 or 91  
  
93. 8 and 19 and 92  
94. 27 and 93  
95. 58 or 62 or 74  
96. 8 and 19 and 95  
97. 27 and 96  
98. 94 or 97  
99. 98  
100. limit 99 to (english language and yr="2009 -Current")

Key to Ovid symbols and commands

\$	Unlimited right-hand truncation symbol
*	Unlimited right-hand truncation symbol
\$N	Limited right-hand truncation - restricts the number of characters following the word to N
?	Wildcard symbol wild card character stands for zero or one characters within a word or at the end of a word
ti,ab,kf. adjN	Searches are restricted to the Title, Abstract, or Keyword Heading Word fields Retrieves records that contain terms (in any order) within a specified number (N) of words of each other
/	Searches are restricted to the Subject Heading field
exp	The subject heading is exploded
pt.	Search is restricted to the publication type field
or/1-4	Combines sets 1 to 4 using OR

## **Appendix B: Search Terms**

Criterion	Text word	Subject headings/MESH
Population	(medicine or medical or medic*) consultant (medicine or medical or medic*) doctor physician	Consultants/ Physicians/
Interventions	research adj2 activ* research adj2 project* research adj2 productiv* scholarship research biomedical research clinical research medical research surgical research professional research protect* adj2 time time adj2 allow* designate* adj2 time allocat* adj2 time time adj2 away time adj2 out dedicate* adj2 time	Research/ Biomedical research/ Fellowships and Scholarships/
Outcomes: Economic/ROI/investment	economic\$ or cost\$ adj3 model\$ monte carlo or markov econom\$ or cost or costs or costing or price or pricing) adj3 (analysis or analyses or evaluation\$1 or study or studies) (economic\$ or cost) adj3 (effect\$ or utilit\$ or benefit\$ or consequence\$ or outcome\$1 or minimi\$)  (economic\$ or cost or costs or value) adj4 (decision\$1 or threshold\$) value adj2 (money or monetary) return on investment or ROI. budget impact\$. decision\$ adj2 (tree\$ or analy\$ or model\$). (resource\$1 adj4 (use\$1 or usage or utilit\$ or utilis\$ or utiliz\$).  (financ* or fund* or mone*) adj2 invest*  Investment cost* benefit	Cost-Benefit Analysis/ models, economic/ Economics/ Investments/

Criterion	Text word	Subject headings/MESH
Private sector	drug adj compan* drug adj industr* drug industry pharma* adj compan* pharma adj industr* private adj2 invest* device adj (industr* or company) increas* adj2 investment* (increas* or improv*) adj2 fund* intellectual property patents commercial*	Drug Industry/ Private Sector/ intellectual property/ Patent/
Personnel	staff adj turnover staff adj retention Person* adj (motivat* or engage* or satisf*) job satisfaction work engagement locum* or backfill* temp* adj staff*	Personnel Selection/ Personnel turnover/ Job Satisfaction/ Work Engagement/ Contract Services/
Patient/health outcomes	quality adjusted or adjusted life year*  qaly* or qald* or qale* or qtime* illness state\$1 or health state\$1 eq-5d or eq5d or eq-5 or eq5 or euro qual or euroqual or euro qual5d or euroqual5d or euro qol or euroqol or euro qol5d or euroqol5d or euro quol or euroquol or euro quol5d or euroquol5d or eur qol or eurqol or eur qol5d or eur qol5d or eur?qul or eur?qul5d or euro* quality of life or european qol mortality surviv* survival or survivorship morbidity quality wellbeing or "well being" "length of stay". quality adj2 care (patient or health*) adj2 (outcome* or benefit* or improv*)	Quality of Life"/ quality-adjusted life years/ Mortality/ Survival Rate/ Morbidity/ Quality of Health Care/ Quality Improvement/ Length of Stay/
Study designs	Systematic Review, review, clinical trial, economic studies, cohort studies, follow up studies, reports	
Limits	English Language Last 10 years	

