

# How can healthcare organisations increase doctors' research engagement? A scoping review

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# Abstract

Clinician engagement in research has positive impacts for healthcare, but is often difficult for healthcare organisations to support in light of limited resources. This scoping review aimed to describe the literature on health service-administered strategies for increasing research engagement by medical practitioners. Medline, EMBASE and Web of Science databases were searched from 2000-2021 and two independent reviewers screened each record for inclusion. Inclusion criteria were that studies: sampled medically qualified clinicians; reported empirical data; investigated effectiveness of an intervention in improving research engagement; and addressed interventions implemented by an individual health service/hospital. Of the 11,084 unique records, 257 studies were included. Most (78.2%) studies were conducted in the United States, and were targeted at residents (63.0%). Outcomes were measured in a variety of ways, most commonly publication-related outcomes (77.4%), though many studies used more than one outcome measure (70.4%). Pre-post (38.8%) and post-only (28.7%) study designs were the most common, while those using a contemporaneous control group were uncommon (11.5%). The most commonly reported interventions included Resident Research Programs (RRPs), protected time, mentorship, and education programs. Many articles did not report key information needed for data extraction, (e.g. sample size). Despite a large volume of research, poor reporting, infrequent use of robust study designs and heterogenous outcome measures limit application of these studies and prospects for future systematic reviews/meta-analyses. The most compelling available evidence pointed to RRP, protected time and mentorship as effective interventions. Further high-quality evidence is needed to guide healthcare organisations on increasing medical research engagement.

## Background

An expanding body of evidence has demonstrated that clinician engagement in research has positive impacts on health system performance, staff recruitment and retention, and outcomes for patients (Boaz et al., 2015; Jonker, Fisher & Dagnan, 2020; Ozdemir et al., 2015; Rees & Bracewell, 2019). Engaging clinicians in research helps align studies to clinical needs, thereby reducing research waste and strengthening the translation of research into practice (Chalmers & Glasziou, 2009).

Accordingly, there is an expectation in many countries that all clinicians engage in some form of research during their career, often beginning during residency (ACGME, 2022; Stehlik et al., 2020). However, balancing research with provision of patient care is often difficult, especially given the growing challenges facing healthcare systems worldwide (McCartney et al., 2021). Concerns have been voiced that research engagement by medical practitioners is declining (Weggemans et al., 2019).

For organisations whose main remit is to deliver patient care, resources directed to research engagement may be scarce and must be carefully allocated. To guide this, there is an abundance of literature on individual strategies to engage and retain clinicians in research. Recently, there have been increased attempts to synthesise this evidence to determine which strategies may be most effective. Previous reviews have focused on residents specifically (Laupland, Edwards & Dhanani, 2021; Noble et al., 2018;

Stevenson et al., 2021), were restricted by location, type of strategy or outcome measure (Laupland, Edwards & Dhanani, 2021; Li et al., 2022; Stevenson et al., 2021), or also included the effect of nonmodifiable factors, such as gender and seniority (Laupland, Edwards & Dhanani, 2021). To date, no reviews have systematically summarised the evidence on strategies affecting research engagement of medical practitioners more broadly.

The aim of this scoping review is to describe the literature on strategies for increasing research engagement in medical practitioners, as implemented by healthcare delivery organisations. While these strategies will invariably work alongside those implemented by outside organisations (e.g. national funding schemes), this review focuses on strategies that can be implemented by an individual health service or hospital.

## Methods

The methodology for this scoping review was based on the Arksey and O'Malley (2005) framework, and conducted and reported in accordance with PRISMA-Scr reporting guidelines (Tricco et al., 2018). A scoping review approach was chosen as this review aims to determine the extent, range, and nature of research activity in this field, with the intention of summarising findings, identifying gaps and informing future systematic reviews/meta-analyses (Arksey & O'Malley, 2005). A protocol was not published for this review.

### Search strategy

Database searching was completed using keywords and subject headings relating to research and different medical specialties (see Supplemental Digital Appendix 1). The initial search strategy was reviewed by a research librarian, then iteratively piloted and refined. Medline, EMBASE and Web of Science were searched in December 2020 and January 2023 for records from 2000-2021 (inclusive) and published in English. Reference lists of all articles included in full text screening were also searched to identify additional relevant articles. Citation management including manual deduplication was completed using EndNote X9 (Clarivate Analytics, Philadelphia, Pennsylvania).

### Study selection

Inclusion criteria for title/abstract screening were:

1. Articles about medically qualified (MBBS, MD) practitioners (not medical students). If the study was multidisciplinary, at least 25% of participants had to be medical practitioners.
2. Articles with empirical data. This included all quantitative and qualitative research which reported tangible data (not opinion pieces).
3. Articles about the effectiveness of an intervention, or role of a modifiable factor in improving research engagement. Articles had to be about what had worked or not worked rather than participants' opinions on what could work. Engagement was conceptualised as the "behaviour

change” level in Kirkpatrick’s (1996) model for programme evaluation (not initial reactions to the intervention or increases in knowledge/skill).

A fourth criterion was added for full text screening to more specifically address the research aim:

1. Interventions/modifiable factors were implemented or modified by an individual health service or hospital (not interventions implemented at a national or state-wide level, or by other types of organisations).

Screening was completed using Covidence (Veritas Health Innovation, Melbourne, Australia). The title and abstract of each citation were independently screened by the first author (CB) and one of the other authors. All authors had received a training set with examples of included/excluded abstracts. The overall agreement rate was 93.6% (average Cohen’s kappa= 0.49). Author pairs met to resolve disagreements, and a third author was consulted if consensus could not be reached. The same process was used for full text screening, except that disagreements were resolved through a group discussion with three authors (SM, CN and CB) for the first half, and by a single author (CB) for the second half, using learnings from the previous discussions. Agreement rate for full text screening was 72.5% (average Cohen’s kappa= 0.35).

### **Data extraction and synthesis**

A data extraction form capturing key study characteristics (e.g. country, profession, study design, intervention type, outcome type) was piloted and refined with team input. Study design types were based on the National Institute for Health and Care Excellence (2012). Intervention and outcome types were developed inductively during the course of data analysis. Other characteristics (e.g. specialties, level) were recorded as stated by the authors. Risk of bias was not assessed. For each of the included studies, study characteristics were extracted by a single author (CB), guided by reflective meetings with other authors (CN, PS, SM) throughout the data extraction process.

## **Results**

### **Characteristics of included studies**

The search yielded 11,084 citations excluding duplicates (Fig. 1). Of these, 639 met the inclusion criteria based on title and abstract, and 257 studies met the inclusion criteria based on full text (references in Supplemental Digital Appendix 2).

### **General characteristics**

Summary characteristics of the 257 included studies are given in Table 1. More studies were published in 2011–2021 (n = 194) than in 2000–2010 (n = 63). In total, 22 countries were represented, though most

studies were conducted in the United States (78.2%), followed by Canada (5.4%), Australia (2.3%), United Kingdom (1.9%) and Japan (1.6%)

Table 1  
Summary characteristics of the 257 included studies

Characteristic	No. (%)
<b>Country</b>	
United States	201 (78.2%)
Canada	14 (5.4%)
Australia	6 (2.3%)
United Kingdom	5 (1.9%)
Japan	4 (1.6%)
Other	27 (10.5%)
<b>Specialty</b>	
Family medicine	34 (13.2%)
Internal medicine	29 (11.3%)
Orthopedic surgery	23 (9.0%)
General pediatrics	21 (8.2%)
General surgery	18 (7.0%)
Surgery (any type)	17 (6.6%)
Psychiatry	14 (5.5%)
All/any specialty	14 (5.5%)
Anaesthetics	8 (3.1%)
Emergency medicine	8 (3.1%)
Hospitalist	7 (2.7%)
Radiology	6 (2.3%)
Other	58 (22.6%)

a. Not necessarily the level of research participants, for example specialists could be interviewed about an intervention they experienced during residency

b. Some studies investigated multiple interventions so the total will exceed 257

c. Included short resident research rotations (< 1 month), monetary incentives for research outputs, research days/events, equipment, laboratory/office space, works-in-progress meetings, a pre-residency research program, team approaches to research, a resident scholarly activity points system, internal grant review panels, database infrastructure, journal clubs and general department resources

<b>Characteristic</b>	<b>No. (%)</b>
<b>Target population of intervention<sup>a</sup></b>	
Resident	162 (63.0%)
All/any level	47 (18.3%)
Specialist	36 (14.0%)
Subspecialty fellow	8 (3.1%)
Other (Junior doctor, multiple)	4 (1.6%)
<b>Intervention type<sup>b</sup></b>	
Resident Research Program (RRP)	76
Protected time	72
Mentorship	52
Education program	41
Research support staff	30
Intramural funding	23
Resident research requirement	21
Department-wide research program	18
Research leadership position	15
Intramural fellowship	14
Other <sup>c</sup>	N/A
a. Not necessarily the level of research participants, for example specialists could be interviewed about an intervention they experienced during residency	
b. Some studies investigated multiple interventions so the total will exceed 257	
c. Included short resident research rotations (< 1 month), monetary incentives for research outputs, research days/events, equipment, laboratory/office space, works-in-progress meetings, a pre-residency research program, team approaches to research, a resident scholarly activity points system, internal grant review panels, database infrastructure, journal clubs and general department resources	

Target populations for the interventions included 39 individual specialties, as well as studies which targeted any/all specialties (5.5%). The most common individual target specialties were family medicine (13.2%), internal medicine (11.3%), orthopedic surgery (9.0%), general pediatrics (8.2%), and general surgery (7.0%). Most interventions targeted the resident level (63.0%) (meaning doctors participating in a



training program to gain specialty status/licensure, also known as trainees or registrars). Interventions were also commonly applied to all/any level of doctor (18.3%) or specialists (14.0%).

## Study designs

Study designs have been separated into two types: single intervention (n = 209) and multi-intervention (n = 48) to capture whether the intervention was being investigated in isolation or alongside others. Study design often had to be inferred based on available information as many studies did not explicitly name their design. The most common study design used for single intervention studies was a pre-post cohort design (38.8%), followed by post-only cohort (28.7%), cross-sectional (17.2%), cohort studies with a contemporaneous control (either matched, unmatched, or waitlist control) (11.5%) and qualitative designs (3.3%). Multi-intervention studies were either cross-sectional (79.2%) or qualitative (20.8%) designs. Further information on study designs including sample sizes is given in Table 2. In some studies sample size was not directly reported but was calculated during data extraction based on other information given in the article (e.g. number of residents the program admits per year). Notably, sample size was not able to be identified for 46 studies, most commonly those using pre-post designs (38/81).

Table 2  
Detail on study designs and outcome measures of included studies

<b>Study Designs</b>			
<b>Type of design</b>	<b>No. (%)</b>	<b>Median sample size (range)</b>	<b>Explanation and further information</b>
<b>Single intervention (n = 209)</b>			
Pre-post	81 (38.8%)	68 (4-327)	Sometimes also known as a before and after study. The majority used an audit or bibliometric approach for data collection, though some used surveys or other prospective data collection. For 38 pre-post studies, it was unclear how many participants were included. It was also often unclear whether the pre and post groups overlapped (aka included some of the same individuals), or were a “historical cohort” design with separate cohorts.
Post-only	60 (28.7%)	31 (2-232)	Post-only studies simply reported the outcomes following an intervention (e.g. the department published 12 articles). Most studies collected data using audits or surveys, though some used both or other methods.
Cross-sectional	36 (17.2%)	142 (32-101,031)	Cross-sectional studies with larger sample sizes usually used retrospective audit/bibliometric data, while smaller samples often used prospectively collected survey data.
Cohort with contemporaneous control	24 (11.5%)	106 (21-754)	Included 18 with an unmatched control, 5 with a matched control and 1 with a waitlist control. These studies usually used audit/bibliometric data, although surveys were also sometimes utilised.
Qualitative	7 (3.3%)	17 (5-72)	Usually as part of an evaluation of an intervention. These studies usually utilised interviews to collect data.
Interrupted time series	1 (0.5%)	N/A	
<b>Multi-intervention (n = 48)</b>			

a. Most used more than 1 outcome measure so the total will exceed 100%

<b>Study Designs</b>			
<b>Type of design</b>	<b>No. (%)</b>	<b>Median sample size (range)</b>	<b>Explanation and further information</b>
<b>Single intervention (n = 209)</b>			
Cross-sectional	38 (79.2%)		Almost exclusively multi-site surveys, either surveying individuals (25 studies) or program directors (13 studies) about the presence of interventions/modifiable factors and outcomes. Surveys of individuals had a median sample size of 136 (range 13-1351), while surveys of program directors had a median sample size of 96 programs sampled (range 24–351). It should be noted that some of these studies only reported statistically significant associations, so complete data was not always available to be extracted about associations which were not significant.
Qualitative	10 (20.8%)	28.5 (10–144)	Mostly used interviews and sometimes surveys to ask participants to reflect on what factors helped them engage in research.
<b>Outcome types measured<sup>a</sup></b>		<b>Explanation of outcome type</b>	
Publication-related	199 (77.4%)	Included measures such as total number of publications, total number of staff who published, percent of staff who published, mean or median publications per staff member, and publications per FTE. Some studies counted all publications, while others only counted specific publications (e.g. publications during a specific time period only), or publications where the staff member was a first or last author. Proxies for quality of publications were also often used, for example type of research published (e.g. retrospective studies or case studies were considered less valuable than prospective research), journal Impact Factor, H index, citations, and whether the journal was indexed or peer-reviewed.	
Presentation-related	126 (49.0%)	Similar to publications, this was measured in many different ways (e.g. total, per staff member, per FTE). Sometimes only presentations at a specific event (e.g. an annual meeting or a resident research day) were counted. It was common for the nature of the conference (regional, national or international) to be used as a proxy for quality.	
Grant-related	63 (24.5%)	Included total number of grants, total amount of funding, mean number of grants per staff member, percent of staff members who had received funding, and number of years funded per staff member.	

a. Most used more than 1 outcome measure so the total will exceed 100%

<b>Study Designs</b>			
<b>Type of design</b>	<b>No. (%)</b>	<b>Median sample size (range)</b>	<b>Explanation and further information</b>
<b>Single intervention (n = 209)</b>			
Career outcome	59 (23.0%)		Current self-reported engagement in research, research FTE, position, and type of practice (i.e. academic vs private).
Project-related	56 (21.8%)		Number of projects begun or completed, and number of protocols submitted or accepted through the Institutional Review Board. This could be a department total or numbers per staff member.
Awards	17 (6.6%)		Total number of awards or awards per staff member.
Other	53 (20.6%)		Examples include subsequent research degrees, whether the research was attributed to the intervention, implementation of research findings, number who fulfilled their research requirements, selection of the site for clinical trials, collaborations (e.g. percent of papers that included residents or university partners), how many students/others a staff member mentored, and participation in reviewing activities.
None (qualitative)	17 (6.6%)	N/A	
<b>Number of outcome types measured</b>			
None (qualitative)	17 (6.6%)		
1	59 (23.0%)		
2	81 (31.5%)		
3	64 (24.9%)		
4	26 (10.1%)		
5	4 (1.6%)		
6	6 (2.3%)		
a. Most used more than 1 outcome measure so the total will exceed 100%			

## **Outcome measures**

Most studies (70.4%) used more than one type of quantitative outcome measure to determine the success of an intervention. Publication-related outcomes were most commonly used (77.4%), followed by presentation-related (49.0%), grant-related (24.5%), career-related (23.0%), project-related (21.8%), awards (6.6%), and other outcomes (20.6%). Each of these broad categories of outcome was measured in variety

of ways, as outlined in Table 2. One hundred and twenty-five studies completed formal statistical hypothesis testing, of which the majority (111/125) found a significant result for the primary outcome.

## **Interventions and findings**

Each intervention type and a brief summary of the outcomes of relevant studies is described below, in order of frequency as given in Table 1. Figure 2 provides a visualisation of the broad outcomes of each study that used formal statistical testing (full data in Supplementary Digital Appendix 3). Findings of individual studies should be interpreted cautiously as no quality assessment was completed. Detailed results can be found in Supplementary Digital Appendices 4 and 5.

## **Resident research programs**

The most common type of intervention studied were Resident Research Programs (RRPs), investigated in 76 studies. RRP were multi-faceted research engagement programs which incorporated individual interventions such as protected time, education programs, a project requirement, mentorship, research support personnel, intramural funding, journal clubs and resident research day events. These programs were integrated into standard residency training, usually across the length of residency or within the last few years of residency. RRP were usually mandatory for all residents of the specialty training program at that site, but some were programs that were available to any interested trainees who satisfied a small set of prerequisite conditions. Programs which were available to only a selective subset of trainees through a competitive process (sometimes called research tracks) usually included substantial periods of protected time and were included within the “protected time” category further down.

RRPs had largely positive impacts on a range of outcomes, especially publication and presentation-related measures (Fig. 2). Four studies using statistical testing used a contemporaneous control group. Three used a ranked-to-match control group, meaning the control group consisted of residents in other institutions who received a ranking that meant they could have matched into the program if they had preferenced it highly enough (Calhoun et al., 2020; Sakai et al., 2014; West, Halvorsen & McDonald, 2011). This was intended to help balance self-selection bias, meaning the possibility that the results were due to the fact that higher performing residents may be more likely to choose programs that offer a RRP. The remaining study (Koontz, Kamer & Heitkamp, 2020) compared residents at the same institution who chose to join the RRP to those who did not. All of these studies reported significant differences in publication-related outcomes in favour of the RRP group, although each study measured publications differently so direct comparison was not possible.

Pre-post studies were the most commonly utilised research design to evaluate RRP. About half of the 25 pre-post studies using significance testing reported a significant difference for publications (13/23), and most found a significant difference for presentations (11/14).

## **Protected time**

Protected time was investigated in 72 studies, inclusive of any study that looked at dedicated research time as an intervention, without describing it as part of a multifaceted program like a RRP or post-residency research fellowship. In single intervention studies, the vast majority of studies examined protected blocks of time of over 6 months (usually 1–2 years) during surgical residency. Multi-intervention studies looked at a variety of types of protected time (e.g. percentage of protected time in role) across a wider range of specialties. For this reason, they will be discussed separately below.

Of the single intervention studies investigating blocked time, four utilised a contemporaneous control group and statistical hypothesis testing (Brandt et al., 2018; Joshua Smith et al., 2014; Krueger et al., 2017; Osborn et al., 2018). All four were in surgical specialties, were retrospective and used unmatched control groups from other institutions. Half of these studies found a statistically significant effect on publication-related outcomes (2/4), and the two that looked at career outcomes both found a significant effect (2/2). Cross-sectional studies universally found a positive impact on publication-related outcomes (7/7), and mixed outcomes for grant (3/4) and career-related (3/7) outcomes. Two pre-post studies also found positive outcomes for publication-related outcomes (2/2). Some cross-sectional studies investigating protected blocks of time for residents also included comparisons of different lengths of time, usually finding that larger amounts of time had positive effects on a range of outcomes (Bhattacharya et al., 2011; Hsieh et al., 2014; Lee et al., 2020; Robertson, Klingensmith & Coopersmith, 2009; Yang et al., 2011). One cross-sectional study also found that protected time produced more publications when provided in a longitudinal format rather than a blocked format (Williams, Agel & Van Heest, 2017).

Multi-intervention studies used cross-sectional designs to determine the impact of various forms of protected time. These studies mostly found statistically significant positive effects on publication (11/17) and grant-related outcomes (3/3), but mixed effects were seen for presentation (2/4) and project-related outcomes (2/4). Participants in qualitative studies also commonly identified protected time as one of the factors that had contributed to their research success (6/10).

## **Mentorship**

Fifty-two studies investigated mentorship as an intervention, which encompassed both formal mentoring programs and general presence of research mentors. Mentoring was often used synonymously with research supervision, rather than in the sense of external career mentoring. Studies also often investigated the characteristics of mentors, for example gender, geographical co-location, mentor research productivity, and the value of having single versus multiple mentors.

No studies which investigated the impact of mentoring used a contemporaneous control group. All studies which used statistical hypothesis testing were cross-sectional, and were mostly multi-interventional. Mentoring was mostly positively correlated with publication-related outcomes (8/12) and had varied effects on other outcomes. Mentoring was identified as an important factor in all qualitative studies that asked participants to reflect on factors contributing to research success (10/10).

## **Education programs**

Forty-one studies focused on educational interventions in a wide variety of formats. Some were short intensive workshops of 1–2 days (Ostbye et al., 2004; Rhondali et al., 2015), while others were more extensive, ongoing education over the course of weeks or months, designed to sit alongside completion of a small project or proposal, sometimes with a mentorship component (Demirdjian et al., 2017; Wojtecki, Wade & Pato, 2007).

All of the single intervention studies using statistical hypothesis testing investigated completely different types of education programs, from a 3-day workshop (Ried et al., 2008), to a 33-session longitudinal program alongside a project requirement and mentorship (Lowe et al., 2008), hence attempts at comparisons may be inadvisable. Similarly, many multi-intervention studies used surveys asking about general availability of research education, which could be interpreted differently by each participant and thus represent many different types of education programs. Accordingly, there were variable associations for most outcomes, though single intervention studies more commonly found positive associations.

## **Research support staff**

The presence of research support staff was investigated as a strategy for increasing research engagement in 30 studies. Research support staff were varied and included biostatisticians, nonclinical PhDs, lab technicians, research coordinators, research coaches, and support units including multiple staff. Most studies which used hypothesis testing were cross-sectional and found varied effects of the presence of support staff on publications (6/11 statistically significant) and most other outcomes.

## **Intramural funding**

Intramural funding, meaning research funding from the recipients' employing institution, was investigated in 23 studies. Most of these studies did not disclose a funding amount, but where specified this was usually under \$10,000USD. A single study used a contemporaneous control (Winn et al., 2019), comparing residents from the same institution who received an intramural grant with those who did not. This study found no difference in publication-related outcome but a significant difference for presentation-related outcome. All other studies using statistical hypothesis testing were cross-sectional studies, which found presence of intramural funding had mixed associations with a range of outcomes.

## **Resident research requirement**

Twenty-one studies looked solely at a mandatory departmental requirement for residents to engage in research or produce a research outcome (e.g. protocol, publication or presentation). The only single-intervention study to use statistical hypothesis testing was a matched control design (Ozuah, 2009), which compared a primary pediatric residency program (which had a research requirement), with subjects from other pediatric residency programs in the same institution. This study found a significant difference in both total and first authored publications during and after residency.

Multi-interventional cross-sectional studies found positive associations with presentation-related outcomes (2/2), and no association with publication (0/5), grant (0/2) or career-related (0/1) outcomes.

All studies using resident participation in research activity as an “other” outcome had significant results (4/4).

## **Department-wide research programs**

Eighteen studies investigated department-wide research programs. Like RRP, these were multi-strategy interventions, but they focused on increasing research engagement of an entire department, rather than residents specifically. These programs contained many of the same strategies as RRP, including protected time, mentorship, training sessions, research activity requirements, journal clubs, research leadership positions, research support staff and intramural funding.

All six studies which investigated department-wide programs using statistical hypothesis testing were single intervention- five pre-post and one interrupted time series design. All of these studies found statistically significant positive effects in publication (6/6) and presentation-related (2/2) outcomes.

## **Research leadership positions**

Presence of a research leadership position, usually a department research director or residency research director, was investigated in 15 studies. Studies were included in this category if they focused on presence of the position itself, but it should be noted that these positions would usually be responsible for initiating and supporting other strategies (e.g. overseeing a RRP, administering an education program). The presence of research directors was associated with exclusively positive findings regarding publication, presentation and grant-related outcomes in all single intervention studies (which were cross-sectional and pre-post designs), whilst all multi-intervention studies found no significant association with these outcomes.

## **Intramural post-residency research fellowship**

Intramural research fellowships after residency were the focus of fourteen studies. These fellowships were competitive placements within an institution, often analogous to subspecialty fellowships in length (1–2 years) and structure. While protected time was a key feature of these fellowships, they were usually formalised and/or accredited placements that incorporated multiple elements. It should be noted that many of these fellowships are administered by national organisations, thus were excluded from this review. Only fellowships administered and funded intramurally were included in this review.

Three studies investigated the outcomes of intramural fellowships using a contemporaneous control. One study found no significant difference in publication outputs between the fellowship group and a control cohort from the same institution matched for specialty and career stage (Brand, Patrick & Grayson, 2008). Two unmatched studies compared different types of programs at the same institution (Barreto et al., 2021; Dyrbye et al., 2008) and found significant differences for publication-related outcomes (2/2). Another four single intervention studies using cross-sectional and pre-post designs found statistically significant results for publications (4/4), but not presentation-related outcomes (0/2).

## **Other interventions**



A variety of other types of research engagement strategies were the focus of fewer studies, listed in Table 1.

## Discussion

This review identified a large amount of literature on strategies for increasing medical practitioner engagement in research. The largest amount of evidence supported RRP, protected time and mentorship as effective interventions. However, articles often failed to report key information, and weaker research designs were commonly used. This review provides some guidance for health services in determining where best to invest their resources, however further high-quality research is needed in this field.

Improved quality of evidence is a key target for further work. While formal quality assessment was not conducted, the vast majority of studies which used a comparator were pre-post studies, a finding reflected in similar reviews (Laupland, Edwards & Dhanani, 2021; Li et al., 2022; Stevenson et al., 2021). This design is vulnerable to bias, especially as very few of these studies determined the trajectory of their outcome measure prior to introducing the intervention. Particularly in resident populations, there is increasing pressure to publish peer-reviewed research, thus any increases in publication-related outcomes over time could be due to this broader trend rather than a specific local intervention (Munzer et al., 2019). Additionally, many interventions were compared to either no intervention, or undefined existing practices. The question of how to best measure the effectiveness of medical education interventions has been the subject of debate (Cook & Beckman, 2010; Mattick, Barnes & Dieppe, 2013), however increased use of contemporaneous comparator groups (especially matched), interrupted time series, mixed methods and designs suited to evaluating complex interventions may help improve the quality of the evidence (Laupland, Edwards & Dhanani, 2021; Mattick, Barnes & Dieppe, 2013).

Compounding questions of study design was the poor reporting of studies, an impediment to attempts to appraise, synthesise and apply this evidence. It was sometimes difficult to determine information as fundamental as study design and sample size. Future research in this field should utilise EQUATOR reporting tools relevant to the study design and type of intervention, to ensure all relevant information is reported (Albarqouni, Glasziou & Hoffmann, 2018; EQUATOR, 2022; Phillips et al., 2016). Reporting bias may also have affected findings, as very few studies reported a lack of effect on their primary outcome. This suggests that there may be a lack of evidence regarding ineffective strategies, which is equally as important to decision-makers as identifying successful strategies.

The evidence was also limited in that over three-quarters of the studies were located in USA (Laupland, Edwards & Dhanani, 2021; Li et al., 2022; Stevenson et al., 2021). Accordingly, the findings of this review may not be generalisable internationally, especially given most countries have different training frameworks, and vastly different healthcare funding models than the USA. A key direction for future research is determining the value of strategies developed in an American context internationally.

Outcome measures were highly heterogeneous, suggesting there is no agreed upon outcome measure for “research engagement”. This poses a barrier to future attempts to synthesise and compare findings of

studies. Traditional output-based measures such as publications predominated as measures of success. Publication is frequently used as a measure of research success, however, may be best used alongside other, non-output based measures (Brandenburg et al., 2021; Lee et al., 2020). Key amongst these should be measures of research translation, which is arguably a more relevant measure for health service delivery organisations than traditional academic outputs. Additionally, as clinician research engagement is attributable to many factors, including factors outside of individual interventions, outcome measures could be better designed to capture this complexity. In particular, a few studies asked participants to indicate how attributable their outcomes were to the intervention itself, which could be a simple approach to tackling this complexity in future research.

While the quality of the evidence summarised in this review posed some barriers to interpretation, there were some practical findings for application to health services. The strongest evidence supported RRP and protected time as effective strategies for increasing medical practitioner research engagement. No comparative studies were found demonstrating the benefits of mentoring, likely due to the difficulty controlling this factor. However quantitative evidence should be considered alongside the strength of qualitative studies in which participants cited mentors as vital to their research success. Department-wide research programs were the focus of fewer studies but showed largely positive outcomes. Research support personnel and training programs were found to have variable effects on outcome measures, warranting further investigation into whether different types of training or support personnel have different impacts. Interestingly, having research engagement as a requirement of residency had mixed effects on outcomes, pointing to it being a weaker strategy. This finding is reflected in other research (Khan et al., 2019; Laupland, Edwards & Dhanani, 2021). While this review provides some guidance for healthcare organisations in choosing individual strategies, this must be informed by each organisation's unique needs and context.

Many studies investigated multiple interventions or complex interventions like RRP or department-wide programs which incorporated multiple individual strategies. Such multifactorial approaches are likely to be the most effective in improving research engagement, however it is difficult to determine the additive value of the individual strategies that comprise them (Laupland, Edwards & Dhanani, 2021; Stevenson et al., 2021). Adding to this complexity, participants in qualitative studies also often attributed their success in research to less measurable aspects, like collaboration, research culture and general supportiveness of their team. These concepts may encompass influential factors like leadership endorsement and engagement, acknowledgement of research as a priority/expectation, peer support, availability of mentors, groundswell/enthusiasm, and anticipated rewards. These aspects are likely antecedents to the introduction of specific strategies, pointing to the importance of the overall research context as a foundation to any planned intervention.

## Limitations

The findings of this review should be considered with the usual limitations of scoping reviews. These include the search limits (databases, years, search terms, English language only), the possibility that

studies were missed, and the lack of quality assessment of studies. Data extraction was completed by a single author, thus vulnerable to bias despite regular liaison with other authors.

The inclusion criteria also introduced limitations on the interpretation of the findings. The focus on strategies modifiable by a single health service should be considered alongside the extensive literature examining nonmodifiable factors, like training location, gender, seniority or prior exposure to research (Laupland, Edwards & Dhanani, 2021) and strategies at the broader level, like large-scale funding schemes, extramural research fellowships, postgraduate degrees, and the role of collaboration between organisations (e.g. university-hospital partnerships). Lastly, this review only included studies that measured outcomes at the “engagement” level of Kirkpatrick’s model (1996). It should be noted that many interventions, especially training programs, focus on skill/knowledge-based outcomes, which are important precursors to engagement.

## Conclusion

There is a large volume of research on potential strategies for health services to increase research engagement of medical practitioners. However, much of this literature failed to report key information, did not use robust study designs, and employed heterogeneous outcome measures, limiting interpretation. The largest volume of evidence pointed to RRP, protected time and mentorship as effective interventions for health services. Further evidence is needed to guide healthcare organisations on how to best invest their limited resources to increase research engagement of their medical practitioners.

## Declarations

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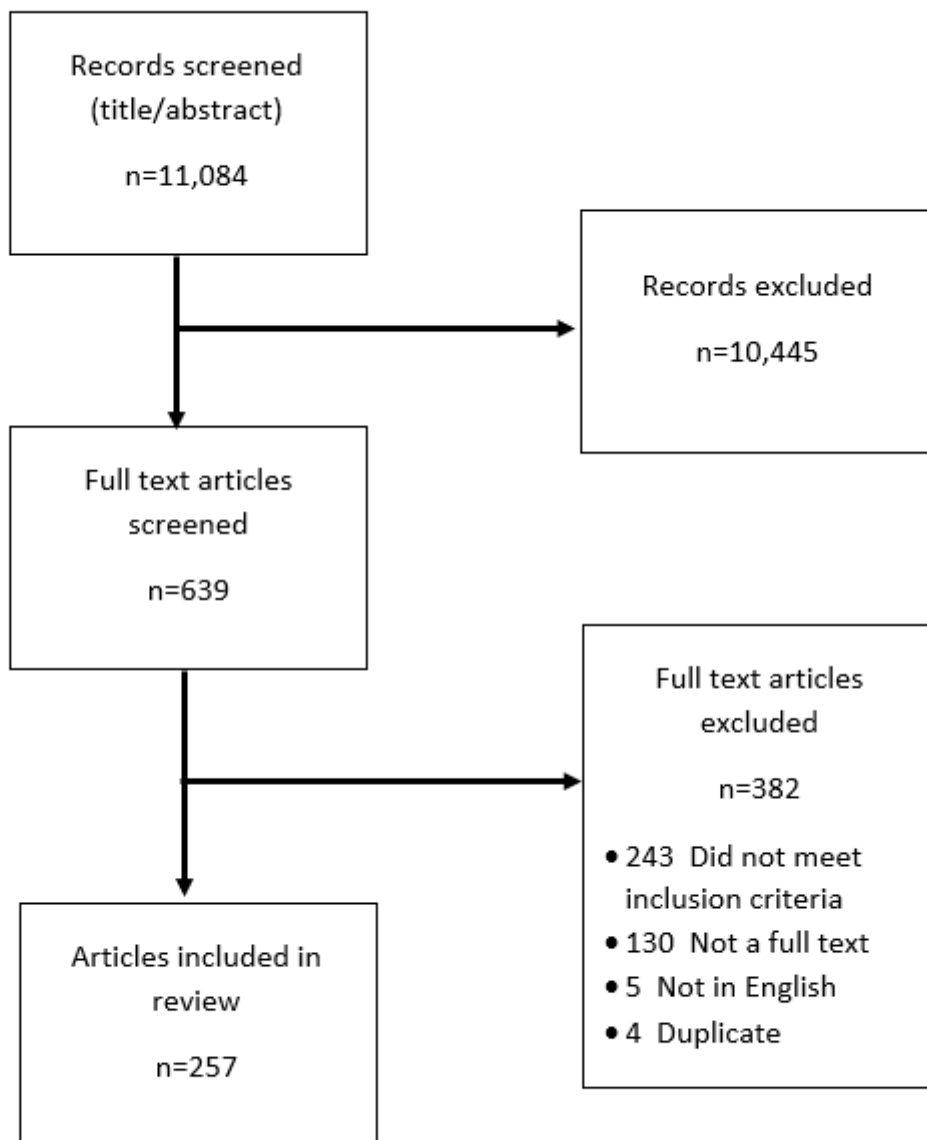
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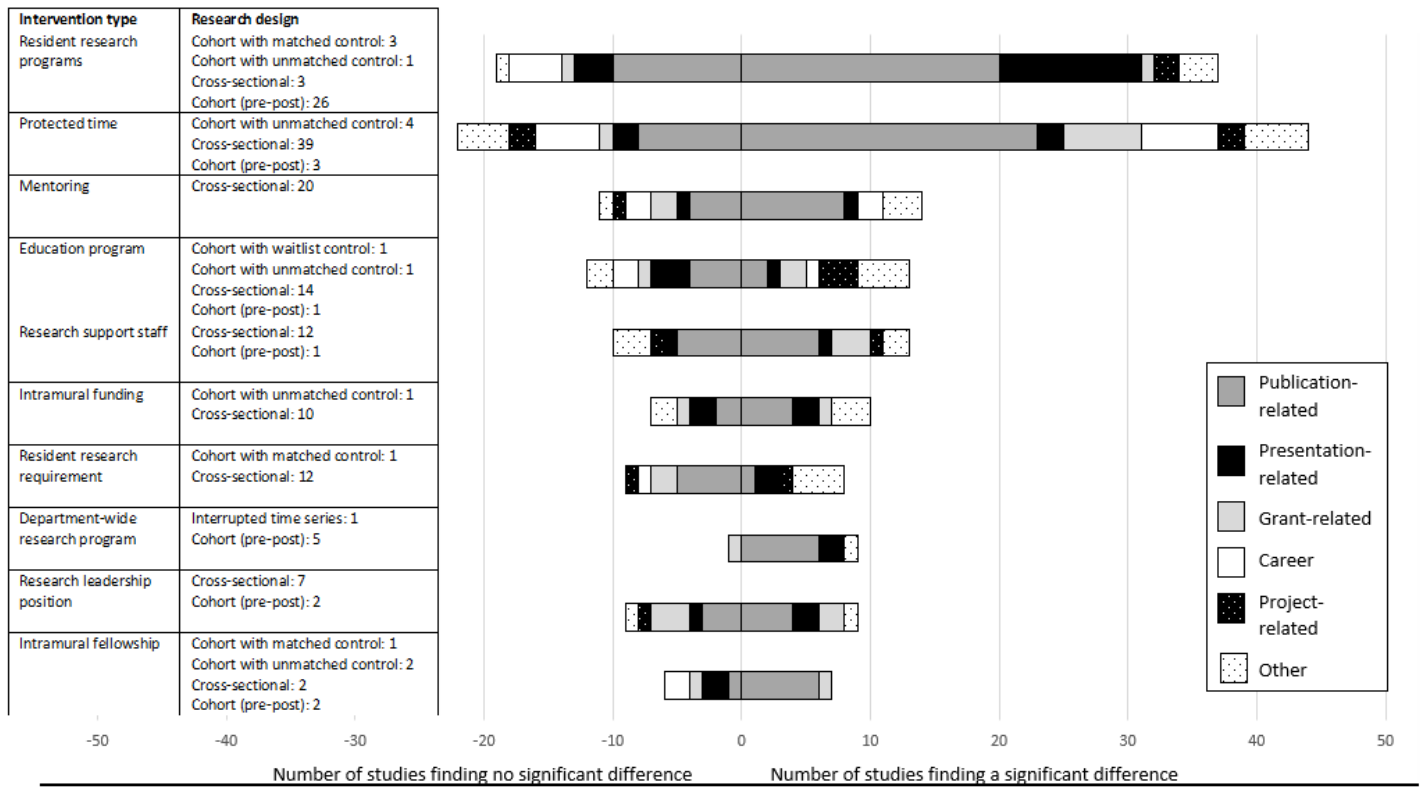
## Figures





**Figure 1**

PRISMA flow diagram detailing the search process and article selection for this scoping review.



**Figure 2**

Summary of the broad outcomes of each study using formal statistical testing by type of intervention

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