Barriers and facilitators for early career researchers completing systematic or scoping reviews in health sciences: A scoping review

Ana Patricia Ayala¹, Lindsey Sikora², Shona Kirtley³, Patrick R. Labelle⁴

1. Gerstein Science Information Centre, University of Toronto, Toronto, ON, CANADA
2. Health Science Library, University of Ottawa, Ottawa, ON, CANADA
3. UK EQUATOR Centre, Centre for Statistics in Medicine (CSM), Nuffield Department of Orthopaedics, Rheumatology and Musculoskeletal Sciences (NDORMS), University of Oxford, Oxford, UK
4. Social Sciences Library, University of Ottawa, Ottawa, ON, CANADA

Corresponding authors:

Ana Patricia Ayala
Gerstein Science Information Centre
9 King's College Cr.
Toronto, ON
M5S 1A5
Canada
1.416.978.6778
anap.ayala@utoronto.ca

Lindsey Sikora
Health Sciences Library, Roger Guindon Hall, Room 1020H
451 Smyth Road
Ottawa, ON
K1H 8M5
Canada
1.613.562.5800 ex. 8959
lindsey.sikora@uottawa.ca

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Abstract

Background

Systematic and scoping reviews are being published in health sciences and medicine at an increasing rate. At each stage during the systematic or scoping review cycle, different challenges can arise, especially for a novice researcher. Some of these challenges relate to inadequate or limited training in research methods, reporting standards, and the publication cycle, resulting in poorly conducted or reported reviews being published. We aimed to identify the challenges and facilitators experienced by early career researchers when undertaking systematic and scoping reviews.

Methods

Using a scoping review approach, we conducted comprehensive searches in multiple databases. The selection criteria for screening were established *a priori* and pilot tested. We included studies that focused on scoping or systematic reviews undertaken by early career researchers in the health sciences and medicine. All levels of screening were performed by two independent reviewers, while conflicts were resolved by discussion or a third reviewer. Two reviewers independently extracted relevant data using a pre-tested form, and discrepancies were resolved through discussion. Results were analysed thematically.

Results

The literature search yielded a total of 14967 citations. Upon completion of title and abstract screening, 148 references were deemed potentially relevant and reviewed. Subsequently, 8 documents fulfilled our eligibility criteria and were included.

Conclusion

This scoping review provides an overview of the barriers early career researchers face when conducting systematic and scoping reviews such as time, experience and expertise, training and mentoring, and methods. We also found facilitators that can be harnessed to assist them including training and adhering to reporting guidelines.

Keywords

Early career researchers, systematic reviews, scoping reviews, challenges, barriers, facilitators, health sciences, medicine

Background

An increasing number of systematic reviews (SysRevs) and scoping reviews (ScopRevs) are being published in health sciences and medicine; however, methodological issues such as incomplete data or problematic reporting, are predominant [17, 38]. Evidence syntheses can help decision makers interpret the deluge of published biomedical literature, but they may be of limited value if the methods used to conduct them are flawed, or if reporting is incomplete [11]. Problematic reporting can include lack of guideline adherence to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement for items such as a lack of a study protocol, or a need for more robust critical appraisal [1, 10, 40]. Strategies are needed to help reduce this avoidable waste in research [11, 23, 29, 30].

There are studies that highlight the benefits of completing SysRevs and ScopRevs as part of training in health research. For example, the opportunity for researchers to gain transferable skills that will provide significant value throughout their career (i.e. how to formulate a relevant research question, how to search for evidence, familiarity with a variety of study designs, and critical appraisal skills). Additional benefits include learning how to synthesise data; discussing the implications of findings for both future research and clinical practice; and how to reduce wasteful research [7, 26, 35, 40]. There is also evidence indicating the challenges that early career researchers (ECRs) might face when undertaking SysRevs and ScopRevs, which includes the increasing complexity of review methods; difficulty maintaining a realistic timeline and retaining team members; increasing time to complete each task; and the lack of methodological knowledge by potential supervisors, which may prevent them from being mentors and assisting novice researchers to complete these syntheses [3, 26, 49].

To date, there is a paucity of empirical literature discussing the specific challenges ECRs in the health sciences face when conducting SysRevs and ScopRevs. There is a lack of knowledge surrounding the extent to which these challenges are recognized as well as the type of facilitators that are in place to allow ECRs to successfully undertake these syntheses. This scoping review was conducted to systematically map research done in this area, identify facilitators that can be harnessed, as well as highlight knowledge gaps.

Operationalized definitions

What is a systematic review?

A SysRev attempts to identify, appraise and synthesize all the empirical evidence that meets pre-specified eligibility criteria to answer a given research question. Researchers conducting SysRevs use explicit methods aimed at minimizing bias to produce more reliable findings that can be used to inform decision making [21]. Acknowledging that there are methods for systematic reviews available, we decided to use the Cochrane Handbook, as it was the most inclusive for our definition of health sciences and medicine. According to the current version of the Cochrane Handbook, a systematic review consists of the following steps: (1) Defining the review question and developing criteria for including studies; (2) searching for studies; (3) selecting studies and collecting data; (4) assessing risk of bias of included studies; (5) analysing data; (6) undertaking a meta-analysis (might not always be possible or necessary); (7) addressing reporting biases; (8) presenting results and tables with summary of findings; (9) interpreting results and drawing conclusions [21]. Despite the benefits of SysRevs in addressing certain research questions, there are cases when they are inappropriate as they are unable to meet the objectives set forth by the researcher. Under those circumstances, it may be more appropriate to use another review methodology, where a broader, structured preliminary search and scoping activity may be required to act as a precursor, informing the need for a SysRev. A ScopRev is a valid approach in these situations.

What is a scoping review?

A ScopRev (or scoping study) is a form of knowledge synthesis that addresses an exploratory research question aimed at mapping key concepts, types of evidence, and gaps in research related to a defined area or field by systematically searching, selecting, and synthesizing existing knowledge [4, 12]. As opposed to SysRevs, ScopRevs do not aim to produce a synthesized and critically appraised answer to a particular question, but rather to provide an overview of the evidence. For this reason, ScopRevs do not require an assessment of the limits of the methods of a study, or an assessment of the risk of bias. The implications of a ScopRev, from a clinical or policy making perspective, are therefore different from those of a SysRev.

Who are early career researchers (ECRs)?

ECRs are “typically assistant professors at research universities and hospitals who have held their positions for 5 years or less” [41]. For the purposes of this study, graduate students (including master’s and doctoral students as well as postdoctoral fellows) are included as early career researchers, as they are learning about evidence syntheses research methods.

Which topics are considered health sciences and medicine?

For our study, the following topics were considered health sciences and medicine: neuroscience, pharmacology, nutritional sciences, physiotherapy, kinesiology, public health, population health, radiation therapy, life sciences, biomedicine, dentistry, health management, epidemiology, virology, rehabilitation, speech language pathology, nursing, midwifery, occupational therapy, psychology, social work, psychotherapy, chiropractor, acupuncture, all medical specialties and all alternative forms of therapies.

What are considered barriers and facilitators?

For the purposes of this study, barriers are defined as any external or internal factor that prevents, or increases the difficulty, in this case, for ECRs to successfully complete systematic reviews or scoping reviews. These factors could include time constraints, lack of adequate mentorship, or lack of proper training. Facilitators include individuals or factors that make an action or process easy or easier. For this study, this would include enabling ECRs to successfully complete systematic or scoping reviews.

Objective

The primary objective of this review is to systematically discover, collect and synthesize the challenges, opportunities and level of preparedness of ECRs when conducting scoping and systematic reviews in the health sciences and medicine.

Protocol

Our protocol was drafted using the Preferred Reporting Items for Systematic Reviews and Meta-Analysis Protocols (PRISMA-P), adapted for scoping reviews [31]. It was then revised by all co-authors and disseminated via social media (Twitter, Facebook, and LinkedIn) to gather feedback. The protocol

[6], along with all project information and material, including search strategies, screening guidelines sheet, data abstraction sheet, and coded abstracted data can be found in the project site [5], hosted in the Open Science Framework (OSF) a free, cloud-based web tool used to streamline collaboration and project workflow.

Protocol amendments

We deviated from our protocol by not conducting a full stakeholder consultation. We intend for this review to inform a survey, and subsequently focus groups or interviews, on the barriers and facilitators ECRs experience when undertaking SysRevs and ScopRevs. Therefore, our stakeholder consultation will take place during future phases of a larger report.

Methods

This scoping review follows the methodological framework described by Arksey and O'Malley [4] along with refinements proposed to this framework by Levac et al [25]; Colquhoun et al., [12], as well as the PRISMA-ScR statement [51]. This six-stage model involves: (1) identifying the research question; (2) identifying relevant studies (search methods used); (3) selecting studies; (4) charting the data; (5) collating, summarizing and reporting the results and (6) consulting with key stakeholders. The refinements to the original framework include establishing a clear research question, purpose and outcome for the scoping review; assembling a team with content and methodological expertise; searching the literature using an iterative process with inclusion and exclusion criteria; using at least two reviewers to independently review abstracts and full-text papers, with a consensus procedure in case of a disagreement; developing a data abstraction form where two researchers abstract the data independently; and performing an analysis which includes a qualitative thematic analysis of the papers.

Information sources and literature search

We conducted comprehensive search strategies in the following databases: Medline (via OVID), Embase (via Ovid), CINAHL (via EBSCOHost), PsycINFO (via Ovid), ERIC (via Ovid), Education Source (via EBSCOHost), and Library, Information and Technology Abstracts –LISTA (via EBSCOHost). We searched databases from their dates of inception to June 15th, 2018, and then re-ran searches until May 25, 2019,

to identify additional articles that may have been published since the date of the original search. Search strategies were developed by an academic health sciences librarian (LS), and peer-reviewed using the Peer Review of Electronic Search Strategies (PRESS) tool [27]. We also crowdsourced synonyms for the term “early career researcher” from social platforms including Facebook and Twitter, while concurrently searching the literature. We adapted the “systematic review” search filter from the Scottish Intercollegiate Guidelines Network (SIGN, n.d.) [46] for Medline, Embase and CINAHL when searching for SysRevs and ScopRevs as a topic. In this case, we refer to ‘topic’ as part of our search criteria, where the process of these reviews needed to be actively conducted. We searched the grey literature source OpenGrey, as well as the reference lists of included studies to identify additional research that might be relevant. All search strategies can be found in Appendix 1. The final search results were exported into EndNote X8, where duplicates were removed.

Eligibility criteria

Inclusion criteria

We included studies that:

- Examined the conduct of systematic reviews or scoping reviews;
- Included participants who were early career researchers in health sciences.
- All publication types, with the exception of knowledge syntheses, were considered, provided the studies were based on empirical research.
- Only articles written in English and French were included, with papers in any other languages screened out during the title/abstract screening phase.

Exclusion criteria

We excluded:

- Editorials, commentaries, letters to the editor
- Comprehensive literature reviews including evidence syntheses as publication types
- Studies that did not examine the SysRev or ScopRev cycle as their main outcome.
- Studies that did not include ECRs or only ECRs who were not in the health sciences were also excluded.

Study selection process

The review team started the process by performing a calibration exercise on a random sample of studies to ensure that there was an agreed common understanding about the inclusion and exclusion criteria. Once the team reached 90% inter-reliability, two independent reviewers screened titles and abstracts of all articles once duplicates were removed. Disagreements for the first level of screening were resolved by discussion amongst pairs of reviewers or by a third reviewer. Following the completion of title and abstract screening, the team performed another calibration exercise for full-text screening, with the goal of reaching 90% agreement. The full-text of the remaining studies was screened by two independent reviewers for compliance with eligibility criteria. Conflicts for full-text screening were resolved via discussion by two independent reviewers (APA, LS). We contacted authors to ascertain the eligibility of two studies resulting in one being excluded, and one included upon receiving clarification. Covidence, an online tool, was used for the first and second levels of screening.

Data items and data collection process

Two reviewers independently assessed each eligible study using a structured data extraction form. The data abstraction form was developed *a priori* by one reviewer (APA), tested by all team members independently, and then revised based on provided input. Two independent reviewers (APA, LS) charted the data, and then compared their decisions to identify and discuss discrepancies, which were resolved through consensus. The extracted data included report characteristics such as first author, year of publication, publication type, study design, location, previous training in SysRevs or ScopRevs, level of education, associated discipline of the participants and study outcomes.

Results

All databases were searched independently, and all returned records were compiled in a citation management software, Endnote X8, ($n=14,967$) before duplicates were removed. Of the 10,466 remaining references after deduplication, 10,311 were excluded during title and abstract screening. Of the remaining 155 records, 146 were excluded during the second level of screening; one record was excluded during data abstraction after contacting the authors for clarification, resulting in eight records

included in the final analysis. A detailed description of the selection process, and results, is given in the PRISMA flow diagram (Figure 1).

Figure 1. PRISMA flowchart

Summary of included studies

There were eight studies included for final analysis [3, 9, 16, 18, 22, 34, 38, 46]. Studies included in the review were from the United Kingdom (n= 3), Canada (n=2), Poland (n=1), the United States (n=1), and India (n=1). Studies were based in universities (n= 5), teaching hospitals (n=2) and a research institute (n=1). The majority of the studies were conducted in the field of medicine (n=4), followed equally by public health (n=1), kinesiology (n= 1), rehabilitation sciences (n=1), and pharmacy (n=1). The

majority of included studies were descriptive in nature. Reports were published between 2013 and 2019.

The following characteristics were extracted from each paper including first author and year of publication, study design, study aim, key findings relevant to the barriers and facilitators of scoping reviews and systematic reviews, and conclusions (see Table 1). Supplementary data can be found at our OSF project site.

Table 1. Study characteristics

Author	Study design	Study aim	Factors identified as barriers	Factors identified as facilitators
Anurhada et al. 2013	Questionnaire	This study aimed to identify the knowledge, attitude and perceived barriers to Evidence Based Practice in radiology among radiology residents	- Relevant literature is not being compiled in one place - Not being able to understand statistical methods - Unable to assess conflicting results in literature - Little perceived benefit to self - Long publication process - Lack of availability of evidence-based literature - Implications for practice are not made clear - Lack of knowledge of technical terms, such as meta-analysis, publication bias, and confidence intervals were poorly understood	- Access to electronic resources such as MEDLINE, and WWW resources, the attitude of other colleagues, and the use of evidence-based protocols, was correlated to a positive attitude towards evidence-based practice - Previous publications, access to MEDLINE in the workplace and the library, the WWW, and other bibliographic databases, the use of evidence-based protocols, and awareness of evidence-based medicine were factors associated with a higher knowledge score among residents. - Training in critical appraisal - Experience in scientific writing

				- Use of evidence-based summaries - Belief that it's best to personally appraise the primary literature
Shepherd et al. 2013	Interviews	This study aimed to collect and examine the experience of health promotion review authors conducting systematic reviews.	- Lack of adequate resources and time - The most difficult tasks in learning, teaching, and conducting systematic reviews were statistical analysis, critical appraisal, evidence retrieval, and developing the review question. - The increasing complexity, and changing nature, of the methods - Ability to exercise judgement with confidence, when making decisions in the review process - The need to exercise judgment was mentioned as being a difficult message to communicate to novice reviewers, particularly those lacking in confidence to do anything other than follow explicit instructions.	- Applying existing research skills, support from colleagues, and training courses were commonly cited ways of learning, often in combination. - Learning through practice was considered the most beneficial way of understanding systematic review steps and methods. - Being mentored by more experienced colleagues
Farrokhyar et al. 2014	Retrospective data analysis	This study aimed to compare and measure whether a new course program would improve the research productivity of residents, in comparison with the previously implemented curriculum.		- Knowledge of research methodology and biostatistics is crucial to appropriately apply evidence-based findings in clinical practice - Implementing a research methodology program (SRM) with an increased methodological rigour, resulted in a higher research productivity (published peer reviewed

				articles) than previous cohorts - Protected time to focus on a research project
Himelhoch et al. 2015	Questionnaire	This study aimed to describe how a systematic review and meta-analysis course was developed, implemented, and evaluated by residents completing the course.	- Identifying faculty members to lead the course - Faculty who do not have a background in research methodology may feel ill equipped to lead a course on systematic reviews and meta-analysis - Residents had concerns regarding the time required to complete all course work	- The right level of difficulty; - Having enough time to complete assignments; - Built in time to meet with course instructors; - A clear, stepwise, structured delivery of course content. - It was found that having support from the chairman and residency program director, the provision of faculty time and funding to support course creation and instruction, was critical to success. - Completing a scientific article was found to be helpful - Students reported an increase in confidence to undertake systematic reviews and meta-analyses after taking the course - The course was vetted by residents and faculty in order to get support from everyone

O'Brien et al. 2016	Cross-sectional web-based survey	This study aimed to understand the experiences of the academic community and other stakeholders, in the conduct of scoping reviews.	- The flexibility, and variability in terminology. - Broad scope of projects - Broad, and at times unclear, concepts of study - Inclusion of grey literature, at times difficult to find. - Time commitment is difficult to ascertain at the beginning of a scoping review due to the flexible and iterative nature of the process, including: defining and redefining the research question, search strategy, and selection criteria. - Lack of detailed guidance, methodology, and standards proved to be challenging - Lack of quality appraisal may result in the need to interpret results with added caution - Stakeholder consultation can be unfeasible - Difficult to report studies in a concise manner given space limitations of journals	- The ability to provide an overview of evidence in a particular field - A good tool to map a broad and diverse range of topics - The flexibility of the entire process: the ability to include published and unpublished literature, and the ability to include a multitude of study designs, methods, and combine qualitative and quantitative mechanisms of synthesising the evidence. - A rigorous process, but not as rigid as systematic reviews - The ability to focus on the state of evidence and research, as opposed to evaluating the existing literature, provides policy makers the opportunity to make evidence-based choices and engage with stakeholders.
Gorczyński et al. 2017	Online questionnaire	The study aimed to describe the implementation challenges, benefits, and lessons learned of a course on evidence syntheses, one in person, and one online, to a science Faculty.	- Additional methodological support in developing the research question, inclusion and exclusion criteria, methods for conducting searches, and data abstraction. - Distance learning as a delivery method was problematic in effectively delivering the course content in an online environment;	- Students appreciated the practical application of their knowledge to relevant research studies in other courses and their own work. - Students were able to write and submit rigorous and high-quality reviews. - Students indicated that being able to read, understand, and provide critical feedback about research studies and

			- Making personal contact with some students in an online environment proved to be challenging - Students didn't feel confident sharing feedback in an online group discussion - Limited interactions resulted in no study and peer-support groups being formed	systematic reviews was extremely helpful. - Librarian involvement was found to be valuable. - Interactivity, ease of access to course material on mobile devices, and rapid feedback was valued
Bonfield et al. 2018	Personal experience narrative.	This study aimed to describe the experience of two early career researchers undertaking a systematic review in the medical ultrasound specialty.	- Screening the search yield was a lengthy process, but the principle reviewer felt able to apply the inclusion criteria confidently using the predefined protocol they had created. - A screening software tool, e.g. Covidence would have made the screening process easier and faster. - Both reviewers felt less confident, in interpreting and evaluating the extracted data, and needed to re-study the basic statistical methods. - Data abstraction was very time consuming - Critical appraisal was particularly challenging due to the degree of subjectivity, even with the use of a tool, resulting in an increased possibility of reviewers arriving at different conclusions. - -Critical appraisal using CASP, requires a high degree of time and attention to each question. - -While at the beginning the CASP tool appears straightforward, as each question was answered it	- An initial literature search was useful in mapping the literature, and determining the study type most appropriate for the review to focus on. - Librarian assistance in developing the search strategy was critical, despite both reviewers having experience in conducting literature searches. - Librarian guidance in designing the search strategy was invaluable in making searches transparent, manageable, and finding an appropriate balance of sensitivity and specificity. - Documenting every step of the process and recording why decisions were made, to ensure transparency and reproducibility, made undertaking the study easier and clearer. - Data abstraction was straightforward due to the clarity of the data

			became evidence it was harder and took longer than originally anticipated	extraction form, but time consuming.
Panczyk et al. 2019	Multimethod design: - Data on the students' profile of Evidence-Based Practice. - Activity reports generated by the Moodle™ E-learning platform. - Test results - Questionnaire	The study aimed to evaluate the evidence-based practice level of doctoral Pharmacy students at the University of Warsaw.	- Doctoral students had a low level working knowledge of evidence based practice - The most challenging task for students were the interpretation of meta-analysis results, and the design and the use of guidelines for clinical practice. - Determining homogeneity, and comparing the precision of individual primary research was challenging - Understanding forest plots, was a frequent problem for students - Students spent the most time on the module for systematic reviews and meta analysis	- The use of the online multi-module course to educate PhD students was found to be an effective educational tool.

Study design

The majority of studies used questionnaires in their study design [3, 18, 22, 34, 48], with one study using a questionnaire in addition to a web-based survey and an in-person consultation meeting [34]. One article used personal experience narratives to collect and present results [9], one article used interviews as its study design [45], and one study analysed retrospectively collected data [16].

The majority of studies assessed the performance and experience of trainees after completing a course in evidence-based practice that included a component on systematic reviews [3, 16, 18, 48] or a course specifically on systematic reviews [22]. Two studies examined the experience of ECRs undertaking and completing a systematic review, not based on coursework [9, 45]. The majority of the studies focused or discussed systematic reviews [3, 8, 16, 18, 45] while only one looked at scoping reviews [34]. Training in EBP or SysRevs was delivered through various approaches. Two studies used

blended learning [22, 45], one study examined two different modalities of purely online modules versus solely in-person delivery, [18], one study delivered course content only in person [14], and one study did not explicitly mention how the course was delivered [3].

Barriers

Time

Having adequate time to complete a SysRev or ScopRev was identified as the most common barrier in the majority of studies [3, 8, 22, 34, 45]. Several studies indicated that insufficient time to complete the project was an issue [3, 45], followed by the fact that the time needed to complete the review took longer than anticipated [9, 34], and the importance of having adequate and protected time to complete the work [22].

Methods

Increasing complexity of the evidence syntheses methods relating to scope, analysis [34, 45], and lack of knowledge or clarity around terminology of the methods were identified, due to the evolving nature of these frameworks [34].

Experience and expertise

Challenges related to the experience and expertise of conducting SysRevs and ScopRevs included lack of confidence in skills [9, 45], managing feasibility and scope [16, 34, 45], lack of knowledge of terminology of research methods [3, 45], lack of awareness of resources [3], training without a practice-based component, and lack of motivation [45].

Training and mentorship

Several studies mentioned barriers concerning insufficient guidance and mentorship [34, 45], and lack of funding for training [45].

Challenges observed when conducting systematic and scoping reviews

When considering the steps involved in conducting a SysRev or ScopRev, the most difficult tasks revolved around data analysis, where several studies reported difficulties performing statistical analysis [3,8, 45], as well as interpreting meta-analysis results [45]. Participants also mentioned that searching

the literature [3, 8, 16, 34, 45], in particular, producing an adequate search strategy, proved to be difficult and time-consuming [9, 16, 34]. Two studies mentioned that locating evidence was challenging [3, 45], and one study reported interpreting conflicting results in the literature, and lack of access to the literature as remarkably challenging [3]. This was followed by critical appraisal, with studies indicating lack of previous training and practice, as the reason this task was so difficult [3, 45], and other studies citing it was particularly challenging due to its partly subjective nature, and laborious process [9, 34]. Other tasks that presented problems for study participants included formulating an adequate research question [16, 34, 45], and developing inclusion and exclusion criteria [34, 16].

Facilitators

Time

Regarding the undertaking of SysRevs or ScopRevs, several authors [14, 16, 22] indicated that having protected time to perform tasks, and that rigour in feedback and assessment were beneficial and motivating.

Experience and expertise

For one study, the importance of having a well-rounded team that included members with methodological expertise, a strong project management plan and open communication where all team members feel empowered to share their opinion were critical to their success [9].

Training and mentorship

Several studies identified having access to mentors as a key facilitator in their understanding and successful completion of these study types [16, 22, 45]. Studies also suggested that being exposed to a structured framework approach for training [14, 22, 45] and that practice-based learning by completing project tasks of a systematic review [45] were imperative to fully understanding the process. As well, being able to communicate with experienced and responsive faculty and trainers was also deemed valuable [14, 22, 22]. One study indicated that guidance from a librarian in conducting literature searching was essential [9].

One study noted that assigning a task to a novice researcher, such as screening, while training or completing a course, would cement the theory behind the methods and that this practical component

equipped them for completing their review [45]. Several studies indicated that training in evidence-based practice (EBP), with practical course components specifically dedicated to conducting SysRevs and ScopRevs, should be mandatory to form well-rounded health professionals [3, 45].

Facilitators in the steps of completing systematic and scoping reviews

When completing steps to conduct SysRevs or ScopRevs, having background knowledge and training in research methods, epidemiology and statistics [16, 45] as well as training in literature searching [22] and critical appraisal [3] were considered of particular benefit. Several studies reported that having a pre-defined protocol to apply selection criteria with confidence was advantageous [9, 34]. Other factors that facilitated the undertaking of systematic and scoping reviews included access to electronic resources and scientific databases [3], and support with regards to protected time for faculty and students to complete projects from program directors [22].

Factors identified as both barriers and facilitators

Peer-learning and peer-support were factors that made a positive impact by providing ECRs with the ability to provide feedback to colleagues, highlight their own strengths and weaknesses, and foster collaboration; however it was also highlighted as a challenge since it could result in a scenario of the blind leading the blind [45]. Two studies indicated that an online learning environment was beneficial [18, 45]. One study mentioned that giving students access to all the course material from the start, having online material that provided immediate feedback, and making available of course modules that could be re-taken at any time were particularly favourable [22]. The same study indicated challenges with exclusively delivering the SysRev course online, such as students were apprehensive to share their thoughts and opinion in an online community, and several students lacking skills to successfully navigate the online learning environment. The flexibility and iterative process, and wide scope of ScopRevs were identified as both favourable and challenging [34]. While a flexible and iterative process of defining (and redefining) the research question, search strategy and selection criteria allowed for fine tuning, it required increased time and resources which are difficult to determine at the beginning of the study. The broad scope combined with a lack of clarity, resulted in challenges for feasibility regarding time, given studies would take longer than initially planned for.

Discussion

This study set out to map the evidence on the challenges and barriers faced by ECRs in the health sciences when conducting SysRevs and ScopRevs. The review revealed eight unique studies that provided insight into the barriers and facilitators that ECRs face when conducting research using these study designs, which can be broadly categorised into the following groups: time, methods, experience and expertise, training and mentorship, and the steps involved when conducting ScopRevs and SysRevs.

The review revealed that the most common barrier in the undertaking and completion of SysRevs and ScopRevs is the lack of dedicated and protected time for students and faculty to undertake and facilitate training and mentorship [3, 8, 22, 34, 45]. Time is also an issue in the completion of tasks that were identified as the most demanding in the steps of conducting SysRevs and ScopRevs, including developing a search strategy, identifying clear inclusion and exclusion criteria, critically appraising studies, and performing statistical analysis [3, 8, 16, 34, 45]. Evidence-based practice courses seem to be a component of the majority of graduate health science degrees, with some programs dedicating more time for these courses than others. Our review revealed consistently that regardless of the EBP course length or time, it is the skills used when conducting SysRevs (e.g. statistical analysis, searching the literature, critical appraisal) that participants found to be the most tasking, took the longest time to complete, and for which they wished they had received additional training [3, 8, 16, 34, 45].

Our findings suggest that a top-down support system is critical for success in the teaching, learning, and undertaking of SysRevs and ScopRevs. Provision of support is required at different levels, such as support from program directors when selecting faculty and instructors that are well-versed in SysRevs and ScopRevs conduct and methodologies to deliver training, having protected time for both ECRs and faculty members to facilitate feedback, and having adequate allocation of funding to ensure infrastructural requirements [45]. With regards to training structure and delivery format, our review revealed that incorporating a practical component to courses while being mentored by trainers and having a structured approach to teaching SysRev and ScopRev methods are linked to successful teaching outcomes [45]. Online learning or blended learning has been discussed as both a barrier and facilitator, where some studies reported participants lacked the necessary skills to adequately engage in their online modules and were apprehensive to post their ideas in an online forum [22]. On the other hand, it has also been found that an online learning environment that allowed access to all the course material

from the start, had the functionality to provide immediate feedback on assignments, and the ability of modules to be re-taken at any time, was particularly useful [22].

Our review highlights that while several studies mentioned or encouraged participants to publish their work, the majority did not incorporate any training in writing and publishing manuscripts, the importance of having a well-rounded team, the peer-review process, ensuring research transparency or the proper reporting of research studies. Only two studies touched upon some of these issues, as one study articulated the importance and impact team members can have on SysRevs [9], while the other discussed the proper reporting of ScopRevs [34]. These findings suggest a gap in the evidence, and that training of ECRs when conducting SysRevs and ScopRevs is insufficient.

The role of the librarian

Our study also re-affirms the importance of literature search training, and the role librarians play in training ECRs in the comprehensive searching methods required for SysRevs and ScopRevs [9, 34]. Librarians can have a significant impact by teaching researchers about practices to properly report findings, as well as by raising awareness about which methodology might be most appropriate for their research question [8, 13, 22, 26]. Research waste is a growing concern [47], and librarians are part of the answer in the role they play as advocates for research integrity and transparency [24]. Recent studies have examined the challenges encountered by librarians when working with researchers in SysRevs and ScopRevs, including lack of awareness surrounding feasibility such as time constraints and methodological knowledge [13, 19, 33, 48]. With that said, librarians are in the unique position of playing a dual role; not only are they potential ECRs, but researchers also increasingly looking to them for expertise as methodologists when conducting evidence syntheses.

We anticipate that our results will be of interest to knowledge users, academic program directors, faculty and lecturers participating in or delivering training on systematic and scoping reviews, librarians, and early career researchers who are interested in learning or refining their skills in conducting these types of syntheses. These findings can be utilized by encouraging support from faculty, administrators, program directors and librarians, to implement an integrated, practice-based approach to training ECRs as well as ensuring there is adequate and protected time for trainers and trainees to complete their work and reinforcing that research methods courses are imperative.

Limitations

We acknowledge that there are varying definitions and naming conventions for these types of knowledge syntheses, particularly for scoping reviews [12, 34, 38]. Terms such as literature reviews, scoping studies and scoping analysis are frequently used interchangeably for systematic and scoping reviews and pose a challenge in identifying studies of interest during first level screening. To mitigate this, we included all studies that mention these term variants during the first screening step, unless they could be clearly excluded. We also acknowledge the limitation of only including studies in English and French. Despite these limitations, this scoping review is of value both theoretically and practically. The search strategy was comprehensive and included multiple information sources.

Conclusion

Although additional empirical studies are needed to examine these findings more closely, the results of this study provides an overview of the challenges ECRs face when conducting SysRevs and ScopRevs, as well as the facilitators that can be harnessed to assist them. The results can be used for evaluation and comparison and to guide the validation of interventions currently being used in training and practice, and to redesign others. The results of this study will also inform the design of a survey that will be disseminated widely to knowledge users and stakeholders to gain further insight into their perceived challenges and facilitators when conducting systematic and scoping reviews. Together, the data collected from both of these projects will create a comprehensive report that will be shared with the research and academic community. The results will benefit university communities and affiliated institutions worldwide, and strengthen or develop relationships among faculties, administrators and staff to find creative solutions that will benefit ECRs who undertake scoping and systematic reviews. Addressing these barriers will not only benefit the skills and knowledge of ECRs, but in turn, will lead to improved methodological rigour, conduct and reporting of published SysRevs and ScopRevs, thus helping to tackle the issue of research waste.

Abbreviations

ECRs: Early career researchers

PRESS: Peer Review of Electronic Search Strategies

PRISMA-P: Preferred reporting items for systematic reviews and meta-analysis protocols

PRISMA-ScR: Preferred reporting items for scoping reviews

SysRev: Systematic Review

ScopRev: Scoping Review

Declarations

Ethics approval

Not applicable

Consent for publication

Not applicable

Availability of data and materials

All data underlying this study is available in the Open Science Framework: <https://osf.io/zdm3c/>

Competing interests

None

Funding

None

Author contributions

APA, LS and SK have contributed to the conception and design of the study. LS developed the search strategies, and APA, SK, and PRL have contributed to the establishment of search and scoring criteria. Screening and article reviewing were performed by APA, LS, SK, and PRL. Scoring and data analysis has been performed by APA and LS. APA, LS, SK, and PRL have made contributions to the drafting and revising of the article. APA, LS, SK, and PRL have approved the final version to be published and its accuracy and integrity.

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Appendix A

OVID Medline

1. Meta-Analysis as Topic/
2. meta analy\$.tw,kf.
3. metaanaly\$.tw,kf.
4. Meta-Analysis/
5. ((scoping or systematic) adj3 (review\$1 or overview\$1 or study or studies or analys*)).tw,kf.
6. exp Review Literature as Topic/
7. or/1-6
8. (early adj2 career*).tw,kf.
9. (entry adj2 level*).tw,kf.
10. pre?intern*.tw,kf.
11. (new adj3 career*).tw,kf.
12. ((emerging* or emergent* or early stage or junior* or early career* or new or recent* or young or novice* or start* or beginner* or newcomer* or newly qualified) adj3 (investigator* or trainee* or researcher* or intern* or graduat* or prof* or facult* or lecturer* or fellow* or scientist* or academic*)).tw,kf.
13. ECR*.tw,kf.
14. (research adj3 (assistant* or associate* or coordinator*)).tw,kf.
15. (post adj3 universit*).tw,kf.
16. pre?tenur*.tw,kf.
17. newbie*.tw,kf.
18. exp Education, Graduate/
19. (grad* adj3 (student* or education*)).tw,kf.
20. Foreign Medical Graduates/
21. post?doc*.tw,kf.
22. exp Internship, Nonmedical/
23. post?universit*.tw,kf.
24. or/8-23
25. 7 and 24
26. (early adj3 career*).tw,kf.
27. (research adj3 personnel*).tw,kf.
28. Research Personnel/
29. PhD.tw,kf.
30. 26 or 27 or 28 or 29
31. 7 and 30

OID Embase

1. Meta-Analysis as Topic/
2. systematic review/
3. meta analy\$.tw,kf.
4. metaanaly\$.tw,kf.
5. Meta-Analysis/
6. ((scoping or systematic) adj3 (review\$1 or overview\$1 or study or studies or analys*)).tw,kf.
7. exp Review Literature as Topic/
8. or/1-7
9. (early adj2 career*).tw,kf.
10. (entry adj2 level*).tw,kf.
11. pre?intern*.tw,kf.
12. (new adj3 career*).tw,kf.
13. ((emerging* or emergent* or early stage or junior* or early career* or new or recent* or young or novice* or start* or beginner* or newcomer* or newly qualified) adj3 (investigator* or trainee* or researcher* or intern* or graduat* or prof* or facult* or lecturer* or fellow* or scientist* or academic*)).tw,kf.
14. ECR*.tw,kf.
15. (research adj3 (assistant* or associate* or coordinator*)).tw,kf.
16. (post adj3 universit*).tw,kf.
17. pre?tenur*.tw,kf.
18. newbie*.tw,kf.
19. exp Education, Graduate/
20. (grad* adj3 (student* or education*)).tw,kf.
21. Foreign Medical Graduates/
22. post?doc*.tw,kf.
23. post?universit*.tw,kf.
24. or/9-23
25. 8 and 24
26. (early adj3 career*).tw.
27. (research adj3 personnel*).tw.
28. personnel/
29. PhD.tw.
30. 26 or 27 or 28 or 29
31. 8 and 30

OID PsycINFO

1. meta analy\$.tw,kf.
2. metaanaly\$.tw,kf.
3. Meta-Analysis/

4. ((scoping or systematic) adj3 (review\$1 or overview\$1 or study or studies or analys*)).tw,kf.
5. Review/
6. or/1-5
7. (early adj2 career*).tw,kf.
8. (entry adj2 level*).tw,kf.
9. pre?intern*.tw,kf.
10. (new adj3 career*).tw,kf.
11. ((emerging* or emergent* or early stage or junior* or early career* or new or recent* or young or novice* or start* or beginner* or newcomer* or newly qualified) adj3 (investigator* or trainee* or researcher* or intern* or graduat* or prof* or facult* or lecturer* or fellow* or scientist* or academic*)).tw,kf.
12. ECR*.tw,kf.
13. (research adj3 (assistant* or associate* or coordinator*)).tw,kf.
14. (post adj3 universit*).tw,kf.
15. pre?tenur*.tw,kf.
16. newbie*.tw,kf.
17. (grad* adj3 (student* or education*)).tw,kf.
18. post?doc*.tw,kf.
19. post?universit*.tw,kf.
20. career development/
21. or/7-20
22. 6 and 21
23. (early adj3 career*).tw.
24. (research adj3 personnel*).tw.
25. PhD.tw.
26. 23 or 24 or 25
27. 6 and 26

OVID ERIC

1. meta analy\$.tw,kf.
2. metaanaly\$.tw,kf.
3. Meta-Analysis/
4. ((scoping or systematic) adj3 (review\$1 or overview\$1 or study or studies or analys*)).tw,kf.
5. Literature Reviews/
6. or/1-5
7. (early adj2 career*).tw,kf.
8. (entry adj2 level*).tw,kf.
9. pre?intern*.tw,kf.
10. (new adj3 career*).tw,kf.
11. ((emerging* or emergent* or early stage or junior* or early career* or new or recent* or young or

novice* or start* or beginner* or newcomer* or newly qualified) adj3 (investigator* or trainee* or researcher* or intern* or graduat* or prof* or facult* or lecturer* or fellow* or scientist* or academic*)).tw,kf.

12. ECR*.tw,kf.

13. (research adj3 (assistant* or associate* or coordinator*)).tw,kf.

14. (post adj3 universit*).tw,kf.

15. pre?tenur*.tw,kf.

16. newbie*.tw,kf.

17. (grad* adj3 (student* or education*)).tw,kf.

18. post?doc*.tw,kf.

19. post?grad*.tw,kf.

20. career development/

21. or/7-20

22. 6 and 21

23. (early adj3 career*).tw.

24. (research adj3 personnel*).tw.

25. researchers/

26. PhD.tw.

27. 23 or 24 or 25 or 26

28. 6 and 27

EBSCO CINAHL

#	Query
S27	S6 AND S26
S26	S22 OR S23 OR S24 OR S25
S25	PhD
S24	(MH "Research Personnel")
S23	(research N3 personnel)
S22	(early N3 career*)
S21	S6 AND S20
S20	S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19
S19	(MH "Education, Graduate+")
S18	(MH "Students, Graduate") OR (MH "Students, College")
S17	(postdoc* or post doc*) or (research N3 (assistant* or associate* or coordinator*))
S16	(postgrad* or post grad*)
S15	(grad* N3 (student* or education*))
S14	newbie* or ECR*
S13	(pretenur* or pre tenur*)
S12	(postunivers* or post univers*)
S11	((emerging* or emergent* or early stage or junior* or early career* or new or recent* or young or novice* or start*) N3 (investigator* or trainee* or researcher* or intern* or graduat* or prof* or facult* or lecturer*))
S10	new N3 career*
S9	(preintern* or pre intern*)

S8	entr* N2 level*
S7	early N2 career*
S6	S1 OR S2 OR S3 OR S4 OR S5
S5	metaanalys*
S4	meta analys*
S3	scoping N2 (review* or study or studies)
S2	systematic N2 (review* or study or studies)
S1	(MH "Literature Review")

Library and Information Science Source

#	Query
S12	S3 AND S11
S11	S8 OR S9 OR S10
S10	PhD
S9	(research N3 personnel)
S8	(early N3 career)
S7	S3 AND S6
S6	S4 OR S5
S5	(early N2 career*) OR (entry N2 level) OR ((preintern* or pre intern*)) OR (new* N3 career*) OR ((research N3 (assistant* or associate* or coordinator*))) OR ((pretenur* or pre tenur*)) OR ne ((grad* N3 (student* or education*))) OR ((postdoc* or post doc*)) OR post universit*
S4	((emerging* or emergent* or early stage or junior* or early career* or new or recent* or young o or start* or beginner* or newcomer* or newly qualified) N3 (investigator* or trainee* or research intern* or graduat* or prof* or facult* or lecturer* or fellow* or scientist* or academic*))
S3	S1 OR S2
S2	((scoping or systematic) N3 (review* or overview* or study or studies or analys*))
S1	(meta analys* or metaanalys*)

Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
TITLE			
Title	1	Identify the report as a scoping review.	
ABSTRACT			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	
METHODS			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
RESULTS			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	
DISCUSSION			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	
Limitations	20	Discuss the limitations of the scoping review process.	
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	
FUNDING			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	

JB1 = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.

* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.

† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).

‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JB1 guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.

§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

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