RESIDENT RESEARCH AND SCHOLARLY ACTIVITY

A PRIMER

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American College of Emergency Physicians®
ADVANCING EMERGENCY CARE

RESIDENT RESEARCH AND SCHOLARLY ACTIVITY — A PRIMER

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THIS BOOK WAS PRODUCED AS A SECTCION GRANT PROJECT OF THE AMERICAN COLLEGE OF EMERGENCY PHYSICIANS.

PUBLISHER'S NOTICE

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ABBREVIATIONS

AAEM/RSA — American Academy of Emergency Medicine Resident and Student Association

AAMC — Association of American Medical Colleges

ACEP — American College of Emergency Physicians

ACGME — Accreditation Council for Graduate Medical Education

ACOEP — American College of Osteopathic Emergency Physicians

ACOEP–RSO — American College of Osteopathic Emergency Physicians Resident Student Organization

ACP — American College of Physicians

AHA — American Heart Association

AHRQ — Agency for Healthcare Research and Quality

AMA — American Medical Association

AOA — American Osteopathic Association

APA — American Psychological Association

APSE — Article-based PubMed Search Engine

ARMED — Advanced Research Methodology Evaluation and Design

aRR — Adjusted RR

BATNA — Best Alternative to a Negotiated Agreement

CDC — Centers for Disease Control and Prevention

CDSR — Cochrane Database of Systematic Reviews

CLER — Clinical Learning Environment Review

CMR — Cochrane Methodology Register

CORD — Council of Emergency Medicine Residency Directors

CPC — Clinical Pathologic Conference

CRD — Centre for Reviews and Dissemination

CREST — Clinical Research on Emergency Services and Treatments

CTSA — Clinical and Translational Science Awards

DARE — Database of Abstracts of Reviews of Effects

DCFs — Data Collection Forms

DO — Doctor of Osteopathic Medicine

DOI — Digital Object Identifier

EBHI — Evidence-Based Healthcare Implementation Interest Group

EBM — Evidence-Based Medicine

ED — Emergency Department

EDTT — Emergency Department Throughput Time

EFIC — Exception From Informed Consent

EHR — Electronic Health Record

EM — Emergency Medicine

EMBRS — Emergency Medicine Basic Research Skills

EMF — Emergency Medicine Foundation

EMRA — Emergency Medicine Residents' Association

EMS — Emergency Medical Services

EPC — Evidence-based Practice Center Program

F.I.N.E.R. — Feasible, Interesting, Novel, Ethical, Relevant

FOAM — Free Open Access Medical Education

FOAMed — Free Open Access Medical Education

FOAM-EM — Free and Open Access Medicine–Emergency Medicine

GME — Graduate Medical Education

GRADE — Grading of Recommendations Assessment, Development and Evaluation

HIPAA — Health Insurance Portability and Accountability Act

HPR — Human Participant Research

HTA — Health Technology Assessment Database

ICC — Intraclass Correlation Coefficient

ICMJE — International Committee of Medical Journal Editors

ABBREVIATIONS *continued*

IHI — Institute for Healthcare Improvement

IRB — Institutional Review Board

ISAPs — Individualized Scholarly Activity Plans

MD — Doctor of Medicine (Allopathic)

MEPS — Medical Expenditure Panel Survey

MERC — Medical Education Research Certificate

MeSH® — Medical Subject Headings

MLA — Modern Language Association

MOOCs — Massive Open Online Courses

MSCR — Master of Science in Clinical Research

NAMCS — National Ambulatory Medical Care Survey

NCBI — National Center for Biotechnology Information

NEDS — Nationwide Emergency Department Sample

NFEM — National Foundation of Emergency Medicine

NHAMCS — National Hospital Ambulatory Medical Care Survey

NHLBI — National Heart, Lung, and Blood Institute

NHS EED — National Health Service Economic Evaluation Database

NIH — National Institutes of Health

OECR — Office of Emergency Care Research

OGME — Osteopathic Graduate Medical Education

OR — Odds Ratio

ORCID — Open Researcher and Contributor Identifier

PBLI — Practice-Based Learning and Improvement

PDSA — Plan-Do-Study-Act

PGY — Post-Graduate Year

PHI — Protected Health Information

PI — Principal Investigator

P.I.C.O.T.S. — Population/Patient, Intervention, Comparator, Outcomes, Timing, Setting/Study Design

PMC — PubMed Central®

PRISMA — Preferred Reporting Items for Systematic Reviews and Meta-Analyses

PROSPERO — International Prospective Register of Systematic Reviews

QI — Quality Improvement

RC — Research Coordinator

RCR — Retrospective Chart Review

RCT — Randomized Controlled Trial

RDIG — Research Directors' Interest Group

RLRSAP — Resident-Level Research or Scholarly Activity Project

RLS — Research Learning Series

RR — Risk Ratio

RRC — Residency Review Committee

RWJF — Robert Wood Johnson Foundation

SA — Scholarly Activity

SAEM — Society for Academic Emergency Medicine

SAEMF — Society for Academic Emergency Medicine Foundation

SAS — Single Accreditation System

SPSS — Statistical Package for Social Sciences

STEM — Society of Teachers of Emergency Medicine

UAEM — University Association for Emergency Medicine

UCLA — University of California at Los Angeles

WHO — World Health Organization

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PREFACE

Peter Rosen once lamented that, "emergency medicine has yet to define to anyone's satisfaction its research goals."[1] Although the speech from which this publication originated (originally delivered at the 5th annual Rocky Mountain regional conference on emergency medicine in January 1979) preceded recognition of emergency medicine as a distinct specialty by nine months, Rosen's observation remains relevant to modern emergency medicine (EM) researchers. Four decades later, acute care research remains under-represented in federal research funding, with only 0.05% of NIH training grants awarded to medical schools going to departments of emergency medicine.[2] As a specialty, EM is still struggling to carve out its niche within the medical research community.

Recognizing the need to produce capable EM researchers who can carry the field forward, residency programs have experimented with various models for engaging EM residents in scholarly activity. Although much has changed over the last four decades, many familiar obstacles remain. Modern residency directors are still challenged to find means to engage EM learners (including medical students and residents) in the scientific method considering the high clinical demands imposed upon EM physicians. As practitioners who pride themselves on being a 'jack of all trades,' EM clinician-researchers may be susceptible to a lack of focus on specific disease entities. Although a handful of EM-trained researchers have achieved great success in the arena of clinical research, many others struggle to find their niche. Despite our successes, the EM community is left with the question of how best to train novices in the field of EM to realize the specialty's goal of innovating and improving upon the care of emergency department patients.

Progress towards achieving the needed balance between clinical and academic commitments continues to be made, and remains a high priority for our specialty. Many EM residencies have made a concerted effort towards increasing their scholarly output, including investments of time and effort in resident research education. Unfortunately, very little guidance is currently available to help residency leaders and others interested in promoting resident scholarship to increase the degree to which EM learners can advance the field. The presented Primer is intended to service this need. The authors hope that the materials contained in this book will aid residency and research leadership in implementing the kind of scholarly activity that is needed to engage and inspire future generations of EM researchers.

The future of acute care research, and of the EM specialty, must necessarily be placed in the hands of today's learners. As the inheritors of Rosen's legacy, and that of his generation of EM pioneers, the authors of this Primer recognize the need to inspire the next generation of EM researchers in promoting and advancing our field. Despite limited resources, we must expand our footprint within the research community to ensure that acute care research remains a priority for federal and other third-party funders. This is a debt owed not only to our specialty's pioneers, but also to future EM researchers and our patients.

It is our earnest hope that this publication will meaningfully contribute to future advances in the field of emergency medicine by facilitating effective training for future generations of EM researchers. Towards this objective, we dedicate this book.

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SCHOLARLY ACTIVITY AND EMERGENCY MEDICINE: AN OVERVIEW

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ABSTRACT

When the foundations of emergency medicine (EM) were laid, the specialty's pioneers recognized the need for formal scholarship as both a gap and an opportunity. Since then, EM scholarship has evolved along with the means of disseminating information. Consensus surrounding what constitutes scholarly activity has changed as the regulatory environment moves training toward an increased focus on quality and patient safety. Technology continues to expand opportunities for scholarly activity. In the single accreditation system, programs previously regulated by the American College of Osteopathic Emergency Physicians (ACOEP) now have a definition of resident scholarly activity that has expanded beyond simple research. While EM has traditionally required faculty to meet the standard of peer-reviewed publications, recent changes to the Accreditation Council for Graduate Medical Education (ACGME) Common Program Requirements have redefined expectations for faculty and resident scholarly activity. This chapter outlines the history, rationale, and accreditation environment for research and scholarly activity in EM.

HISTORICAL CONTEXT FOR SCHOLARLY ACTIVITY AND RESEARCH IN EMERGENCY MEDICINE

When the American Medical Association (AMA) created an interest section for Emergency Medicine in 1972, one barrier to recognition as a specialty was the paucity of EM research.[1] An organized approach to developing EM researchers was noticeably absent in the early years of the specialty.[2] Early EM researchers were guided in their development by established researchers in other specialties, emerging from EM residency programs that encouraged resident scholarly work.[2] These residency graduates helped to develop and establish the specialty's research portfolio. Early programs were successful at providing mentorship and environments for scholarly activity and research, and were effective at identifying ways to overcome barriers,[3] recognizing that emergency physicians, "must be trained not only [to] practice the specialty, but also [to be] its proponents through any avenue of medical scientific communication."[4]

The first "Model Research Curriculum for Emergency Medicine" was published in 1992, establishing the foundations for the modern EM academic environment.[5] Research in EM has advanced considerably since then, including the establishment of an Office of Emergency Care Research (OECR) within the National Institutes of Health (NIH).[6] In the modern era, the value of and need for rigorous research and rapid dissemination of accurate information is greater than ever before, as evidenced by the COVID-19 pandemic. To meet this challenge, innovative approaches, including crowdsourcing, are being used.[7]

WHAT IS SCHOLARLY ACTIVITY AND RESEARCH?

Many EM residents question why they are expected to do research. Early in residency, the focus is placed on learning the basic skills of acute care delivery and integrating the first principle of medicine: Do no harm.[8] As EM residents master the clinical skills required of their specialty, questions arise about how to advance clinical care and improve population health. Those questions usually start with "why?" For example: Why do we use this assessment tool? Why do we use this medication? Why do we use this technique? These questions help to form the foundation for contemporary scholarly activity and research.

An early attempt to define best practices for scholarly activity was published by the Research Directors Interest Group of the Society for Academic Emergency Medicine (SAEM).[9] This consensus paper noted that a best practice scholarly activity, by definition, includes hypothesis generation, data collection, data analysis, and interpretation of results.[9] Recognizing the emergence of new types of scholarship, a second consensus group chose to consider implemented protocols, abstracts, and oral presentations as evidence of scholarship.[10] This paper also broadened the list of best practice projects to include critical appraisals, quality improvement (QI) projects, evidence-based guidelines, systematic reviews and book chapters. This recent focus on evidence-based medicine (EBM) stems from the recognition of the close relationship between EBM and research.[11] The difficulty in translating new knowledge research into evidence-based practice has been described and represents an entire area of scientific inquiry.[12,13]

The broad use of social media requires consideration and potential inclusion as evidence of scholarly activity. Recent commentary suggests that other types of work, including the development of curricula, should be considered scholarly activity, with individual residency program directors passing final judgment on what is defined as scholarly activity on a local level.[14]

ACCREDITATION CONSIDERATIONS

Research and scholarly activity can advance knowledge and improve patient care, while simultaneously meeting the requirements for graduate medical education accreditation as set forth by the ACGME in its *Common Program Requirements*.[15] This document notes that each program "may place a different emphasis on research."[15] Scholarship is defined broadly by the ACGME, requiring that each residency program must "demonstrate accomplishments in at least three domains" (Table 1).[15] Each specialty review committee may further specify both the output requirements of faculty and the definition of scholarly activity for residents. The Emergency Medicine Review Committee has specified that peer-reviewed publication is an outcome that will be measured for faculty.[16] Other measurable types of faculty output include "faculty participation in grand rounds, posters, workshops, quality improvement presentations, podium presentations, grant leadership, non-peer-reviewed print/electronic resources, articles or publications, book chapters, textbooks, webinars, service on professional committees, or serving as a journal reviewer, journal editorial board member, or editor."[16] The same document states that EM residents, "must participate in scholarship," but does not offer further details, definitions, or best practice models.[16] Ultimately, the stated intent of the ACGME is that, "the scholarly approach to patient care begins with curiosity, is grounded in the principles of EBM, expands the knowledge base through dissemination, and develops the habits of lifelong learning by encouraging residents to be scholarly teachers."[16] The seven "scholarly domains," as defined by the ACGME, are provided in Table 1.

TABLE 1.

The Seven ACGME-Defined Scholarly Domains[15]

1. Research in basic science, education, translational science, patient care, or population health
2. Peer-reviewed grants
3. Quality improvement and/or patient safety initiatives
4. Systematic reviews, meta-analysis, review articles, chapters in medical textbooks, or case reports
5. Creation of curricula, evaluation tools, didactic educational activities, or electronic educational materials
6. Contribution to professional committees, educational organizations, or editorial boards
7. Innovations in education

THE SINGLE ACCREDITATION SYSTEM

The recent transition to a single accreditation system for graduate medical education in the United States is expected to impact the continued development and requirements of EM scholarly activity and research. In the past, scholarly activity requirements were slightly different for osteopathic EM residency programs than for allopathic EM programs, and were defined by the American Osteopathic Association (AOA) and the American College of Osteopathic Emergency Physicians (ACOEP).[17] These guidelines suggest that residency programs must give residents the, "opportunity to develop an interest in and understanding of research," and later prescribes that residents must "participate in clinical research."[17] For faculty, scholarly activity includes both major and minor categories completed over a four-year period. The ACOEP scholarly activity faculty definitions and requirements are provided in Table 2.

TABLE 2.

ACOEP Scholarly Activity Faculty Definitions and Requirements[17]

6.3 Scholarly Activity: Each core faculty member shall demonstrate scholarly activity prior to and throughout the duration of their appointment. Scholarly activity is the academic pursuits that serves either the specialty or profession and/or involves creative, intellectual work that is peer-reviewed and publicly disseminated.

- 6.3.1 Scholarly activity shall occur within a four-year period. Acceptable activities may include a minimum of 2 major or 1 major and 2 minor scholarly activity within this time frame for each core faculty member. Other activities may be accepted on an individual basis at the discretion of the ACOEP Committee on Graduate Medical Education. Scholarly activities for each core faculty member shall be well documented, to include dates, locations, and details.

6.4 Major Scholarly Activities: Major scholarly activities may be defined as follows:

- 6.4.1 Serving as chair or vice chair of a national, regional, or state medical society committee.
- 6.4.2 Serving as an active member of a committee of a national, regional, or state medical association.
- 6.4.3 Publication of original research or review article in peer-reviewed medical or scientific journal, or chapter in medical textbook.
- 6.4.4 Receipt of grant funding for medical, educational, or service research.
- 6.4.5 Presentation or publication of case reports or clinical series at national, regional, or state professional and scientific society meetings and conferences.
- 6.4.6 Member of an editorial review board of a national, regional, or state peer-reviewed publication.
- 6.4.7 Participation in item writing or as an examiner for a national medical certification board.
- 6.4.8 Presentation at a national, regional or state CME meeting or seminar.

6.5 Minor Scholarly activities shall be defined as:

- 6.5.1 Research projects currently in progress. The study has been approved by IRB and data-collection actively occurring.
- 6.5.2 Preparation of grant funding request material for medical, educational or service research.
- 6.5.3 Visiting professorship (guest emergency medicine lecturer to peers or residents at an outside institution).
- 6.5.4 Item writing for the ACOEP Resident In-Service Examination.
- 6.5.5 Serve in the capacity as an active judge (or evaluator) at a national, regional or state academic meeting.
- 6.5.6 Publication of an article or chapter in a non-peer reviewed medical or scientific journal.

Faculty members have the additional responsibility to "encourage and support residents in scholarly activities and act as mentors for required research projects."[17] Similarly, scholarship for osteopathic EM residents is clearly defined:

> "The resident shall complete a research project during the course of the emergency medicine training program that will be sent to the ACOEP in the following manner. The resident shall submit an outline for the project by the end of the [Osteopathic Graduate Medical Education] OGME-2 training year, [submit] implementation and data collection methods and provide an interim report by the end of the [OGME-3] year, and a final product suitable for publication six months prior to the completion of the Osteopathic GME-4 year of residency. A permanent copy shall be retained in the resident's file at the institution. All research projects shall be approved by the program director."[17]

These clearly-delineated scholarly activity requirements remain relevant to optimizing scholarly activity and research for EM residents and faculty in the single accreditation system.

WHAT CAN SCHOLARLY ACTIVITY AND RESEARCH LOOK LIKE DURING RESIDENCY?

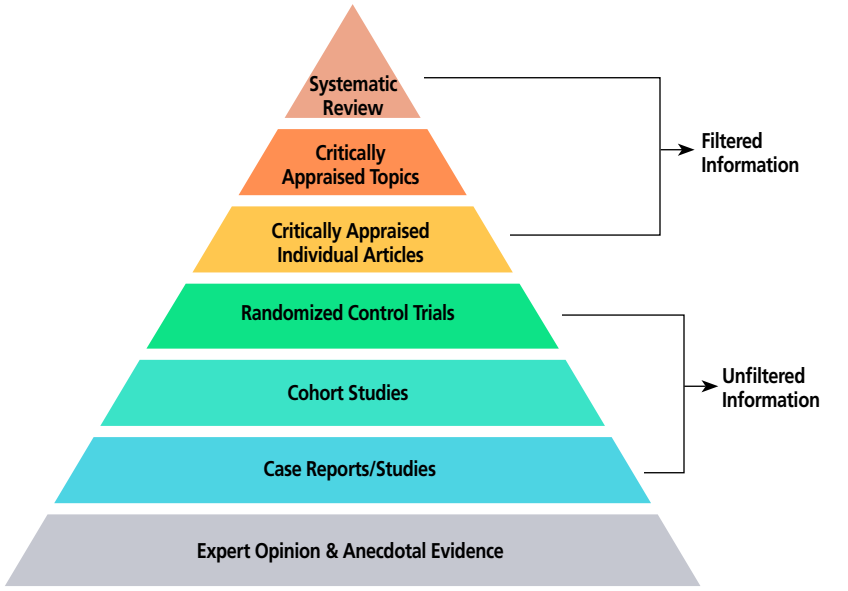
The ACGME scholarly productivity requirements for faculty and residents provide a roadmap to success. It has been shown that didactics paired with mentorship can increase resident scholarly output.[18] Some four-year EM residency programs offer embedded scholarly tracks into the curriculum, with a clear rationale.[19] The embedded curricula offer more intense academic exposure and include not just research experience but also advanced training, career guidance, mentorship, and preparation for an academic career.

Pioneering researchers' reflections on their academic journeys have suggested that mentorship and the pursuit of an advanced research degree were the cornerstones for achieving a successful research path.[2] Publication experience is the strongest predictor of an academic career among EM residents, outside of earning an advanced degree.[20] Emergency medicine also offers two- to three-year research fellowships for residents, allowing them to participate in a rigorous research path while working a reduced clinical schedule.[21] Retaining personnel to support resident scholarship at a departmental level has been demonstrated to have a significant impact on measurable scholarly output.[2,22]

Numerous types of research/scholarly projects are discussed in further detail elsewhere in this publication. The hierarchy of scientific evidence is often graphically represented as an evidence pyramid (Figure 1), with the lowest quality (i.e., least likely to represent 'truth in the universe') at the bottom, with increasing rigor and quality as the pyramid ascends.[23]

FIGURE 1.

The Hierarchy of Evidence[23]



Examples of low-quality evidence include expert opinion and case reports / series, where data are culled from a small number of patients in an uncontrolled, nonexperimental setting and thus heavily subject to bias and error. This type of work is important as it can generate data and hypotheses to inform future studies with greater methodologic rigor. Observational studies based upon a sound hypothesis that follow patients and assess for prespecified outcomes represent an increased quality of evidence. At the top of the pyramid are systemic reviews and meta-analyses, which combine and analyze data from study designs lower on the pyramid. These aggregated works have the potential to better detect so-called 'truth in the universe,' with the *caveat* that if the included studies were of low quality, the combined analysis will also be of limited quality (i.e., garbage in, garbage out).

Often logistical and practical realities, including the time and resources required to conceive and perform large and complex studies such as randomized controlled trials, constrain the types of resident-initiated scholarly projects that can be completed during residency. All scholarly projects on the evidence pyramid can provide an enriched educational experience for residents, while benefiting patients and improving clinical care.

Quality improvement (QI) projects offer another venue for scholarly activity. The ACGME requires that faculty must possess and be assessed on their QI and patient safety skills.[16] Residents should gain competence in QI methodology and as noted in Table 1, QI is an identified area for programmatic scholarly focus. The ACGME routinely assesses compliance with QI and patient safety requirements through Clinical Learning Environment Review (CLER) visits.[24] As such, developing a systematic approach to universal trainee involvement in QI and patient safety is imperative.

How the QI project is conducted is very important.[25] Ensuring a systematic approach to the QI project, both the operational imperative for the project and the potential for scholarship can be accomplished simultaneously. Such a project may benefit patients and can teach fundamentals of research design (e.g., how to perform a chart review study) and analysis, or how to design an effective educational intervention. Additional benefits include presenting results in abstract format or in some cases, as a full manuscript.[26] Participation in QI projects is valuable to medical students, and likely provides similar benefit to EM residents.[27] However, QI projects are not limited to clinical care topics and can include diverse subject matter such as patient experience or satisfaction, resident education, or physician-nursing communication and interactions. The feasibility of involving medical students on emergency medicine QI projects has also been demonstrated.[26]

CREATING A CULTURE OF INQUIRY

There are multiple opportunities for EM residency programs and departments to develop an organized approach to scholarly activity and create a culture of inquiry.[28] An alignment of priorities, guided by the adage that, "if it is worth doing, it is worth measuring. If it is worth measuring, it is worth disseminating," can be a first step. Departmental leadership should ask, "Is this project one which could lead to dissemination?"

Application of the F.I.N.E.R. criteria (Table 3) may help departmental leadership to determine which projects deserve allocation of scarce resources.[29]

TABLE 3.

The F.I.N.E.R. Criteria

- **Feasible (F):** Feasibility denotes the ability of the investigator and institution to successfully complete the study. The researcher must have access to an appropriate number of potential study participants, as well as both the necessary financial and personnel resources. Further, the personnel involved must possess the skills needed to conduct the study.
- **Interesting (I)**: The anticipated knowledge obtained in the study must be of interest to others. The "so what?" test is often applied here. If a colleague says, "so what?" when the goal of the study is explained, the project is unlikely to be of interest external to the research team.
- **Novel (N):** The answer to the research question being posed should be different from what is already known. The project should be designed to be able create new knowledge or contradict what is already known. The new knowledge generated may provide confirmation, but ideally will extend our understanding to new situations or populations.
- **Ethical (E):** All research should follow established good clinical practice guidelines. Investigation involving humans should respect their physical privacy and the confidentiality of the data they generate. Local Institutional Review Boards interpret and apply Federal Common Rules to ensure the project is conforming to best possible practices.
- **Relevant (R):** While the answer to a question may be interesting, the answer should also be able to be utilized to improve the delivery of care. The term relevant is often used similarly to generalizability. The ultimate expression of both terms is that of external validity, or how the information will be applied by others.

Application of the F.I.N.E.R. criteria can yield several benefits for both the department and the resident. This process begins with a review of the literature, providing leadership with a current evidence basis for the potential project.[30] Active discussion of the project's potential will bring focus to its goals and identify the measurable outcomes to determine its likely success or failure. Following this approach is consistent with a rigorous application of the Plan-Do-Study-Act (PDSA) model disseminated by the Institute for Healthcare Improvement (IHI).[31] This model may be taken one step further with the application of implementation science, where improvement is sought through a systematic approach.[32] Departmental leadership can, by embracing an organized approach, support the **triple aim of improved patient health, improved patient experience, and decreased cost, while the residency realizes a fourth aim — scholarly activity with measurable output**.

Residency leaders can apply the same type of organized approach throughout their educational training model. The Clinical Pathologic Conference (CPC) involves the resident presentation of a case report followed by an organized presentation by academic faculty, and is done both regionally and nationally in EM.[33-35] One residency program described a process wherein an organized approach to CPC led to awards for cases and discussants, documentation of advanced (so-called "Level 5") milestones for senior residents, faculty development, and increase publications in the form of case reports.[36] Offering a research didactic curriculum paired with an organized research rotation has resulted in significant increases in academic output as measured by publications.[37] Journal Club, an ACGME-required educational activity,[16] can qualify as scholarly activity if approached in an organized fashion. It has been demonstrated that this educational activity can lead to published letters to the editor.[38,39] The resident-as-teacher model has also been described in textbooks.[40] The application of a curricula on the topic has led to publication.[41] Once EM residents have teaching responsibilities, the efficacy of their teaching can be measured, both to provide them feedback and to produce further scholarly activity.[42] Even the feedback that residencies provide to residents can be studied and published. The Association of American Medical Colleges (AAMC) has published, "Research in Medical Education," which may be a valuable resource for the implementation of such projects.[43] Whether an organized approach is applied to the operations of the department or the education provided by the residency or clerkship, creating a culture of inquiry can lead to both internal improvement and measurable scholarly activity.

THE BENEFITS OF SCHOLARLY ACTIVITY

The development of a culture of inquiry and scholarly activity offers myriad benefits for residents, residency programs, faculty, and departments of EM. An alternative to resident-initiated projects is a systematic approach to research and scholarly activity where residents are meaningfully involved in pre-existing faculty projects. A faculty with broad research interests allows residents to seek mentorship in an area or niche of EM where their passion lies. There are benefits to alignment: faculty members must complete scholarly activity for the residency program to maintain accreditation while residents must meaningfully participate in scholarly activity to complete residency training requirements.

For residents, such a program offers the benefit of increased resident-faculty interaction outside of the clinical arena. One-on-one time affords residents opportunities to develop and hone overall research-related knowledge, explore career niches through specific scholarly interests, and engage in mentorship relationships — thereby helping to overcome some recognized barriers to successful resident participation in scholarly activity. These interactions can also help residents overcome barriers to scholarly success.[44-46]

For example, resident participation with manuscript or abstract writing improves critical appraisal of the medical literature, as residents learn how to interpret study findings and place them within the context of existing literature. Residents learn to organize their thoughts using the **P.I.C.O.T.S. (Patient, Intervention, Comparison, Outcome, Time Setting) Model**.[47] Using this model, they can search for answers, appraise what they find, and try to apply their new knowledge to the next patient.[48] At some point, most residents will begin to share what they have learned. Alternatively, what they find may not answer their clinical question. The ambitious learner might wish to apply what they have learned not only to their next patient, but to all the patients in their emergency department (ED). These are but a few examples of how residency education grows into scholarship. A close working relationship between residents and faculty on one or more projects can function as a "collaborative peer work group, a useful model from both educational and productivity standpoints.[49] The establishment of clear expectations at the outset of a project is critical to maximizing the benefits of this resident-faculty collaboration. A detailed plan (the more specific the better) of what is needed and when will help keep everyone on track. While flexibility is important, so is accountability; when agreed upon goals are not met, this should be discussed honestly and directly. Faculty members should help create workable solutions but expect that repeated instances of missed deadlines will result in discontinuation of their project involvement. These relationships require access to faculty time and other departmental and institutional resources. Potential changes to the ACGME Common Program Requirements could impact the faculty-protected time available to engage in such mentoring activities.[15,50]

For faculty members, an environment of scholarly activity will help build the foundation for their academic career. Initial appointment at assistant professor level (rather than clinical instructor or volunteer faculty), with benefits such as protected academic time, is more likely for those with a track record of scholarly productivity, especially in research.[51] Faculty promotion and tenure generally requires productivity in three areas: scholarship, education, and service. Additionally, significant professional satisfaction and development can result from mentoring relationships with residents and students.[52]

CONCLUSIONS

Scholarly activity, research, and publication are essential for EM departments aspiring to foster an environment providing residents with the skills needed for academic success.[53] Scholarly output is integral to academic advancement for residents in determination of their initial level of faculty appointment, and for the promotion and tenure of faculty. For residents, demonstration of academic / research interests via early research output, including presentations at local or state meetings, can increase competitiveness for academic jobs. Encouraging research requires the creation of a positive attitude towards scholarship, including, "an organizational culture that values research and nourishes evidence-based medicine and practice."[28]

➲ *KEY CONCEPTS*

- The current EM resident scholarly activity requirement is the result of a confluence of the evolution of the specialty and current accreditation requirements for Graduate Medical Education (GME).
- Recent consensus has broadened the definition of scholarly activity best practices beyond research to include a greater variety of scholarship types, including work on quality improvement and evidence-based medicine.
- Creating a local "culture of inquiry" allows the opportunity to find scholarship in the work for which the resident and local programs have passion.

- Participation in scholarly activity has the potential to provide the resident with measurable skills that can positively impact their future career.
- The future of EM resident scholarly activity may be influenced by the changing requirements and resources of EM faculty.

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DEFINING AND STRUCTURING A RESIDENT-LEVEL RESEARCH AND SCHOLARLY ACTIVITY PROGRAM

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ABSTRACT

A successful resident research program provides residents with the skills to critically evaluate the medical literature, apply new knowledge to improve patient care, and disseminate new information to others. At its foundation, a research program should possess a research curriculum teaching core research methodology and concepts, including mentoring activities provided by content experts that facilitate project development and completion. This chapter suggests required elements for resident research, including methods by which residency programs may fulfill these requirements.

INTRODUCTION

Residency programs play an important role in creating a learning environment that can foster scientific inquiry and lifelong learning. The successful emergency medicine (EM) resident research program provides residents with basic skills in reading and appraising the scientific literature, applying new knowledge to the improvement of patient care, and disseminating new information to other learners. In this chapter, we briefly review the competencies and objectives required by EM governing organizations and present concepts that may be used to develop or improve upon resident research curricula.

THE ACCREDITATION COUNCIL FOR GRADUATE MEDICAL EDUCATION

The ACGME requires residency programs to promote a scholarly approach to patient care, in which residents learn how to think critically, evaluate the literature, assimilate new knowledge, and practice lifelong learning and teaching.[1] Programs should recruit and retain education leaders and faculty who participate in scholarship and teaching, allocate resources to facilitate resident and faculty involvement in scholarly activities, and demonstrate evidence for scholarship.[1,2] The goals for a resident research program are summarized according to the endorsing organization in Table 1.

TABLE 1.

Resident Research Program Goals and Objectives

Goals for Resident Research Program	ACGME[3]	CORD[4]	SAEM RDIG and EBHIG[5]
Teach residents lifelong learning skills (i.e., search strategies and critical appraisal)	X	X	X
Instruct residents in the process of scientific inquiry: • Methods of hypothesis development and testing • Study design and methodology • Information gathering or data collection • Interpretation of results or statement of conclusion	X	X	X
Teach resident how to formulate a question, search for the answer, and evaluate the strength of the answer		X	X
Expose residents to the mechanics of research		X	X
Learn various methods of obtaining consent for biomedical research		X	
Understand basic statistical methods		X	
Understand data analysis and critical/ analytical thinking	X	X	X
Understand the ramifications of the ethical considerations of research		X	
Learn the skills to develop a manuscript that is acceptable for publication in a peer review journal		X	
Understand grants and the funding of research		X	

NOTES: CORD = Council of Residency Directors in Emergency Medicine; EBHIG = Evidence-Based Healthcare Implementation Interest Group; RDIG = Research Directors Interest Group

Scholarly activities may reflect a program's mission, as well as the community it serves, and include projects related to quality improvement, teaching and education, population health, or traditional biomedical research (Table 2). Other evidence of scholarship includes dissemination of scholarly activity within and external to the program through public speaking and writing.

TABLE 2.

Endpoints of Scholarly Projects

Types of Scholarly Activity	ACGME*,[3]	CORD[4]	SAEM RDIG and EBHIG[5]
Research in basic science, education, translational science, patient care, population health	X	n/a	X
Published, original research paper	X	n/a	X
A paper of publishable quality		n/a	X
Grants	X	n/a	
Quality improvement or patient safety initiatives	X	n/a	X
Systematic reviews, meta-analyses, book chapters	X	n/a	X
Case reports	X	n/a	
Developing an evidence-based practice guideline		n/a	X
Creation of education materials and evaluation tools	X	n/a	
Contributions to professional or education organizations, editorial boards	X	n/a	
Education innovations or curricula	X	n/a	
Electronic educational materials	X	n/a	
Developed and implemented research protocol		n/a	X
Research abstract submission	X	n/a	X

NOTES: CORD = Council of Residency Directors in Emergency Medicine; EBHIG = Evidence-Based Healthcare Implementation Interest Group; RDIG = Research Directors Interest Group

*The ACGME requires programs to demonstrate evidence in three domains.

There are no ACGME milestones for EM specifically relating to resident research and scholarship. Milestone 19, also known as "practice-based learning and improvement (PBLI)," touches on several aspects of resident research and education.[3] Specifically, in the level 1 competency, the resident should be able to describe basic principles of evidence-based medicine. The level 3 competency states that the resident should demonstrate the ability to critically appraise scientific literature and apply evidence-based medicine to improve one's individual performance. To reach a level 4 competency, residents must be able to apply performance improvement methodologies, demonstrate evidence-based clinical practice, and participate in a process improvement plan, whereas to reach a level 5 competency, residents must be able to teach evidence-based medicine.

THE COUNCIL OF RESIDENCY DIRECTORS IN EMERGENCY MEDICINE

Recently, the Council of Residency Directors in Emergency Medicine (CORD) collaborated with experts from six national organizations to update the *Model of the Clinical Practice of Emergency Medicine*, a curriculum of core EM topics including content related to Practice-Based Learning and Improvement (PBLI) (Table 1).[6] The research topics presented in the model curriculum are very broad, so for programs seeking to refine or develop their own curriculum, CORD also created a list of 19 objectives that meet those goals.[4] These objectives are prioritized to indicate the depth and breadth of knowledge required of an EM specialist. We would like to highlight several objectives that appear to be most critical for EM trainees. Most importantly, all EM physicians should be able to demonstrate an understanding of the differences between clinical and statistical significance. Other important skills include understanding the advantages and disadvantages of different study designs, understanding the difference between dependent and independent variables, and understanding basic statistics (e.g., sensitivity, specificity, positive predictive value, and negative predictive value). We feel these specific topics should be foundational knowledge for EM residents.

THE SOCIETY FOR ACADEMIC EMERGENCY MEDICINE

In 2018, the Society for Academic Emergency Medicine (SAEM) Research Directors Interest Group (RDIG) and Evidence-Based Healthcare Implementation (EBHI) Interest Group jointly published a consensus statement defining and describing EM resident scholarly activity.[7] By expert consensus, they developed a best practices guideline that describes the goals, objectives, and acceptable endpoints of scholarly work (Table 1 and Table 2). The consensus document was approved by the boards of SAEM, American College of Emergency Physicians (ACEP), and ACOEP. However, several organizations opposed this document, including Emergency Medicine Residents' Association (EMRA), CORD, American College of Osteopathic Emergency Physicians Resident Student Organization (ACOEP-RSO), and American Academy of Emergency Medicine Resident and Student Association (AAEM/RSA), and supported a broader definition of scholarly activities.[8]

STRUCTURING A RESIDENT RESEARCH PROGRAM

A comprehensive resident research program consists of two primary components: a research curriculum and scholarly work oversight and mentorship.

Research Curriculum

The primary goals of a research curriculum are to teach both biomedical research concepts and a structured approach to critical appraisal of the literature. Specific goals and objectives for a research curriculum were previously described.[2-4,6-7] Most programs teach research topics during their weekly morning didactic conferences, similar to other core EM content. Other formats include journal club activities, during which residents and faculty discuss published articles and discussions of quality improvement/patient safety principles and activities.

Core content in research and quality improvement does not need to be created de novo. Online resources (including some free and open access) appeal to all types of learners and may be incorporated into established curricula in the form of asynchronous or individualized learning, particularly for programs without a large cohort of research or

quality improvement faculty to provide formal teaching. In addition, members of the SAEM Education Committee have created a number of podcasts and modules available to society members to use in residency education.

For residents interested in taking a deeper dive into research methodology to develop a research project, many programs offer opportunities to incorporate a research elective into their rotation schedule. Online courses or modules may be used for asynchronous learning or supplemental material to provide some curricular structure to the elective.

Another way to provide more intense research training is a longitudinal curriculum focused on a specific area of study, led by faculty experts in those areas. Often referred to as scholarly tracks, mini-fellowships, or areas of concentration, these may be more easily offered and implemented by programs with a diverse cohort of research faculty. Program experiences with implementing scholarly tracks were previously described by Regan et al.[9] For departments with few research-focused faculty, we recommend looking externally to other departments for resident mentorship and research opportunities. A few programs require all residents to choose an academic track and use time during weekly conferences for small group activities. Specific activities might include a discussion of research methodology, a review of articles related to the content area, or assistance with individual project development. Examples of specific tracks for which programs may already have faculty expertise include emergency medical services, medical education, global health, ultrasound, critical care, and toxicology. One added benefit of cohorting busy residents based on interest is that they can work together on projects to fulfill their scholarly activity requirement.

Scholarly Work Oversight and Mentorship

Oversight of scholarly work in most EM residency programs is provided primarily by the program director and/or assistant and associate program directors. Some programs have research directors, quality improvement directors, department chairs, or medical directors involved in overseeing resident projects, depending on the type of scholarly work. Interestingly, the involvement of research directors in resident scholarship has evolved over the years. In the 1999 consensus statement developed by the SAEM Research Directors Interest Group, the authors noted that research directors were often primarily responsible for overseeing residents' scholarly work.[5] In our current state, however, oversight has shifted primarily to education leadership, sometimes with other faculty involvement.

In our education community survey, we found several innovations being used by programs to oversee resident scholarship and increase residents' scholarly productivity. In one model, an assistant or associate residency director is assigned to oversee resident scholarship, serving a dual role as a *residency research director*. The faculty member assigned to this role understands the resident scholarly activity educational objectives and should be familiar with the academic interests of other faculty such that they can more easily match residents with similar interests. Essential responsibilities include working with faculty to involve a resident on every research project, creating and updating a master spreadsheet of research projects to include the names of faculty lead(s) and resident(s) involved, and reminding faculty and residents about journal and conference presentation submission deadlines. The benefits of having a residency research director who also is part of the education leadership is to keep residents on track to complete this requirement, encourage residents to disseminate their work, and to assist collaborating faculty in the promotions process.

Another innovative model is a *resident research oversight committee*. This committee is often composed of education leadership, the research director, and other faculty advisors who are actively engaged in scholarly work or projects (i.e., quality improvement director). Oversight by a committee, as opposed to any one individual, distributes the administrative responsibility and workload to multiple faculty members who can offer different perspectives and expertise, and who may also benefit personally from the resident scholarship. The responsibilities of committee members are to meet regularly with each resident to help guide, develop, troubleshoot, and complete their scholarly projects. On a program level, there may not necessarily be a need to provide additional protected effort or compensation to committee members.

Faculty support and engagement are critically important for a resident research program to be successful. Alignment of resident and faculty academic interests provides additional motivation to complete and disseminate the resident's scholarly work. Most residency programs reported a mentorship structure in which each resident works with a faculty mentor and often participates in a faculty project to satisfy the scholarly work requirement. A program or department can support this effort by creating and maintaining an easily accessible living document or platform to showcase faculty research interests and ongoing research projects. Ideally, this document would have details about short- and long-term project needs so that residents can assess the amount of time they are able commit to doing the work and enable multiple residents to work on different portions of the same project. At most programs, residents learn about ongoing faculty scholarly work through word of mouth, weekly residency conferences, or emails. At the time of writing this chapter during the SARS-CoV-2 pandemic, the academic medicine community has switched to remote working and learning because most nonclinical work has moved to virtual platforms. Developing and maintaining online platforms to communicate important information enables residents and faculty to access this information remotely.

Project Selection

Defining what counts as a scholarly activity can be challenging because the ACGME categories are broad and no consensus is provided from national EM organizations.[2,7,8] Readers are encourage to read *Chapter 3* for more details on this topic.

Institutional Support

To encourage dissemination of scholarly work, many programs support their residents' travel to regional or national meetings to present their scholarly work using departmental or institutional funds. An added benefit of sending residents to conferences is they may also comprise the team representing their program in EMRA activities, such as SIMWars, or the Academy of Emergency Ultrasound's Sonogames, held during the annual SAEM conference since they will already have been excused from clinical responsibilities. Some institutions offer statistical support, summer research scholarships to help medical students with research activities, and grants for GME or medical staff activities for which residents and faculty may apply. Under-resourced programs might encourage residents and faculty to join multi-institutional research collaboratives (focused on various content areas) through SAEM and ACEP.

While not feasible as a steady funding stream, alumni networks can be tapped for additional support. Some ways to keep alumni connected to the program include sending departmental newsletters, inviting alumni to departmental socials at regional or national conferences, and hosting fundraisers for faculty and local alumni. A fun way to raise money is to set up an auction for goods and services that leverage the diverse nonmedical skills of the EM community, like a beer-brewing session, homemade dinner, or a boat excursion.

A nontraditional form of institutional support is through quality improvement initiatives. Some institutions offer pay-for-performance programs for residents to participate in quality improvement projects.[10] Residents may propose, implement, and complete improvement projects over the course of the academic year. If they meet their target, they receive a small stipend at the end of the year. Participation in improvement initiatives can lead to publications that can aid in faculty promotion.[10,11]

Challenges to Implementing a Successful Program

The primary barriers to structuring and implementing a successful resident research program are related to people, time, and money — regardless of whether programs are university- or community-based. Faculty members with a broad range of interests and expertise are needed to supervise and mentor residents on projects and educate residents in research methodology. Community-based residency programs or programs without a research director or cohort of research physicians may need to partner with another department or division within the institution, using the national network of EM residency programs or online resources to help facilitate resident research and scholarly output. Financial resources are needed to support faculty research time, purchase project materials, fund research assistants and data analysts, and facilitate meeting attendance.

CONCLUSIONS

In this manuscript, we have presented several ways to structure a research program with limited resources. Faculty, even those without extensive research experience, can use a variety of free online resources to provide educational content for a research program, including those curated by CORD or SAEM. We recommend that departments form a faculty committee to help distribute the work of providing oversight and mentorship for resident projects, and include involvement in this committee as a teaching / administrative requirement for core faculty.

In addition, we would like to highlight the importance of partnering with the academic community outside the department, such as a local university hospital (which may have library or statistical resources, and/or medical students who can be research assistants) or an interest group or committee through one of our national organizations to collaborate on multi-institutional projects. Some community-based health systems have found ways to harness big data to answer clinical research questions. A great example of this innovation is Clinical Research on Emergency Services and Treatments (CREST), a collaborative research network for emergency research at Kaiser Permanente. Finally, it is easy to forget that the resident research requirement includes more than traditional biomedical research. Residents from programs without an extensive research infrastructure may still be able to satisfy this requirement through quality improvement initiatives, process improvements, case reports, case images, or educational curricula.

➲ *KEY CONCEPTS*

- A resident research program consists of a research curriculum and a process for scholarship oversight and mentorship.
- Program administrators can access online curricula through SAEM and CORD to supplement their own research curriculum.
- Financial support through research or travel grants encourages the dissemination of scholarly work, which can also promote faculty advancement.

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TYPES OF SCHOLARLY ACTIVITY

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ABSTRACT

Scholarly activity is a required part of EM training in the U.S. In the most traditional sense, scholarly activity is the intellectually rigorous pursuit of discovery that extends one's knowledge base and can be documented, validated, and shared with others. However, definitions of "scholarly activity" are diverse and historically lack consistent interpretation. The rise of social media and Free Open Access Medical Education (FOAM) has challenged traditional interpretations of scholarly activity. This chapter provides: (1) an objective means of identifying scholarly activity; (2) a descriptive review of traditional and nontraditional forms of scholarly activity; and (3) practical ways in which programs, faculty, and residents can use these resources to meet Accreditation Council for Graduate Medical Education (ACGME) common program requirements.

INTRODUCTION

The ACGME requires both EM residents and core faculty to engage in scholarly activity (SA).[1] This requirement is applicable to all medical specialties.[1,2] Traditionally, scholarly activity has been viewed as the intellectually rigorous pursuit of information that extends one's knowledge base and can be documented, validated, and shared with others.[1,3,4] However, definitions vary and even within any definition there is inconsistent interpretation.[1,3,5] Further, what meets the requirements of scholarly activity, according to the ACGME, differ for EM residents and core faculty physicians.[1]

This situation is further complicated by: (1) the recent transition to a single accreditation system (SAS) for both allopathic and osteopathic EM residency training programs under the ACGME; and (2) recently updated program requirements that resulted in more inclusive, less structured, definitions of scholarly activity requirements.[1,2] The new ACGME guidelines on acceptable examples of scholarly activity for EM residents do not account for, nor offer thoughts on, the growing number of possibilities present in academic EM. This includes nontraditional forms of education that utilize social media or stem from the FOAM movement.[6] Given SAS, there is a need for EM residents and residency training programs to better understand the ways to meet ACGME requirements. Further, given the expansion of nontraditional forms of scholarly activity, there is a need for improved clarity on the different types of SA. This chapter focuses on these issues, as summarized in the key concepts below. The chapter also provides a descriptive review of types of SA (both traditional and nontraditional) and describes a feasible means for EM residents, core faculty, and residency training programs to meet and track ACGME common program requirements through individual scholarly activity plans (ISAP).

IS SCHOLARLY ACTIVITY IMPORTANT FOR ALL EM RESIDENTS?

Previous studies suggest that resident physicians who engage in scholarly activity are more likely to pursue an academic career.[5] For EM residents with career interests in academic EM, or those with a more specific interest in research, this comes as no surprise. However, even those without plans to pursue an academic career can benefit from scholarly activity. [5] Exposure to scholarly activity in residency training can increase the ability to practice evidence-based medicine and result in enhanced analytical and critical thinking skills. [5] The ACGME recognizes the value of scholarly activity for all learners. In the most recent version of program requirements for EM, the ACGME reiterates its requirement for EM residency training programs to demonstrate scholarly activity and create an environment that fosters participation in, and demonstration of, scholarly activities.

Programs facilitating EM resident engagement in scholarly activity do not necessarily need to be focused on creating a cadre of academic scientists. They should instead center upon providing all learners, from the EM resident with career aspirations in full-time clinical EM to the physician scientist dedicated to a career in basic science, an opportunity to expand their knowledge base, advance their analytic skill sets, and develop both clinical and nonclinical skills. Exposure to scholarly activity provides learners with a toolkit for evidence-based practice. It has value to every EM resident in their role as a life-long learner.

DEFINING SCHOLARLY ACTIVITY

At present, no clear definition of EM resident 'scholarly activity' has been provided by the ACGME.[1,2] There is also no uniformly-accepted way to assess scholarly activity for EM residents.[7] This is an issue further complicated by the ACGME's recent transition to a more broad, inclusive, definition of scholarly activity for both EM residents and core faculty.[1] The most recent version simply states that, "residents must participate in scholarship."[1] Although definitions of (and requirements for) core EM faculty scholarly activity are clearer, they have also seen an overall change in terminology with the most recent ACGME guidelines. In addition to demonstrating dissemination of scholarly activity, the ACGME requires faculty to demonstrate accomplishments in at least three of seven core domains, as reported in Table 1.

TABLE 1.

ACGME Faculty Scholarly Requirement Core Domains[1]

- Research in basic science, education, translational science, patient care, or population health
- Peer-reviewed grants
- Quality improvement and/or patient safety initiatives
- Systematic reviews, meta-analyses, review articles, chapters in medical textbooks, or case reports
- Creation of curricula, evaluation tools, didactic educational activities, or electronic educational materials
- Contribution to professional committees, educational organizations, or editorial boards
- Innovations in education

Scholarly activity (or scholarship) is often considered synonymous to "research," which many academicians equate to the process of authoring and publishing a peer-reviewed manuscript.[3] Although authoring a manuscript does capture what many consider to be the most basic form of scholarly activity, it is not the only feasible or acceptable way to engage in scholarly activity.[3] Nontraditional forms of scholarly activity, including those incorporating online platforms as spearheaded by social media and the FOAM movement,[6] have gained increasing traction within academic EM.

Although there is no clear consensus on the definition of scholarly activity (either by the ACGME or among those within academic medicine at large), several frameworks exist that can be used to evaluate individual activities. The two most prominent of these frameworks are Boyer's model[3] and Glassick's Criteria.[4]

Boyer's model of scholarship is an inclusive framework aimed at rethinking what it means to be a scholar and an attempt to view scholarship as more than research. Boyer's model advocates for the expansion of traditional definitions of research and scholarly activity.[3] It identifies four separate, albeit overlapping, types of scholarship: *discovery*, *integration*, *application*, and *teaching* (Table 2). Although an ideal activity should have components of all four types of scholarship, this is not a requirement. All scholarship is considered equally important, and can be considered acceptable if one element of scholarship is present. In support of this framework, the ACGME includes these four elements in Section IV of its definition of scholarship.[1]

TABLE 2.

Boyer's Model of Scholarship[3]

- **Discovery:** Advancement of knowledge
- **Integration**: Synthesizing and make connections; fitting one's own work into the work of others
- **Application:** Application of knowledge
- **Teaching:** Dissemination of knowledge

Glassick's criteria constitute an elaboration on Boyer's model.[3] Although Boyer's model set the stage for a more inclusive definition of scholarly activity, it also created the need for a universal set of standards and criteria capable of evaluating each of the four types.[4] How could faculty and institutions determine if work in domains other than discovery (i.e., research) could appropriately be classified as scholarship? To identify the "common dimensions of scholarship" and best create a list of criteria that could be useful to academicians independent of background, Glassick, Huber, and Maeroff reviewed hiring and promotions practices from colleges and universities and engaged key stakeholders from granting agencies and editors and directors of scholarly journals and university presses.[3,4] Although this exhaustive process identified certain features that varied depending on the background of the academician, the group also identified a set of obvious commonalities that lie in the process of scholarship itself.[4] These common qualitative standards found to be shared among all types of scholarship (e.g., discovery, integration, application, and teaching) were: *clear goals, adequate preparation, appropriate methods, significant results, effective presentation, and reflective critique*.[4]

In summary, Boyer proposed a model that successfully expanded upon what can and should be classified as scholarly activity. In the setting of a more inclusive definition of scholarly activity, Glassick's criteria were a necessary addition to Boyer's original model. Glassick's criteria provide a structural framework to help determine whether an activity can be classified as scholarly activity. Technology has advanced the way in which learners engage in scholarly activity and the way in which information is disseminated. Although, the definition of scholarly activity has continued to evolve, these frameworks continue to be important. Not all work is scholarly activity, although activities that fit within these frameworks probably are.

COMMON TYPES OF SCHOLARLY ACTIVITY

Prior versions of the ACGME requirements defined acceptable forms of scholarly activity as: peer reviewed and non-peer reviewed submissions, textbooks, textbook chapters, conference presentations, and participation in research.[1] At present, core EM faculty requirements also include presentations, committee leadership, editorial work, and receiving grants (Table 1). The most basic forms of acceptable scholarly activity have traditionally included: preparation of a manuscript, authorship of a textbook chapter, and presentation of data at a national meeting.[1,3] However, the ubiquity of online platforms, social media, and the FOAM movement have led to new avenues via which both EM residents and faculty can create and contribute educational material as well as disseminate scholarly activity. Independent of platform or media type, proponents of FOAM cite decreased knowledge translation time and open access of material as characteristics that contribute to the widespread adaptability of practice among the current generation of learners. A descriptive review of traditional and nontraditional forms of scholarly activity is presented in Table 3.

TABLE 3.

Examples of Traditional and Nontraditional Forms of Scholarly Activity

(Adapted from North Carolina State University's *Examples of Scholarly Activity*)[8]

Abstract	Exhibition	Research Presentation
Book Chapter	Extension publication	Software application
Book review	Focus group	Software program
Case report/study	Foreword	Translation
Commentary	Interview/appearance • TV • Radio • Online	Technical report
Conference presentation • Applied research/ extension • Conference paper • Conference proceeding • Oral presentation • Poster presentation	Invention disclosure	Team meetings
Documentary	Magazine article	Web page
Editorial	Manual	White paper
Electronic publication • Twitter • Tweetorial • YouTube • Podcast • Graphic images • Blog • Vlog • Webinar	Manuscript	Workshop
	Patent	
	Performance/show	
	Proceeding	
	Professional licenses	
	Public lecture/seminar	
	QI/performance improvement	

PITFALLS AND PROMISES OF A MORE INCLUSIVE DEFINITION FOR SCHOLARLY ACTIVITY

As stated previously, there is currently no single agreed-upon definition for scholarly activity as it relates to EM residency requirements. This ambiguity provides EM residency training programs with a certain degree of freedom in interpreting the ACGME scholarly activity requirements.[9] Different programs may approach these requirements in different ways. With the emergence of social media and FOAM, nontraditional forms of scholarly activity are becoming more commonly accepted and more frequently pursued. Characteristics of nontraditional activities may overlap significantly with those of more traditional forms, although nontraditional activities may be more likely to contribute to the rapid, open dissemination of information. Ultimately, determinations of whether an activity qualifies as scholarly activity depend partially upon the local institution's interpretation of the ACGME requirements. Some activities may not satisfy departmental and / or institutional requirements for scholarly activity, especially as these requirements relate to faculty promotion and tenure.

The use of a broad definition for scholarly activity is associated with potential pitfalls, including the possibility that an activity does not qualify as scholarly activity. This pitfall can be avoided by ensuring that projects fit an established framework. including those provided by Boyer and Glassick. In addition, ACGME training program guidelines (for residents) and departmental guidelines (for faculty) may be referenced. Such frameworks often function independent of the topic, focusing rather on the underlying process of inquiry and learning. Scholarly activity in any form should extend from work with clearly-defined goals and be conducted utilizing sound methodology. Findings from these activities should be presented thoroughly, clearly, and in a manner easily understood by a larger population – the results of which should include increased context-expertise by the learner and an improved ability to provide evidence-based care.[9]

There need not be a one-size-fits-all model, if the proposed scholarly activity contains key elements suggesting that it will challenge and educate the learner. Emergency medicine-led efforts with social media and FOAM continue to challenge the notion that only "traditional forms" of scholarly activity are acceptable. Success in this area suggests that EM is poised to lead the field towards a more inclusive definition, with the caveat that we do so in a measurable and verifiable manner.

PRACTICAL WAYS TO MEET ACGME REQUIREMENTS

Emergency medicine residents are expected to engage in some form of scholarly activity prior to graduation; similarly, residency programs are expected to support this activity. Program support includes the provision of dedicated, core EM faculty members to supervise and facilitate resident scholarly activities. These faculty members are essential to resident success, but faculty involvement may require devoted, protected time to engage with residents. Although the ACMGE requires participation in scholarly activity for both residents and faculty, it does not specify that this work must be original basic science or clinical research.[9] Despite the many commonalities seen between EM residency training programs in the U.S., each program has its own mission, distinct aims, and a unique patient population. Methods for satisfying the scholarly activity requirement should therefore be flexible and adaptable to meet the individual needs of each program.

Both program- and department-level initiatives can aid EM residents and core faculty in satisfying the ACGME requirements. One such initiative is the **individualized scholarly activity plan** (ISAP), which is unique to the interests and needs of the individual EM resident or faculty member. An ISAP defines scholarly activity goals early on in EM residency training or an EM faculty appointment. These are combined with a longitudinal plan structured around frequent check-ins to monitor the progress of an individual's work and ensure that EM residents and core faculty: (1) have the appropriate level of support; (2) are progressing toward their prespecified goals; and, (3) maintain a plan whose content and direction continue to be on target.

The following are ISAP examples for both EM residents and faculty.

Faculty A is a community emergency physician and a member of the core faculty for her local EM residency program. She has an interest in music therapy. One evening, while attending a forum on clinical music applications at a nearby conservatory, she meets a resident in the program with similar interests, Resident A. After talking, she learns that Resident A wants to study the impact of music therapy in patient exam rooms to identify if patients in rooms with background music have higher satisfaction scores than those without background music. Under Faculty A's guidance, Resident A devises a list of **clear goals** for the project. Resident A then spends the next several weeks **adequately preparing** for her

project including meetings with Faculty A, facilities staff, and the departmental medical director. Faculty A helps Resident A select **appropriate methods** to identify how many rooms will have background music and for how long they will have it. The two meet regularly for the next several months and Faculty A ensures Resident A is supported and on track. The work produces **significant findings** and the two submit a proposal for a workshop at the conservatory where they met. The proposal is accepted and both Faculty A and Resident A are required to offer **reflective critique** on their work and the work of others.

Faculty B is an EM residency program director with a strong presence on social media. In conjunction with other EM program directors on social media, he is interested in putting together a series of Twitter forums. His **clear goal** is to organize a series of weekly, live, forums before residency interview season where Faculty B and other EM program directors serve on a panel to talk about: (1) what makes a successful personal statement; (2) interview day tips; (3) how to identify if a program "fits;" and (4) offer a question/answer session. Faculty **B adequately prepares** and uses **appropriate methods** to set up a suitable structure for the forum, recruits other program directors, and publicizes the Twitter forums using a distinct hashtag. To ensure **effective presentation**, he establishes a process for the content to be recorded and subsequently disseminated on Twitter using his own hashtag. After the first forum, he organizes a Zoom meeting with the panel and other faculty members not involved in the process. Faculty B presents his **significant results** and discusses metrics on the number of likes, retweets, mentions, and participants, comparing it to a similar forum done by colleagues in anesthesia. He offers **reflective critique** on what went well and what could have been better, hoping to ensure the success of remaining forums.

Resident C has an undergraduate degree in art history and is interested in how disease has been presented historically in paintings. She wants to prepare a lecture series for the medical community that explores various famous paintings portraying illness and disease. For each lecture she intends to create a panel composed of art historians who can talk about a painting, the painter, , and the time period. She also intends to include physicians who can offer context on the pathology and its significance both today and in the painting's time period. She develops a list of **clear goals** and **adequately prepares** by coordinating with her residency program and the curator at a nearby art museum. Together they use **appropriate methods** to identify pieces of interest, context experts, a timeline for the lecture series, and a venue. They also secure continuing medical education credit for attendees. These efforts result in **significant findings** that are presented at a series of six lectures, where Resident C moderates and offers **reflective critique,** along with the panel experts.

Resident D is interested in climate change. During his second year of EM residency, he learns that Faculty Member D, in the school of environmental sciences, studies the intersection of climate change and health policy. After meeting with his program director, Resident D and Faculty D develop an ISAP. They then draft a research plan with **clear goals** to study trends in ED visits for heat-related illness for undomiciled patients. The work requires **adequate preparation** by Resident D as he reviews journal articles and textbooks to gain a better sense of the facts and unknowns on the topic. Together, the two devise **appropriate methods** to use the electronic health record to study their research question. At pre-specified intervals, residency program leadership checks in with Resident D to ensure that he is supported and on track. The work produces **significant results** that are subsequently implemented by the department. Findings require **reflective critique** as Resident D presents his work during the program's resident research day, where he answers his colleagues' questions about the impact and limitations of his work.

CONCLUSIONS

The ACMGE requires participation in scholarly activity for both EM residents and core faculty, but does not require that the activity involve original research.[9] Individual programs are given some flexibility in determining how to meet ACGME common program requirements.[9] Although programs may have differing opinions on what qualifies as scholarly activity, all programs must meet certain minimum requirements. Nontraditional forms of scholarly activity, including activities related to social media and FOAM, are becoming more popular vehicles for the rapid and open dissemination of information in the field of emergency medicine.

However, there are potential pitfalls associated with utilizing a more inclusive definition of scholarly activity. Not all work can qualify as scholarly activity. Multiple frameworks exist to aid both residents and faculty in determining what can and should be classified as scholarly activity, including those by Boyer[3] and Glassick.[4] Regardless of the framework, however, scholarly activity should be predicated upon clearly defined goals and conducted utilizing sound methods. Findings should be presented thoroughly and in a manner easily understood by a larger population. Finally, the result of this activity should be increased context expertise for the learner, improved ability to provide evidence-based care, and a meaningful contribution to the culture and practice of medicine.[9] Although the lack of a clear definition for scholarly activity can be frustrating, it can also be liberating. Programs successfully meet the ACGME scholarly activity requirements in different ways. The use of ISAPs can help EM residents and faculty members to meet ACGME requirements by defining their scholarly activity goals early on and keeping learners on track and supported. They can also help residency programs and departments to ensure compliance with the ACGME requirements as they explore a more inclusive definition of scholarly activity.

➲ *KEY CONCEPTS*

- Nontraditional forms of scholarly activity, which can overlap considerably with more traditional forms, are gaining momentum and merit consideration.
- Certain established frameworks, independent of content area, can be useful in determining which activities satisfy the ACGME requirements for scholarly activity.
- The ACGME definition of scholarly activity is vague, but does provides flexibility in how both academic and community-based EM programs are able to satisfy common program requirements.
- The rise of social media and FOAM has underscored the need for clear EM residency training guidelines, detailing the different types of scholarly activity that can meet the ACGME's required standards.

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MOTIVATING RESIDENTS TO ENGAGE IN RESEARCH AND SCHOLARLY ACTIVITY

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ABSTRACT

Motivation is key to any self-driven process, and resident research is no exception. The innate inclination toward scholarship varies widely between EM residents. Consequently, certain budding scholars may require more tutelage than others. Emphasizing the scholarly process may help to ignite the first spark of scholarly intrigue in a learner. But this spark of interest must be fanned by a mentor who can provide crucial resources and advice to fuel the project's completion. In fact, effective mentorship has been shown to be the single most important factor in predicting the success of a resident research project. It is important that research and other scholarly activities provide a positive experience for the learner; however, deadlines and expectations must be clearly defined and facilitated by project mentors and academic faculty. This chapter explores motivational techniques intended to keep EM residents interested in completion of a scholarly project.

INTRODUCTION

Before becoming an attending physician, an emergency physician's medical education is compressed into two years of clinical rotations as a medical student, and three to four years of EM resident education. Although the clinical care of the patient is the primary focus of resident education, other topics and skills are of vital importance to becoming a well-rounded EM physician. One such skill is the ability to understand the research process as it relates to the broader field of academic medicine. Engagement in scholarly activity is important to the development of intellectual curiosity among EM residents. Intellectual curiosity and the pursuit of new medical knowledge are necessary skills as an attending EM physician, enabling attending physicians to effectively participate in the continual improvement of patient care. Other potential benefits of scholarly activity include increased satisfaction with training, increased lifelong learning and development of analytical skills, and an increased likelihood of pursuing academic careers. Unfortunately, scholarly activities and research may seem to be less important to EM residents than in-service scores, clinical shifts, and participation in didactic teaching.

The ACGME-mandated scholarly project requires substantial motivation on the part of the EM resident to successfully complete this requirement prior to graduation. Naturally, residents will vary significantly in their interest in and experience with scholarly activity. Therefore, motivating EM residents to participate and be engaged in scholarly activity is imperative to the success of any scholarly activity program.

Self-determination theory purports that intrinsic motivation is maximized when three psychological needs of participants are met: autonomy, competence, and relatedness. Residents need to feel some independence (autonomy) in the completion of their scholarly project. They must also feel that they have the skills and support (competence) necessary to complete the project, and that they are part of a larger community working toward similar goals (relatedness). Residency programs should consider these needs when determining how to best engage residents in research or other scholarly activity projects.[1] A one-size-fits-all scholarly activity program for EM residents may not maximize both learning and the likelihood of success for scholarly activity projects. In this manuscript, we offer approaches and advice to maximize a resident's motivation towards completing the ACGME scholarly activity requirement.

RESOURCES AND SUPPORT

Emphasizing scholarly activity and the educational process is the first step toward achieving a satisfactory outcome. Scholarly products have evolved over the past few decades and many residents suffer from misconceptions that bench research is the only valuable form of research. Boyer proposed that there are four outcomes of the scholarly process: *discovery, integration, application,* and *teaching*.[2] These outcomes give the trainee a starting point and a direction. It may be helpful to focus primarily on the process of producing scholarship, and less on the final product of their activity. One study in pediatric residents used the aforementioned self-determination theory to focus on the process of creating scholarship without a mandated end product.[1] Study authors found that this allowed participants to focus on self-motivation and their own curiosity and inquisitiveness. Additionally, Glassick's criteria builds upon Boyer's work by providing a framework for each step of the process, including setting clear goals, ensuring adequate preparation, utilizing appropriate methods, achieving significant results, providing an effective presentation, and employing reflective critiques.[3] **Autonomy** allows the trainee to take command of the project and to develop it in their own way. **Relatedness** reveals the applicability of the

project, which can become the driving force behind completion. Finally, **competence** is what the trainee can learn along the way from mentors, the educational process, and reflection upon project findings. Sharing current projects by peers and faculty (in various stages of completion) can emphasize the importance of the educational process and peer success, while encouraging collaboration.

The identification of available resources to support scholarly activity, effective communication of their utility and availability, and making these resources as user-friendly as possible for new scholars is crucial to the initiation and maintenance of resident engagement in the scholarly process. Vital factors include the presence of a research director, a departmental mindset reflecting the belief that resident research is important and useful, the availability of protected time and financial support for learners and mentors, and the support of core faculty, including the program director and departmental chair.[4] Studies have suggested that a research retreat and the availability of a statistician also enhance resident engagement and ultimate success in completing a scholarly activity.[5]

***Case Example**: An intern thinks that he may be interested in clinical research. However, he has no undergraduate medical education research experience. He identifies a clinical question and completes an abbreviated literature search. However, he is unable to design a feasible study to execute. His progress stalls until he attends an annual residency research retreat that has been integrated into his department's weekly didactic series. There, he is exposed to multiple projects that are underway, including one in his area of interest. He joins the group project and participates in the development and ultimate completion of the project, including development of the study design, the collection of study data, and regular meetings with the department's statistician to discuss the data analysis. The project is ultimately accepted for publication. At this point, he can leverage both this experience and the relationship that he has developed with the senior faculty member to design a feasible study that will answer his clinical question of interest.*

MENTORING

Leading by example can be an effective, though unstructured, form of education. This occurs in various settings but is found mainly on shift as residents experience the way in which faculty interact with patients, patient families, and ancillary staff. Providing an example of how to successfully produce scholarship requires staff members to be involved in scholarship activities themselves. Encountering a wide range of research faculty, with varying research interests, can help to foster a passion for education and research.[6]

Matching trainees with research mentors early in their residency career maximizes a resident's opportunities to develop a successful research project. One study found that beyond the development of a curriculum or hosting annual events, the most significant predictor of success in executing a scholarly project was their mentor's research productivity.[7] A mentor's inspiration and drive can contribute greatly to trainee success in completing a scholarly project.

Faculty development should include workshops addressing the scholarly process, a venue for idea exchanges, and adequate protected time for faculty to guide learners through the process of achieving their scholarly project goals. Physicians who choose to remain in academia must have adequate motivation to seek answers to clinical questions through the scholarly process. Appropriate engagement in scholarship requires the mentor to have adequate protected time for their own research, as well as protected time to mentor residents through the scholarly process. Resident education can be a substantial obstacle

for faculty when clinical time is not decreased to accommodate the increased workload required for mentorship of resident scholarly activity.[8]

> ***Case Example:*** *A new resident learns that her residency program has a mentorship arrangement in which attending physicians are paired with interns to help guide them throughout their residency. The intern is paired with a talented clinician who is very kind; however, she is interested in performing research and the attending physician is not. Despite being told that she needs to develop a research question during her intern year, she has made little progress halfway through her intern year. During her six-month evaluation, she voices her concern to the program director, who then pairs her with a more appropriate research mentor. With appropriate mentorship, she gains the guidance needed to develop a proper research question and forms a plan to explore this question during her second year of residency. She presents her findings during her third year of residency, and ultimately succeeds in her quest to complete a research project.*

SETTING EXPECTATIONS

Scholarly projects can require a seemingly overwhelming amount of time to complete. The satisfactory completion of a research project typically requires completion of multiple distinct phases, though these phases are not always completed in a linear fashion. The complexity of executing multiple phases of a research project can seem daunting and perhaps even impossible when attempted without a systematic approach. The establishment of clear timelines can simplify the process and provide smaller, seemingly more achievable, immediate objectives that will ultimately lead to project success.

One study implemented a phase-style process called **Think-Do-Write**.[4] In this process, years of residency are broken down into phases. The first phase, to **Think** about the project and feasible ways to accomplish it, is finalized by the end of the first post-graduate year (PGY-1). The second phase, to **Do** the project, requires implementation of the intervention and collection and analysis of the data by the end of the PGY-2 year. Lastly, the resident enters the **Write** phase, producing an end-product for submission before they graduate (PGY-3). Final products for the project can include a manuscript, case study, QI project, abstract, or poster presentation.

Deadlines are more than just a date on a calendar. They can be dressed up as events, rather than a checkbox on a list of graduation requirements. To encourage the first-year resident to have their idea completed before year-end, a date can be set (usually a conference day) to hold an annual residency scholarly activity "Think Tank."[9] The intern should prepare a final concept for their scholarly project, and present the idea to the entire residency on this date. This event provides faculty and other residents an opportunity to give their input and suggestions for improvement. The deadline then becomes tangible and the intern is held accountable. In that same regard, the third-year (i.e., graduating) residents enter their project into a "poster day" where they present outcomes and data. Establishing scheduled events at which the resident will present their plans or data hold more significance than arbitrary deadlines.

Throughout the year, the project should be discussed at semiannual evaluations and mandatory meetings with mentors. Having smaller, less intense meetings to ensure accountability will help to keep the resident on track for larger presentations and deadlines.[1]

Case Example: An intern is scheduled to meet with his mentor every two months. However, it is already January of his first residency year and he has not created a project idea. The mentor discusses upcoming project ideas with colleagues based on the intern's stated interests. At the next meeting, the mentor discusses the ideas with the intern, instructing him to choose and build upon an idea before their next meeting. The intern now has the necessary guidance. Two months later he is excited about his project idea and anxious to share it with the residency in June at the annual Think Tank.

MATCHING SCHOLARLY ACTIVITY AND RESIDENT INTEREST

Different personalities respond to different types of motivation — positive versus negative reinforcement. Examples of positive reinforcement include giving rewards to those who completed the project or rewarding those who are voted to have the best project among classmates. Examples of negative reinforcement include assigning an extra clinical shift for late or incomplete projects or assigning an extra task to make up for the previous late project. Negative reinforcement is the lowest level of extrinsic motivation and does little to support the integration and adoption of extrinsic forces to intrinsic motivation.

There is no one-size-fits-all method for motivating residents to produce academic scholarship. **Organismic integration theory** identifies three regulatory styles: (1) intrinsic motivation at one extreme (highly productive and spontaneous); (2) motivation at the other extreme (complete lack of volition, failure to act, or only going through the motions); and (3) extrinsic motivation in between (actions prompted by an external force or regulation).

Some residents will be intrinsically-motivated and need little prompting to complete required activities. These residents act to satisfy an inherent curiosity or to master a skill, and need little to no incentive to be productive. In fact, evidence shows that incentives and disincentives diminish intrinsic motivation. The highest, most creative, productive achievements occur when one is motivated by an intrinsic interest in the task.

Extrinsically-motivated people are driven by social values, which can become self-determined over time by integrating and internalizing values. It is through internalization and integration that individuals can be extrinsically motivated and still be committed and authentic.

It is important to encourage psychosocial needs when creating incentives and disincentives in a scholarly program. **Autonomy** is promoted by providing opportunities for choice, acknowledging feelings, avoiding judgement, and encouraging personal responsibility for actions. Thus, rewards, punishments, deadlines, and other controlling actions can all undermine autonomy, and a program should utilize these on an individual basis. **Competence** is supported by optimal challenge, and by feedback that promotes self-efficacy and avoids negativity. **Relatedness** is promoted through environments exhibiting genuine caring, mutual respect, and safety. Research suggests that these three psychosocial needs (e.g., autonomy, competence, relatedness) promote the internalization and integration of extrinsic motivations, with relatedness and competence being particularly important for internalization, and autonomy being critical for integration.

It is paramount to the success of a scholarly project to accurately identify the resident's own intrinsic interests. Residents with low or no intrinsic interest in scholarly activity may still be motivated by extrinsic means. The most successful extrinsic motivators demonstrate the scholarly activity's usefulness for the resident. For example, this might include outlining concrete ways in which participating in and publishing a research project can positively

affect the resident's career goals. Negative extrinsic motivation, such as acting only to avoid punishment, is much less likely to result in internal motivation.[10]

Case Example: *In July, each intern fills out a questionnaire to identify their areas of interest. Interns are then placed into smaller groups based upon chosen interest and mentors are assigned to that group based on their areas of expertise. For example, emergency medical services (EMS) staff members are assigned to those who identified areas of interest in prehospital algorithms and care. This then facilitates the appointment of mentors based on research areas of interest.*

Case Example: *In July, staff members involved in research give a brief, five-minute overview of their ongoing studies. At the end, a list is passed out to the interns for them to mark their areas of interest. This can facilitate early mentorship for ongoing projects, pairing mentors with mentees seeking to develop new projects based on similar areas of interest.*

A POSITIVE RESIDENT EXPERIENCE

Multiple studies have identified barriers commonly cited by residents that inhibit their ability to complete a scholarly activity: (1) inadequate protected time to complete the activity; (2) deficient mentorship; (3) poor infrastructure for scholarly activity; and (4) lack of enthusiasm.[11-12] These barriers must be addressed before any initiative aimed at motivating residents to complete a scholarly activity can be successful. Failure to do so can be frustrating to residents and may give the perception that completing a scholarly project is yet another 'hoop' to jump through prior to graduation.[11] Program leaders should address these barriers directly and openly with residents, so that they can understand the value and necessity of performing a scholarly activity, and perceive the experience as a positive one rather than yet another obstacle to graduation.

Other proactive steps should also be taken to ensure that the process of completing a scholarly activity provides a positive experience for EM residents. In one qualitative study of residents who successfully completed a scholarly activity (defined as first authorship on at least one published paper based upon their resident scholarly activity), residents reported that they felt positively about the experience when they were the project champion and had sufficient faculty mentorship and oversight.[13] Independence and autonomy were felt to be important, but residents also preferred to be held accountable for their progress with clearly-defined deadlines. Clear expectations and established deadlines must be communicated to the residents. In addition, faculty project mentors must ensure that residents are undertaking projects that can be feasibly completed within the timeframe of their EM residency. If the project scope is too broad or impossible to complete within the time constraints of residency, this will lead to frustration and a negative experience for residents.

Residents must also choose a project that is of interest to them.[13] The resident should have a genuine interest in the content area of the project. Mentors must be chosen with this in mind, as a project is much less likely to be successful (and may lead to resident dissatisfaction) if residents do not have a genuine interest in the topic. If, during the project's design, it becomes apparent that the resident's interests and the mentor's expertise are not well-aligned, the resident should be given the opportunity to seek a different mentor, rather than being forced to change the focus of their scholarly activity.

Case Example: *At the beginning of residency, an intern is assigned to a research mentor. This faculty member is involved in cardiovascular research and advises the intern to do a study related to heart failure screening in the ED. The resident has an interest in medical education and would like to do an educational project instead. However, they soon realize that their mentor knows little about medical education research, so they go along with the clinical project. A year later, still disinterested in the topic, the resident has done little to advance the project and feels the faculty mentor is "too busy" with their own research to oversee their own progress. At the semiannual review meeting with the program director, the resident mentions these concerns. The two discuss the barriers to completing the scholarly project, and the program director assigns a new mentor based upon the resident's interests. Together the resident and their new mentor create and execute a medical education initiative, which leads to a successful project and publication of a valuable report.*

CONCLUSIONS

Internal motivation is important to the successful completion of a resident scholarly activity project. Completion of a scholarly project is a challenge for EM residents, and requires adequate and appropriate education for residents on the value of scholarly activity to their development as a skilled emergency physician. The obligation to complete a scholarly project should be viewed by EM residents as an opportunity to enhance their skills as a clinician, rather than a roadblock to graduation. The appropriate assignment of a skilled mentor is paramount to the success of a scholarly project. Residents should engage in scholarly projects that seem important to them, rather than simply participating in projects assigned through external mechanisms. Autonomy, competence, and relatedness are important concepts when determining an appropriate EM residency scholarly project.

➲ *KEY CONCEPTS*

- The motivation of EM residents to complete a scholarly activity project should emphasize the importance of the scholarly project to the resident's growth as a physician, rather than emphasis upon the need to complete a scholarly activity project to graduate.
- Appropriate mentorship is the most important factor associated with success in scholarly activity projects. Deficient or inappropriate mentorship is a common cause of resident dissatisfaction with the scholarly activity process.
- Early identification of resident interests and matching of the resident with a mentor of similar interests is vital to a project's success
- Think Tanks or similar scheduled events fielding potential scholarly projects may be valuable to both residents and mentors in determining the viability of projects.
- Mentors should assist residents in establishing clear deadlines for their scholarly projects, and program directors should consider appropriate repercussions for residents when established deadlines are not met.
- Motivation for achieving positive results on scholarly projects may be enhanced by engaging in planned opportunities for residents to share their ideas and findings at regularly-scheduled meetings including departmental "Think Tanks."
- Program leadership can reinforce the positive aspects of scholarly activity by emphasizing incentives for project completion over disincentives.

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RESOURCES FOR SUCCESSFUL RESIDENT-LEVEL RESEARCH

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ABSTRACT

This chapter describes the strategies and resources required to establish a research program in the context of an EM residency program. Attention is given to the differing needs and opportunities associated with community-based and university-based programs. Although mentorship is discussed in another section in detail, it is mentioned here to provide proper context. Research support staff roles are introduced, including research associate training programs. Resources to accelerate and leverage support are also detailed, including collaboration within and between research institutions. The importance of educational opportunities, faculty leadership and faculty engagement and participation are emphasized.

INTRODUCTION

In his landmark 1910 report, *Medical Education in the United States and Canada*, Abraham Flexner emphasized the importance of clinical research, especially that which is, "relevant to bedside practice."[1] Expressing contemporary attitudes, Flexner suggested that research be performed side-by-side with the clinical encounter as a necessary component of usual patient care for the competent physician.[1] Over the last century, this spirit of intellectual curiosity and ingenuity in clinical practice has been preserved. In its earliest days as a specialty, emergency medicine research focused almost exclusively upon topics with direct applicability to clinical practice. Today, however, emergency care researchers are active in a wide variety of research efforts, including basic science, epidemiologic studies, and clinical research.

This chapter details many of the resources needed for resident EM physicians to successfully execute a resident-level research or scholarly activity project (RLRSAP). Although these resources may not be available at all institutions, it is important for residents to seek these resources out and make best use of them when available.

TYPES OF RESEARCH INSTITUTIONS

Not all healthcare institutions are equally committed to academics. Consequently, EM residency programs generally fall into one of three categories, according to their institutional emphasis on research and scholarly activity. At one end of the spectrum is the **university-based** program, which typically engages in a broad range of scholarly efforts. Such programs generally house everything from basic science to bedside research, including both funded and unfunded research. While the university setting has always emphasized basic science research, such institutions will often have very active clinical research programs as well. University-based programs typically have a strong publication imperative, resulting in a relatively high volume of scholarly output. At the other end of the scale is the **community-based** program, where most of the institution's resources are allocated to providing clinical care, leaving very little time or money for scholarly activity. Research may still be conducted at such institutions, but it is usually conducted by a small cohort of highly-motivated individuals who are able to obtain external funding and execute their protocols in an otherwise resource-scarce environment. The middle ground on this spectrum is occupied by the **community health center** program. This type of program retains a strong focus on clinical care, but has chosen to allocate the resources needed to support medical education and a moderate amount of research activity. Residents engaged in an EM training program may not know which type of institution that they have joined at the onset of their clinical training; but those who seek to complete a scholarly project will quickly learn the degree to which their institution is able to support their research efforts. Since most EM residency programs are affiliated with a university-based program or community health center program, motivated faculty and resident physicians who wish to engage in clinical research or other scholarly activity can usually elicit some degree of institutional support.

ACADEMIC FACULTY

Consensus on the perceived value of scholarly output for faculty and residents in an EM residency program is dynamic and evolving. Previously, the ACGME Emergency Medicine Residency Review Committee (RRC) required a minimum number of peer-reviewed publications to be generated by a program's faculty. However, traditional requirements like this have been replaced recently with more inclusive criteria. The 2019 RRC faculty scholarly activity requirements for EM residency programs are provided in Figure 1.[2]

FIGURE 1.

ACGME Faculty Scholarly Activity Requirements[2]

IV. D. 2. Faculty Scholarly Activity
Background and Intent: For the purposes of education, metrics of scholarly activity represent one of the surrogates for the program's effectiveness in the creation of an environment of inquiry that advances the residents' scholarly approach to patient care. The Review Committee will evaluate the dissemination of scholarship for the program as a whole, not for individual faculty members, for a five-year interval, for both core and non-core faculty members, with the goal of assessing the effectiveness of the creation of such an environment. The ACGME recognizes that there may be differences in scholarship requirements between different specialties and between residencies and fellowships in the same specialty.

IV. D. 2. a. Among their scholarly activity, programs must demonstrate accomplishments in at least three of the following domains: (Core)

- Research in basic science, education, translational science, patient care, or population health
- Peer-reviewed grants
- Quality improvement and / or patient safety initiatives
- Systematic reviews, meta-analyses, review articles, chapters in medical textbooks, or case reports
- Creation of curricula, evaluation tools, didactic educational activities, or electronic educational materials
- Contribution to professional committees, educational organizations, or editorial boards
- Innovations in education

IV. D. 2. b. The program must demonstrate dissemination of scholarly activity within and external to the program by the following methods:

IV. D. 2. b. (1) faculty participation in grand rounds, posters, workshops, quality improvement presentations, podium presentations, grant leadership, non-peer-reviewed print/electronic resources, articles or publications, book chapters, textbooks, webinars, service on professional committees, or serving as a journal reviewer, journal editorial board member, or editor; (Outcome)

IV. D. 2. b. (2) peer-reviewed publications.

As these guidelines state, one role of the residency program is to create an, "environment of inquiry that advances the residents' scholarly approach to patient care." Academic core faculty play an integral role in the creation of such an environment, and available faculty to guide and facilitate scholarly activity is a vital resource that residents will need in their development of a RLRSAP.

Program faculty play a central role in the establishment, continuation, and growth of the research enterprise for the residency program. Residents only remain in the program for a three- to four-year period; hence, they cannot independently provide a stable foundation for a resident research program. Academic faculty must provide this needed continuity and serve as the primary driving force for resident-level research. The process of building a resident research program cannot be completed overnight, and rarely proceeds from a single defining action. Rather, most resident research programs are brought into

being through a process analogous to the "flywheel" effect, in which a handful of highly-motivated faculty members gradually create enough momentum for research to allow other faculty and residents to "jump on" and join them.

LEADERSHIP AND GUIDANCE

Effective leadership is key to the success of any resident research program. One important role of the **departmental research director** is to identify and remove roadblocks to participation in research. Many faculty members (and most residents) do not have adequate experience in the multistep process of initiating and conducting research. Thus, it is essential for residency leadership to identify those individuals who require research assistance, and to support the efforts of the research director and others who are providing leadership in this crucial area. Access to central, cross-specialty GME resources should also be facilitated.

Faculty mentors — those who help to guide, foster, and support the resident's research goals — are another essential departmental resource. Mentors can help to locate resources, navigate the institution's institutional review board (IRB) submission process, provide tools for keeping the resident's research on track, and identify barriers to success. Although they are an essential guide to successfully conducting research, faculty mentors don't necessarily have to be involved directly in the scholarly project. A good mentor is knowledgeable, available, willing, engaged, and able to give honest feedback.

Making the most of the mentor-mentee relationship requires the resident to be a good mentee, who will take ownership of the scholarly project, come prepared to each meeting, and ensure that the mentor is frequently updated. The learner should remember that their mentor is usually volunteering their time. Even if they have an academic salary, they undoubtedly have many other responsibilities. Residents should show interest by coming to meetings prepared; this is crucial to getting the most out of the mentor-mentee relationship. The resident should ask well-researched questions of their mentor, including how to best design and develop the project, what is needed to keep the project moving, expected timelines to get the project through the IRB, and what pitfalls to expect. The resident must take responsibility for the project and try to meet deadlines. It is a good idea to set up a series of recurring meetings to provide the impetus needed to keep the project moving. Each time they meet, the resident should provide the mentor with a concise update on what has happened since their last meeting.

Several online tools can aid the novice or even more experienced researcher in defining a new project, such as the one available at www.CoolResearcher.com.[3] These tools can help the resident to structure the research proposal prior to presenting it to their mentor, which will help to identify aspects of the proposal that require additional clarification.

RESEARCH PROGRAM AWARENESS

Resident learners have no control over the research infrastructure that exists at their institution. However, it is imperative that they understand the way in which resident research and scholarly projects are handled at their institution. The department will have already assigned a specific individual or committee to oversee the assignment of mentors, establishment of guidelines, and troubleshooting of any issues that may arise for resident researchers. If an individual, this person will generally be the residency program director or departmental research director. This individual will usually keep track of mentor-mentee assignments, ensure consistent meetings, and monitor the residents' progress. The resident should find out who serves this function within the department, contact this individual early

in the project development process, and keep the lines of communication open. Residents should know who to contact if their mentor does not appear to be willing, capable, or have the time to follow through with their assigned role.

BIOSTATISTICAL TRAINING AND SUPPORT

Institutions vary in their provision of statistical support. Ideally, faculty and residents should have access to a biostatistician, as such access can significantly decrease barriers to conducting original research. Statistical services might be shared across GME programs at smaller institutions, where research funding is limited. If funding has been acquired for the resident project, statistical services might be contracted on an hourly or by-project basis. Whether the biostatistician is paid or voluntary, residents should plan to involve the biostatistician early in the project development process. A nightmare scenario for most statisticians is one in which the investigator shows up in their office asking, "Can you find statistical significance in these results?" Statisticians would always rather help to establish data collection methods than try to clean up poorly-organized data after it has been collected. Consequently, investigators should involve statistical support staff in the early stages of project design. This will avoid many problems later and improve the likelihood of a mutually beneficial and productive interaction. Initial discussions with statistical support should revolve around the research question itself, what types of data are available, and how to achieve a successful study outcome. The resident and mentor should keep an open mind and understand that the biostatistician's perspective may differ from their own regarding study design and which data points are most vital to the project's success.

We recommend that faculty, residents, and students who wish to engage in clinical research learn the basics of research design and statistical analysis prior to needing this information. Researchers should learn what educational resources exist at their institution and try to acquire the necessary statistical knowledge early in the project development process. Good statistical decisions made in the planning phase of a new scholarly activity project will ensure that the study obtains the needed results and will prevent problems later in the process. The resident should seek a working awareness of the principles of EBM. When formulating a new research question, this will provide familiarity with established methods of formulating a valid research question and increase the likelihood that the resident's methods will be accepted by those evaluating the study's methods when reporting results (e.g., journal reviewers, judges at research competitions, etc.). That said, the goal of any junior clinical researchers should be to have sufficient knowledge to communicate effectively with a statistician, rather than seeking to gain all the requisite knowledge to conduct the statistical analysis themselves. Statistical services can also be contracted from extramural sources, including private organizations that may bill GME programs directly for clinical research advice and statistical analyses.

RESEARCH COORDINATORS

A research coordinator (RC) is another very helpful, if not essential, resource. These are individuals employed by the department with experience in conducting clinical research. They are usually paid a salary by the department and provide oversight to a specific research trial or trials. It is unlikely that an RC will be assigned to manage unfunded resident-level projects. However, research coordinators can provide critical assistance to resident researchers in navigating institutional requirements, including best methods for protocol submission to the IRB. The RC can also provide continuity concerning database management

and help ensure the protection of protected health information (PHI). This individual can also play a critical GME role by providing education and training to faculty, residents, and students who engage in research across departments.

INSTITUTIONAL REVIEW BOARD

Resident researchers should become familiar with their local IRB, including those individuals responsible for IRB review and the process for submission of new research protocols. Although the IRB does not need to provide oversight for quality improvement initiatives or projects that involve de-identified data, the IRB is the final arbiter of which projects require IRB oversight. When in doubt, researchers should plan to submit their protocol to the IRB for its determination on whether the study requires IRB oversight and approval.

Many GME programs require research ethics training for all residents prior to or during residency orientation. One popular source of this educational content is the Collaborative Institutional Training Initiative (CITI Program),[4] which provides concise, online research ethics training and is used by many institutions. This training provides an excellent foundation in research ethics, but may not impart a practical understanding of the responsibilities of a principal investigator (PI) or how to properly interact with the IRB and other regulatory bodies.

RESEARCH ASSISTANTS

Research assistants are typically paid or volunteer departmental employees who are responsible for the day-to-day aspects of data collection and assist the research coordinator in aspects of executing a protocol. This may include preparing documents for IRB submission, proofreading study protocols, coordinating data collection, and (at some institutions) obtaining informed consent from subjects to be enrolled in prospective research projects.

RESEARCH ASSOCIATES

Titles differ across institutions, but a **research associate** (RA) is generally an individual who has received *formal specialized training* in the performance of research, enabling them to assist in the collection and organization of data, as well as other research-related activities. There are approximately 45 designated research associate programs across the U.S., usually integrated into local or regional universities. In a typical program, students receive training on Health Insurance Portability and Accountability Act (HIPAA) compliance, research ethics (e.g., CITI training and other educational resources), and use of the electronic health record. Many such programs also train students on how to obtain informed consent, enabling research associates to enroll patients into prospective clinical research studies. The primary purpose of a research associate program is to decrease the barriers to research for unfunded faculty while providing valuable research training to students. Because most resident research is unfunded, access to RAs may be extremely valuable to a RLRSAP. However, because this resource may already be allocated to funded research studies, the resident should not assume that RAs will be available to work on the RLRSAP. The resident should discuss the potential availability of RAs with the departmental research director to determine whether access is available to this resource for data collection, subject enrollment, or other RLRSAP-related activities.

MEDICAL LIBRARIANS

Most institutions have access to a medical library, although many residents may not be aware that they also have access to **medical librarians**. Medical librarians are usually quite adept at performing literature reviews, and can be instrumental in performing systematic literature reviews or other preliminary reviews to inform scholarly pursuits. Since a good literature review will improve the quality of the entire RLRSAP, the resident should identify this resource early in the development of the scholarly project to better inform their literature review. Because medical librarians usually receive an institutional salary, their services may be free of charge to other institutional employees, including resident researchers.

If the project involves a systematic review of the medical literature, the resident should consider using a software program such as Covidence (https://www.covidence.org/) to assist them in completing the review.[5] This program is helpful in organizing systematic review activities, with an easy-to-use interface facilitating rapid abstract and full manuscript review, including the option for the medical librarian to preload .pdf article files from the literature search into the program. This makes tracking and sorting the original references much easier and can speed up the collaborative process when multiple individuals are conducting the review. Residents should find out whether their institution has a paid subscription to this type of service. If not, many offer a free trial.

QUALITY IMPROVEMENT DEPARTMENT

Partnering with the hospital's quality improvement department is an easy way to develop a quality improvement or research study idea and to obtain extra help for the RLRSAP. This will help align the project with the hospital's goals. One example of this is working with the quality improvement department to improve the hospital's sepsis quality measures, such as door-to-antibiotic time.

COLLABORATION WITH OTHER DEPARTMENTS

Collaboration across and within departments can be a key resource for resident researchers. Recruiting residents from other departments to assist in the project can bring more ideas and better follow-through. Collaborators can also move the project forward at different times and assist with larger projects. It is important to designate a lead person or champion for the entire project when collaborating with other departments, as this person will ultimately be responsible for moving the project along. It should be emphasized to potential resident and student collaborators that the project will require a significant time investment. The resident can also collaborate with nursing staff or members of the ED administration on projects within the ED. This is always a win for both departments. For those residents affiliated with university-based programs, we recommend considering collaboration with students from graduate nursing and other medical graduate degree programs.

RESEARCH TRAINING

Many options are available for residents (or even junior faculty) who want to improve their understanding of research methods and study design. The AAMC sponsors the Medical Education Research Certificate (MERC) program,[6] designed to prepare faculty members to participate in medical education research. This program is available across a variety of specialties. The EM Council of Residency Directors (CORD) offers their MERC program in the form of live courses at major EM conferences.

The American College of Emergency Physicians (ACEP) offers a unique, in-person research training program known as Emergency Medicine Basic Research Skills (**EMBRS**).[7] Originally conceived by Edward Panacek, MD, the EMBRS course enrolled its first class in 1997. This course is intended to benefit senior residents and junior faculty members in EM who are interested in learning basic research skills; it provides an excellent venue for them to get started on the road to scientific investigation. The one-year long program is held over nine "in-person" days, which are divided into two sessions. During these sessions, participants develop and refine a research proposal, with the goal of ultimately submitting their proposal for competitive funding.

The Society for Academic Emergency Medicine (SAEM) also offers a clinical research training program for senior EM residents and junior faculty, entitled the **Advanced Research Methodology Evaluation and Design (ARMED)** course.[8] Originally developed by the SAEM Research Subcommittee led by Drs. Esther Choo, Deborah Diercks, and James Paxton, ARMED enrolled its first class in 2017. This one-year course offers training in advanced research methodology, and merit scholarships are available. Grant writing and study design are heavily emphasized in this course.

Another resource for junior researchers is the SAEM **Research Learning Series (RLS)**, which offers monthly lectures on research topics, including a wide variety of topics that are supplemental to the EMBRS and ARMED curriculum.[9] These RLS lectures are available to all SAEM members and address a wide variety of EM research topics.

More general (i.e., non-EM focused) online education is also available through the recent advent of **massive open online courses (MOOCs)**. Online courses can be identified at https://www.mooc.org or by searching individual MOOC platforms.[10] Examples of such courses include "Understanding Clinical Research: Behind the Statistics" (Coursera, Capetown University), and "Understanding Medical Research: Your Facebook Friend is Wrong" (Coursera, Yale University). Such resources are freely available to junior investigators and may provide additional insight into the methods through which resident investigation can be conducted. The Research Methods Knowledge Base (https://conjointly.com/kb) is a comprehensive web-based textbook that addresses many topics relevant to an undergraduate or graduate course in social research methods.[11] Although the Research Methods Knowledge Base was developed as a free online resource for social researchers, much of the content is applicable to clinical research and other scholarly activity.

FUNDING

Although most RLRSAPs do not require funding to complete, prospective research (e.g., studies that require observation or interaction with subjects) can be expensive. It is imperative that residents carefully consider the potential expense of a project before committing to it. The departmental research director should be able to offer insight into typical expenses, such as administrative overhead, salaries for paid research staff, biostatistical support or IRB review fees, and other costs required to perform a resident-level study. Departments may offer funding to help defray the costs of travel to present study results at a conference, and other research-related expenses.

Many EM organizations offer competitive awards and grant funding mechanisms that are designed exclusively for student- and resident-level research projects. If funding is needed to complete the research project, applying for and receiving departmental, institutional, or extramural funding may be a crucial determinant of the project's success.

CONCLUSIONS

The successful development and execution of a resident-level research or scholarly activity project requires awareness and mobilization of many institutional and departmental resources. Resident researchers should become familiar with the resources available to them early in the scholarly project development process, as the availability of key resources may limit the project's feasibility.

➲ *KEY CONCEPTS*

- Community- and university-based EM residency programs may differ with respect to the resources available to support resident-level research and other scholarly activities.
- Resident researchers should identify and seek guidance from leaders and research champions within their department, GME program, and institution.
- Faculty mentors should be aware of their central role in serving as a stable, driving force and resource for resident-level research and scholarly activities.
- Basic education in research principles is available to novice researchers and may help to motivate the resident and improve the educational value of their scholarly project.
- Collaboration within and between departments or institutions can expand the pool of available resources, enhancing the likelihood of success and benefiting all involved.
- The potential need for funding should be determined early in the process of considering a proposed research project, as inadequate funding can doom an otherwise feasible project to failure.

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TEN COMMON PITFALLS ON THE JOURNEY TO PROJECT COMPLETION

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ABSTRACT

The ACGME expects EM residency programs to provide residents with the opportunity to develop critical thinking skills. The scholarly activity requirement formalizes this expectation. One means of satisfying this requirement is through a research project, which teaches the resident how to generate an appropriate question, appraise the available literature, assimilate and expand their knowledge base, and hopefully apply these skills to lifelong learning and practice.[1] Programs that can successfully support resident-level scholarly activity projects typically have a broad faculty group with the skills necessary to mentor learners through this process. Time is a limited commodity, especially in residency. Therefore, it is critical to avoid common pitfalls that can stand in the way of successful completion of research projects and other scholarly work. In this chapter, we describe ten common pitfalls that can interfere with the successful development, implementation, and completion of a resident-level research or other scholarly activity project. Our aim is to provide struggling departments and novice researchers with a quick reference guide to these challenges, which may be of value when building or reviewing a resident-level research and scholarly activity program.

INTRODUCTION

How scholarly activity is operationalized, and related challenges to its successful completion, may be unique to the individual institution. Larger departments, especially older, university-based programs, have likely already navigated this challenge. Some smaller, newer, and non-university-based programs have also done so, with great creativity. But many programs continue to struggle with these challenges, placing them in danger of being cited during RRC review. This chapter is intended to help departments identify and overcome common pitfalls limiting the successful development of a resident-level research and scholarly activity program. Although the target audience of this chapter is academic faculty — including leadership from the residency, research group, and department — the lessons provided in this chapter will also be of value to residents and junior faculty who are just embarking on their scholarly journey.

PITFALL NO. 1: FAILURE TO PLAN EARLY ENOUGH

Early planning is required for success with any scholarly activity. Residents will come to a residency program with varying levels of experience and skill in project management and organization. Faculty must be aware of this diversity in resident experience and plan to guide residents through time management and other critical aspects of scholarly project planning. Few residents recognize the tremendous effort required to complete a successful research project. There is a balance to be struck between self-directed and mentored timeliness. One time-saving method is to consider utilizing quality improvement projects with measurable outcomes to satisfy the scholarly activity requirement.[2]

Planning early is also necessary for the residency program. Departmental leadership needs to support building a research education program, which takes time and patience.[3-11] Performing a needs assessment (including surveys, committee formation, interviews, and faculty and/or resident retreats) prior to the development of a research curriculum or educational program is recommended, but not routinely performed. After program implementation, evaluation of the program should be performed through standard measures of curriculum review such as surveys, quizzes, or interviews.[8] Establishing a residency research director role early in the process (who will implement the program and work to overcome the perceived barriers to resident research) can be a catalyst for early planning, program organization, project management, and improving the match between resident and faculty research interests.[5]

PITFALL NO. 2: FAILURE TO ALLOCATE ADEQUATE TIME

Residents must allocate adequate time to prepare and complete their scholarly project, despite many competing demands for their time and attention. In addition to the time needed to complete the project itself, the resident may also need to allocate time to participate in research training or other educational activities intended to prepare them for the experience. Consequently, the amount of time needed to complete a scholarly project will depend somewhat on the degree to which the resident is already capable of engaging in the educational effort. The amount of time that will need to be allocated to the scholarly project should be predicated upon an understanding of the learner's previous experience with scholarly activities and their ability to rapidly integrate new information, in addition to the specific needs of the proposed project. This determination depends upon a familiarity with both the resident and the timeline associated with the selected scholarly activity. For this reason, we suggest that determinations of the time needed to complete a scholarly project should be made by a member (or members) of the faculty who are familiar with

both the resident's past experiences, as well as the requirements of the scholarly project. It may be necessary to engage multiple members of the departmental faculty in this decision-making process.

Residents should be encouraged to learn research fundamentals and explore options in choosing a scholarly project early in their residency career — preferably in their first year of training. Delayed completion of this task will lead to overly hasty decisions later in residency, lowering the overall quality of the scholarly project. We recommend that residents be informed of the need to seek a mentor and develop their scholarly activity project during the first year of residency — preferably *early* in their first year. The expectation should be that they have settled on a well-formulated plan for their scholarly activity by the end of their second year of residency at the latest. Firm deadlines for these landmarks may need to be established and communicated by residency leadership. Residents should be educated on the time commitment required for both prospective and retrospective research, as well as other options for completion of the scholarly activity requirement early in their residency career. This will help establish realistic expectations regarding the time required to satisfy this requirement.

Prospective data collection may take several years, and residents may not be able to obtain the required data unless the project was initiated and well-managed early in their training. A retrospective project may be a more reasonable option if the resident plans to initiate the project later in their training. A detailed timeline prepared by the faculty mentor may help the resident stay on track and not feel as if their efforts are being compressed into an unreasonable timeframe. The timeline will also serve as a benchmark to assess the project's progress and may enhance the resident's satisfaction with completion of each timeline task.

PITFALL NO. 3: FAILURE TO SET REALISTIC GOALS

With guidance from their mentor(s) and departmental research director, *residents should set realistic goals regarding the time required to achieve research goals, the available resources at their institution, and the ability of the faculty mentor and resident to complete the project*. Many programs face limitations in facilitating certain types of research. However, they can still provide the resources needed to support meaningful scholarly activity, educating residents to become lifelong learners[12] and preparing them to become informed consumers of the medical literature.[13] Faculty mentors, including the departmental research director, must assess the resident's goals for the scholarly activity project and determine whether these goals are achievable with the time and other resources allotted.

PITFALL NO. 4: FAILURE TO CONSIDER ADMINISTRATIVE CHALLENGES

Residents who wish to engage in scholarly activity require guidance from experienced researchers and academic faculty. To facilitate this guidance, *program administrators must invest time and effort to establish a clearly-defined administrative structure for research and scholarly activity*, including specific roles and responsibilities for faculty. This structure will depend somewhat on the degree to which departmental faculty already engage in research and scholarly activity. Departments with a large research budget may already have a paid research director, as well as other resources (e.g., biostatistician, administrative staff to assist with IRB submission, etc.) that can be co-opted for resident-level projects. However, programs with little or no departmental resources allotted to support research and scholarly activity may need to be more creative in finding ways to utilize available

resources to support resident-level projects. One universal struggle for departments seems to be balancing available resources for research against other priorities. Operational and education priorities often occupy limited administrative resources.[4,11,14,15]

The research director role is crucial to the success of a research and scholarly activity program. If your department already has a research director, it is important to confirm that this individual is able and has adequate time to assist with resident-level projects. If this role does not exist at your institution, or if that individual is not able to facilitate resident projects, it is advisable to establish a distinct resident research director, with responsibilities specific to resident-level projects. This role could be filled by a program director or assistant program director if the individual has sufficient familiarity with research methods and local resources.

The research director should have ultimate responsibility to ensure that residents are able to complete a scholarly activity. They should coordinate and track the assignment of mentors, as well as vet mentors to ensure that they are appropriate to the topic and individual resident's needs. This role also needs to facilitate the creation of a resident scholarly activity policy for the program and ensure that this policy is communicated to residents and faculty. This person should be prepared to respond to queries about local resources for scholarly activity, including: (1) sources of funding (as appropriate); (2) biostatistician and medical librarian services; (3) pre-existing departmental research studies; and, (4) other sources of departmental assistance for resident researchers. They should be an advocate for the resident research and scholarly activity experience within the department and provide a clearinghouse function to match interested residents with opportunities to pursue their vision for completion of this graduation requirement. Investment in a dedicated and enthusiastic research director will help overcoming challenges in coordinating scholarly projects and result in a worthwhile experience for learners.

Many programs do not have adequate ancillary staff to assist in the day-to-day activities required to coordinate a resident research program. It may be unreasonable to expect the research director to absorb the additional workload associated with coordinating a resident research program alone. When feasible, this role should be assigned administrative support staff to help schedule meetings and compile data related to the resident research program. If this is not feasible, we suggest that other faculty be assigned to assist the research director in completing specific functions related to this role. A research assistant can help streamline review by the IRB, collect / abstract data, and aid in manuscript submissions. A biostatistician can help faculty learn data analysis and research methodology, while also providing statistical review prior to manuscript submission. Research assistants and biostatisticians can be a costly investment for the program, yet some programs are able to have funding provided via their academic affiliation.[3]

Programs should also consider the additional administrative burden associated with navigating the process of IRB review and approval for resident-level projects. As discussed in other chapters, many projects perceived by the study team as quality improvement projects may be considered human subjects research by the IRB. The institutional review board is ultimately responsible for making this determination, and many target journals where study results are reported will require formal confirmation from the IRB that the project has been either approved or exempted from their supervision. Case report publication often requires written consent from the subject, even when the patient information is de-identified. In cases where written consent from the subject is not feasible, many journals require a letter from the IRB confirming that adequate effort to contact the subject of the case report has

been made.[16] Familiarity with the local IRB's policies regarding resident involvement in research is essential to the success of a resident-level research and scholarly activity program and is therefore also an essential characteristic of a competent research director.

PITFALL NO. 5: FAILURE TO FOCUS ON RESIDENT INTERESTS AND MOTIVATIONS

Failure to align scholarly projects with the career goals, fellowship aspirations, and interests of the resident will undermine efforts to generate enthusiasm and motivation on the part of the resident to complete the project. Faculty must try to foster resident enthusiasm for scholarly activity in general, and specifically for the scholarly project. Understanding that scholarly activity can improve their clinical performance may help to motivate some residents.[17] Lack of interest can be overcome by creating an atmosphere of inquiry throughout the department using conference or asynchronous learning features, including an evidence-based medicine curriculum or journal club where residents learn to search and critically appraise the primary literature relevant to improving emergency care.[3,18] It is important to create a departmental culture in which scholar activity is recognized as a valued educational outcome.

Some programs have developed recognition and rewards[19,20] to incentivize resident and faculty completion of these milestones. This helps overcome the perception that there is limited value in scholarly work by residents.[3,4,14,21,22] Additionally, residents often perceive required scholarly work as checkbox activity mandated by the program that is not relevant to current performance and future success as a lifelong learner.[23,24] However, resident research has shown to be associated with increased clinical performance during training,[17] as well as the decision to continue an academic career after residency.[25]

Faculty motives and interests are also important. Academic faculty members are role models for residents in many ways, and residents may consciously or subconsciously mirror the attitudes of their mentors toward scholarly activities. Therefore, it's important that resident-level scholarly projects are seen to have value to the faculty members involved, and that project mentors appear enthusiastic in their support of the residents' efforts. Some project mentors may possess the technical skills and knowledge needed to complete a project but lack the time or enthusiasm to properly support the resident. For this reason, the research director should consider how a proposed scholarly project fits into the career goals and academic interests of the mentor, as well as the resident.

PITFALL NO. 6: LACK OF SUPPORT FOR FACULTY IN BECOMING GOOD MENTORS

Many faculty members feel uncomfortable or underqualified to serve as a scholarly project mentor, which can create reservations or resistance to serving as a mentor. When building or strengthening a resident research and scholarly activity program, **program leadership should allocate time and resources to faculty development of project mentors**. These efforts will pay dividends for education, resident experience, and creating a community of inquiry. As an important component in developing and fostering an academic culture, these efforts should be coordinated with the department's vice chair of education or other individuals delegated by the chair and should be treated as a department-wide initiative, rather than being offered only to select faculty. Developing a high level of comfort with the prospect of resident mentorship will broaden the field of candidates

eligible to serve in this capacity and help avoid bottlenecks in matching residents with a mentor. Qualified faculty members should plan to train other faculty to serve as resident mentors, and this "training the trainers" process" will require additional planning and resource allocation.

As mentors, faculty members should promote an open dialogue with learners, and encourage their mentees to seek assistance from them when "hitting a wall."[3,7,8,14,15,26-34] Regularly scheduled meetings promote a feeling of project progression and help identify issues early on that might otherwise lead to delays. However, a balance must be struck between meeting too frequently (leading to low-yield meetings) and meeting so infrequently that the resident and faculty do not feel accountable to complete tasks in a timely manner. Mentors should plan to set aside time to meet with their mentees regularly while also being flexible in varying the meeting frequency over the course of the project, recognizing the fluctuating demands on residents' time as their clinical rotations change

Junior faculty, especially those early in their research career, benefit from mentorship by more senior faculty, including targeted advice, coaching of a specific skill (e.g., data analysis, grant writing), or assistance in making extradepartmental research connections.[35] Meetings between mentors and mentees may be held individually or as part of a group. Distance mentorship may become more frequent in the future and may be less demanding on the mentor, though perhaps less effective for the mentee.[36,37]

PITFALL NO. 7: OVERESTIMATING THE RESIDENT'S ABILITY TO COMPLETE THE PROJECT

Overestimating one's own abilities as they pertain to specific types of scholarly work (e.g., chart review, prospective data collection, or review of the literature) can lead to delays in meeting deadlines.[19] Although early and frequent mentorship meetings may help predict future bottlenecks, acquiring the necessary skills to complete a scholarly project may require additional time, coursework, mentored learning, and self-study by the resident. It is imperative that the mentor critically and objectively assess the resident's ability to complete the project early in project planning to identify additional training that may be required. The necessary time for the resident to acquire these prerequisite skills should be thoughtfully incorporated into the project timeline, and the mentor should plan to reassess the resident's progress in achieving these educational goals in subsequent meetings. It may not be possible for all residents to acquire the skills needed for some projects that include advanced statistical analysis or familiarization with statistical software packages. Mentors may also need to acquire additional skills or knowledge to support the project. This can also be problematic, considering the tight timelines associated with completion of resident scholarly activity projects. For example, it may be difficult for faculty to acquire skills with advanced statistical software packages before the project is due or if it is nearing the completion of a resident's training. It is important for residents to complete activities in a timely fashion, without cutting corners, in relation to graduation. Residents and mentors without a substantial fund of knowledge in research may do well by collaborating with others and considering packaging a well-designed quality improvement project to meet the scholarly activity requirement.

PITFALL NO. 8: FAILURE TO CAPITALIZE ON COLLABORATION AND NETWORKING OPPORTUNITIES

Collaboration with other faculty, departments, or institutions can lead to improved access to resources, including funding, data, ancillary support staff, technical expertise, and content knowledge. However, collaboration has its own investment costs, and opportunities to collaborate with others outside of the program will require early effort and an upfront investment. Leaders should ponder the potential benefits of these additional resources when considering potential collaborative partners, while also recognizing that collaboration may place additional burdens or expectations on the program.

Networking with individuals or programs outside of your department can also benefit the program. Experiences at national conferences or professional interest groups can be motivational for faculty and residents and may provide a venue for networking opportunities. Consider individually-centered versus group-centered mentorship while using a variety of communication platforms (e.g., teleconsult and emails, rather than face-to-face meeting, etc.) to make this process easier.[28] Some networking opportunities worth considering are:

- Institutional / interdepartmental
- Local, state, regional, national, and special interest groups, such as a county medical society or the state chapter of a national organizations (e.g., ACEP, SAEM)
- Institutional, public health, and national information databases
- Platforms for collaborative learning and project development

Collaboration and networking may be especially helpful for smaller programs that do not have adequate expertise or resources to develop and maintain a scholarly activity program. Focused discussions with faculty from other departments or institutions may provide valuable insight into best practices for developing your scholarly activity program and help identify common pitfalls your program will face.

PITFALL NO. 9: FAILURE TO PROVIDE ADEQUATE FACULTY TRAINING

It is difficult for faculty to effectively teach methods for the conduct of scholarly activity if they do not have this skill set themselves. Faculty members may be hesitant to reveal their deficiencies or may not have identified gaps in their knowledge prior to assuming the mentor role. This underscores the importance of an open and adequate conversation between the research director and prospective faculty mentors focused on the mentor's skills and what resources must be mobilized to prepare them for this important role. It should not be assumed that all faculty members have already received adequate training in research methodology, even when they have prior experience in conducting research or generating scholarly output. Faculty may be learning it as they go, and may not recognize the need for additional training. This is an important role of the research director — to recognize that need and facilitate training for interested faculty members. The prospect of additional training may be a motivator for faculty members to become involved in resident mentorship, as it may yield positive benefits for them in their own academic pursuits.

Faculty members may also not have a strong background in research curriculum design and/or academic writing skills. Curriculum development and research education is often cited as an impediment to program success. This includes ensuring core faculty have familiarity and promote understanding of research methodologies.[3,4,8-10,14,15,19,22,26-28,38-40] A structured research curriculum could be created to address research methodology, academic

writing, biostatistics, literature searching, and IRB operations.[3] Alternatively, some faculty members may choose to enroll in a research fellowship or program that grants an advanced degree in clinical research. A much less time-consuming option for faculty members is to enroll in non-degree granting coursework such as the EMBRS course sponsored by ACEP, or SAEM's Advanced Research Methodology Evaluation and Design (ARMED) course and grant writing workshop.

PITFALL NO. 10: FAILURE TO PRIORITIZE RESEARCH WITH LOW FINANCIAL IMPACT

Programs with limited research funding availability should prioritize low financial impact projects. Examples of research that do not generally require funding include systematic reviews and meta-analyses, structured reviews of the literature, commentaries, case reports, surveys, and quality improvement projects. Research programs have implemented evidence-based medicine educational programs to teach lifelong learning skills to both residents[12] and faculty[18] by increasing their knowledge of how to perform and analyze systematic reviews and meta-analyses. Residents paired with a faculty member who has similar or overlapping areas of academic interest may choose to write a brief commentary or review of a topic on which they would like to have a deep fund of knowledge. Additionally, many large datasets are publicly available, such as National Hospital Ambulatory Medical Care Survey (NHAMCS), National Ambulatory Medical Care Survey (NAMCS), Medical Expenditure Panel Survey (MEPS), and Nationwide Emergency Department Sample (NEDS), which are free to access but do require a faculty member or resident to have or acquire the skills necessary to analyze "big data."

CONCLUSIONS

The development of a formal resident research and scholarly activity program is a daunting task that requires the coordination and mobilization of many different resources. The success of such a program relies heavily upon identifying the right individuals to lead and support it, especially the appointment of a dedicated and enthusiastic research director. Faculty members should be provided with the tools necessary to be effective mentors to resident learners, including adequate protected time, establishment of a departmental culture of inquiry, and prerequisite skills in research methodology. It is important for departmental leadership to allocate adequate resources to this effort and to identify which resources are needed early in the process. Collaboration and networking may help motivate residents and faculty members to succeed and can also provide additional resources to ensure their success. Recognition of common pitfalls to developing a resident-level research and scholarly activity program may prevent programs from making costly and potentially disastrous mistakes.

➲ *KEY CONCEPTS*

- Planning for a resident-level research or scholarly activity project should begin as soon as possible, preferably within the first year of residency.
- Residents should meet with their project mentor frequently, and make best use of their time by preparing specific questions and other needed materials before the meeting.
- Residents should set realistic goals for their scholarly activity projects, including appropriate timelines and manageable objectives. Similarly, residency programs should establish realistic expectations of what residents can achieve while in training.

- Departmental leadership must invest in faculty development to ensure that both faculty and residents receive quality research training.
- Departments and residency programs are responsible for establishing a culture of inquiry that values and facilitates research and other scholarly activity.

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DEFINING A RESIDENT-LEVEL RESEARCH / SCHOLARLY ACTIVITY PROJECT

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ABSTRACT

This chapter suggests an approach that residents and residency directors can use to define an achievable resident-level research / scholarly activity project (RLRSAP) in emergency medicine. Such projects are often executed in a low-resource environment without external funding despite many other competing demands for participant time and other resources. We suggest that the early definition of an achievable project is of critical importance to the success of the venture. Valuable RLRSAPs need not be limited to clinical or basic science research. Those organizations that govern the education of EM residents have made it clear that quality improvement (QI) efforts, book chapters, evidence-based clinical guidelines, systematic reviews, and more modern formats such as Free and Open Access Medicine-Emergency Medicine (FOAM-EM) podcasts can satisfactorily fulfill this requirement. Although the ACGME has not yet defined specific milestones for resident physicians regarding scholarly productivity, a systematic approach should nonetheless be employed to evaluate potential RLRSAPs.

Important parallels exist between QI and research topics, although key distinguishing features between these two main types of inquiry must be carefully navigated to avoid regulatory inquiries or sanctions. Regardless of which type of RLRSAP is completed, the resident and their faculty mentor must define achievable expectations, mindful of the attributes and limitations inherent to both the academic department or division and those individuals executing the project. Specific examples of potential resident-level clinical research projects are provided in the chapter to illustrate these points.

"A man's gotta know his limitations"[1]

— Clint Eastwood, as "Dirty Harry" at the end of the movie "Sudden Impact"

BACKGROUND

Before discussing methods for defining a worthwhile RLRSAP, the authors would like to recap and elaborate upon key points described in other chapters of this text that are germane to the discussion. Such review will enable the reader to gain adequate background and context for this chapter, helping to maximize its usefulness.

Chapter 1[2] notes the manner by which the recently merged accreditation requirements constituting the Common Program Requirements for allopathic (MD) and osteopathic (DO) residency programs have broadened the definition of an acceptable RLRSAP.[3] Chief among these changes is a clarification that QI projects can satisfy the requirement for a RLRSAP, because such investigations may still represent an important component of an institution's culture of inquiry. The Society for Academic Emergency Medicine (SAEM) Research Directors' Interest Group (RDIG) also recently proposed a concise definition for best-practice scholarly activity. This group suggested that the steps in the scholarly activity process should include: (1) hypothesis generation; (2) data collection; (3) data analysis; (4) data interpretation; and (5) critical appraisal.[4] These discrete steps will be required for both traditional clinical research and QI efforts, which share the common goal of "assessing or changing behavior in discrete settings," and are equally applicable to the creation of evidence-based clinical guidelines, systematic reviews, and book chapters.[4]

Chapter 2[5] provides specific language from the ACGME for EM,[6] CORD,[7,8] and SAEM,[4] summarizing expectations regarding the acceptable completion of a RLRSAP. Following the SAEM Board of Directors' approval of specific language for these expectations, ACEP and ACOEP also explicitly adopted the SAEM language. However, the wording of these expectations was opposed by EMRA, CORD, the ACOEP-RSO, and the AAEM/RSA. These dissenting organizations voiced an alternate opinion supporting a broader definition of scholarly activities.[9] Despite the general transition within EM toward tracking residents' achievements of clearly defined educational milestones while in training, it is pointed out that **no ACGME milestones exist** for EM specifically relating to resident research and scholarship.[10] It is also noted how helpful and important a specific curriculum can be toward supporting a program capable of facilitating RLRSAP completion, including clearly defining which academic faculty are ultimately responsible for each component of the overall enterprise.

Chapter 3[11] reinforces the concept that no clear consensus exists for the definition of "scholarly activity," with suggested definitions ranging from the narrow definition endorsed by the ACGME to more inclusive definitions espoused within the broader academic medicine community at large. Many differing opinions exist within the academic EM community as to what type of project qualifies as scholarly activity. There may not need not be a one-size-fits-all model for RLRSAPs, although the scholarly activity must incorporate certain key elements,

including how it will challenge and educate the learner and contribute to an institution's culture of inquiry. This chapter also advises how less traditional scholarly activities, such as contributions to FOAM-EM, can satisfy these RLRSAP requirements.

Chapter 4[12] centers on how to motivate residents to develop their intellectual curiosity and complete an RLRSAP despite other competing goals, such as achieving satisfactory in-service examination scores, attending clinical shifts, and participating in scheduled didactics.

Having established this basic groundwork for the current challenges facing residency leadership and research directors in defining the scope of a RLRSAP, this chapter includes our interpretation of this requirement's purpose, citing practical methods that can be used to define an individualized plan and identify common pitfalls to avoid while planning and executing such a project. Our guidance in this chapter includes how to address the following topics:

- Defining the purpose of the RLRSAP
- Framing project expectations
- Identifying key challenges
- Avoiding the overly ambitious project
- Preparing for success
- Getting started
- Defining the clinical question (P.I.C.O. Criteria)
- Assessing the clinical question (F.I.N.E.R. Criteria)
- Distinguishing research from quality improvement
- Identifying departmental resources
- Considering funding sources
- Developing a timeline

We propose that a firm understanding of these basic principles will enable the EM resident to define and develop a suitable RLRSAP, and aid the mentor in facilitating its successful completion.

DEFINING THE PURPOSE OF THE RLRSAP

The overarching purpose of a RLRSAP in EM is to aid in the development of analytical skills that will facilitate lifelong learning for the resident. Lifelong learning is a crucial skill for all emergency physicians. One should expect that the dogma and accepted practices of EM will change more over the next 30 years than they have in the past 30 years.

Toward an informed historical perspective, let us consider some of the "standard of care" practices espoused as recently as 1990. At that time, few if any emergency physicians performed their own bedside ultrasound examinations. Although the exact date of the first peer-reviewed publication regarding emergency physicians' use of this technology is somewhat controversial,[13] the ability to perform bedside ultrasound did not appear as a milestone in the core content of EM until 2012.[14] [For detail on the history of adoption of bedside ultrasound as an important emergency physician competency, the reader is referred to Lewiss et al.[15]]. Similarly, contemporary editions of Cope's "Early Diagnosis of the Acute Abdomen" from the 1990s retained the same outdated precautions regarding the provision of opiate analgesia to patients with acute abdominal pain that prior editions had conveyed since the book's initial publication in 1921.[16] Readers of this well-respected textbook were reminded that patients with an "acute abdomen" should not receive opiate pain medication until the patient had received a proper evaluation by a surgeon — assessment by an emergency physician did not suffice. By 2000, this dogma had been

successfully challenged by thought leaders within our own specialty.[17] Thanks to the efforts of clinical researchers in EM, this specific imperative from Cope's opus is now little more than a historical footnote. Finally, the use of aminophylline infusions to complement oral theophylline was common for patients with difficult-to-manage acute asthma exacerbations three decades ago. In fact, aminophylline was proposed as an "essential medicine" on the World Health Organization (WHO) Model List of Essential Medicines as recently as 2004.[18] However, increasing awareness of this drug's arrhythmogenicity has informed an updated view of its limited utility in the emergency department. A 2012 Cochrane Database review reinforced the notion that the harms of this drug, chiefly dysrhythmia and severe vomiting, are now felt to exceed any benefit of its routine use for acute asthma exacerbations.[19]

These examples illustrate the risk of relying exclusively on anecdote and historical precedent to inform emergency care, and the need for those who actively practice EM to be involved in advancing the field forward. Although our specialty owes its roots and origins to our academic ancestors in the broader fields of surgery and internal medicine, we are now responsible for vetting historical medical practices from our own dynamic and evolutionary viewpoint*. Because we seek and deserve authority to spearhead the early management of time-sensitive conditions, we must continue to refine our practices.* Ongoing research and critical revision of the medical literature are required and expected if our field is to continue its hard-won leadership in the treatment of acute conditions.

We cannot know which of our current EM practices will seem dated when viewed through the lens of a medical practitioner in 2050. Thus, the essential skills required for critical appraisal of the medical literature and lifelong learning must be imparted to all EM residents-in-training. Given the rapid advance of medical knowledge, emergency physicians who fail to successfully incorporate lifelong learning skills into their medical practices will find it increasingly difficult to shed the misconceptions of traditional management strategies in favor of the newer and better-informed evidence-based practices and technologies that will inevitably emerge.

In the modern era of social media and fake news, it is especially important for EM physicians to be capable of critically appraising new research information, including the methods by which that information was acquired. *The execution of an RLRSAP hones many skills that will enhance effective lifelong learning, helping to mold the EM resident into an educated and fair-minded critic and consumer of the medical literature.* The resident will be empowered to capably integrate new knowledge and procedures into their practice of the specialty. This ability will yield benefits for both patients and the practitioner throughout their medical career.

FRAMING PROJECT EXPECTATIONS

The ability of each program to define institution-specific guidelines for the development and completion of an RLRSAP hinges largely upon **framing reasonable expectations** and avoiding overly ambitious goals. To this end, we propose three basic criteria for defining a study question to be answered by any resident-level scholarly activity project:

1. **The knowledge gained by successful completion of the RLRSAP should, at a minimum, *have value to the local institution*** at which the project is executed. Though desirable, it should not necessarily be required that the project produce new information usable outside of the local practice environment.
2. **Completion of the RLRSAP must *be supported by adequate institutional resources*** to make the project feasible. For instance, there must be enough relevant information on a clinical problem of interest available for collection over the time allotted to the project.

3. **The RLRSAP must *be guided by an appropriate faculty mentor*** with sufficient interest and expertise to serve capably in guiding the learner through the process of project development and execution.

While the presence of these three basic criteria does not guarantee successful project completion, it does at least suggest the feasibility of the project beyond the concept phase.

One especially important component of an appropriately constructed RLRSAP is a well-defined completion date. Realistically defining completion parameters for the project will ensure that the RLRSAP can be completed by the learner in a timeframe that allows the resident to maintain ownership of the project from beginning to end. A sense of ownership over the project and its outcome will add value to the educational experience for the learner and facilitate active learning rather than passive participation in the project.

Framing reasonable expectations for the RLRSAP should begin with a general understanding of the resident's skill set and career focus. Some residents will have academic aspirations. To best mentor them, it is useful to know if they have previously participated at a meaningful level in other research projects, perhaps during their years as a medical student or while obtaining an advanced degree such as a PhD. The RLRSAP can be an important, if not the first, installment in a long and fruitful career in academia.

Other residents will possess a strictly clinical interest and have no plans for academic endeavors after graduation. In such cases, gaining the skills of inquiry needed to execute a high-quality QI project or interpret a literature review may be of greatest value to them, regardless of the type of patient population (e.g., rural, urban, academic, or community-based) they will eventually serve. It is impossible to imagine any clinical department of EM that does not value and undertake periodic efforts toward QI within the local care environment. Any residency graduate who learns the skills needed to execute a worthwhile QI project will have gained skills of great value to future employers.

The wise faculty mentor will ensure that the resident has a self-motivating interest in the topic of their RLRSAP. While residents may express an interest in contributing to developing or ongoing research projects, one must not overestimate the level of interest and intellectual curiosity that the resident possesses in fulfilling this obligation. Ultimately, the resident must be excited to contribute to the project, whether the project is self-generated or previously established by others. Understanding the resident's career focus and their demonstrable level of interest in the proposed project will enable the faculty mentor to aid the resident in developing a worthwhile RLRSAP of long-term value to the resident, leveraging their intellectual curiosity and enthusiasm to help ensure a positive and productive scholarly activity experience.

IDENTIFYING KEY CHALLENGES

The 2012 ACEP publication, "Emergency Care Research: A Primer," includes a great deal of useful information regarding common challenges that EM investigators face when developing and executing a clinical research project.[20] Table 1 (extracted from this source) lists some of these important challenges to consider in developing such a project.[20] The wise resident and mentor will review this list prior to making any final decisions on the feasibility of a RLRSAP, as any or all of these difficulties could complicate or even subvert an otherwise appropriate project. Although these additional factors relate most directly to prospective clinical research, similar considerations will emerge for other types of investigations, including QI projects and retrospective chart review studies.

TABLE 1.

Key Challenges in Emergency Care Research[20]

	Time	Personnel	ED Conditions
Study population	Life-threatening, acute conditions, unstable physiology	No prior relationship with subject, multiple providers at any given time	Crowding, acuity of other patients
Intervention	Time-sensitive action of drugs or use of devices	Shift work, need to train many staff, on-call research personnel who require travel time	Storage issues for drugs, devices, and other research materials
Data collection	Missed time points	Difficult to maintain quality oversight	Interference due to need for clinical care
Infrastructure	Dependent on intervention	Need to train a large number of staff, monitor process	Staff burdens, competing clinical tasks, privacy issues
Individual patient factors	Dependent on intervention	Staff uncomfortable with research personnel	Staff burdens, competing clinical tasks, privacy issues
Informed consent	No family or surrogates present; may exclude certain populations	Off-site personnel; large need for training and orientation; language, literacy, and vulnerability issues	Need for clinical care, bias toward staff performing status quo
Regulatory issues	Multiple reviews	Inexperience	Competing demands for clinical care

The challenges listed in Table 1 illustrate some of the crucial aspects of a proposed RLRSAP in EM that may inform an awareness of the potential challenges and limitations inherent to clinical investigations in the field of emergency care. Depending on the precise question to be answered, some of these challenges may exert a larger influence over the feasibility and success of the project than others. Nonetheless, all should be considered, if only to rule them out as potential pitfalls.

AVOIDING THE OVERLY AMBITIOUS PROJECT

A common mistake of the uninitiated into any field of inquiry is overestimation of one's ability to advance that field. Resident researchers, like all novices, will be naturally inclined to expect more than can reasonably be gleaned from a simple research project. For this reason, it is common for the unseasoned researcher (in the absence of expert guidance) to construct a well-intentioned project that could deliver clinically useful information if successfully completed, but that ultimately fails to "deliver the goods" upon its execution.

Chapter Example: Strangulation victims who suffer laryngeal fracture often die at the scene, but those who survive strangulation may be at risk of ischemic stroke due to subsequent arterial dissection.[21] A hypothetical novice researcher may wish to explore whether certain patient history or physical examination findings can predict the presence of such an arterial dissection, and whether an algorithmic approach to the problem[22] that has been compiled and disseminated without a supporting body of research can be supported by clinical data. In developing their RLRSAP proposal, the resident might define a methodologically sound study intended to investigate whether certain patient history clues (e.g., loss of consciousness, bowel or bladder incontinence) or physical examination findings (e.g., subconjunctival hemorrhage, pervasive facial and/or cervical petechiae, overt bruising to the neck) could accurately identify victims of strangulation who are at risk of an arterial dissection — thus placing them at risk for a subsequent ischemic stroke. Such a project, if executed properly, would have clear clinical value. However, most institutions would be challenged to accrue an adequate number of such patients *prospectively* during the span of a single resident's training. On the other hand, the granularity of individual patient history and exam data available from a *retrospective* review of the EHR might also be insufficient to discern whether these clinical criteria are predictive for the outcome of interest. The presence or absence of clinical clues deemed to be potential predictors of arterial dissection may not have been recorded in the EHR by care team members at the time of the patients' clinical care episode. Thus, the proposed study might appear feasible in principle but would ultimately fall victim to a lack of available data. As this example illustrates, *the lack of adequate recoverable patient data or other crucial resources can render a well-intentioned project impossible to execute.*

Unfortunately, RLRSAP execution is not an endeavor like the college application process where one may have simultaneous goals, such as a "stretch" goal of admission to a prestigious or highly selective school, while simultaneously supporting the achievement of an alternative goal, such as admission to a less-desirable institution. An RLRSAP is more of an "all-or-nothing" endeavor, in which the failure of a RLRSAP may have an adverse effect on the learner's motivation and future academic efforts.

The time required to develop and execute an RLRSAP is an investment that is likely to be without full reward if the project fails to achieve its primary purpose. Although the learner may still acquire limited skills and knowledge in developing a failed project, they will not have the satisfaction of completing the project and will likely never have the chance to share their results through publication or other forms of information dissemination. This robs the resident of a large measure of the value in scientific inquiry and may discourage them from future academic efforts.

If the research mentor does not recognize early in the development phase the limitations that will ultimately commit a project to failure, the resident may spend an inordinate amount of time developing the protocol and collecting the limited data available. This can lead to much wasted time, frustration, and (eventually) loss of intellectual enthusiasm, culminating in inevitable project failure.

Given the competing demands of residency training, the brief three- to four-year training period (including approximately 50% of clinical rotations centered outside of the ED) and the fact that data collection processes require time and ongoing supervision, abandonment of a failed resident research project can be catastrophic for the resident researcher. Most will not have the time and resources needed to begin a second project later in the training period. In short, *a modest but completed project is far superior to an overly ambitious and ultimately failed one.*

PREPARING FOR SUCCESS

The "Ten Commandments" of emergency care research offered by ACEP's 2012 *Emergency Care Research: A Primer*, provide additional guidance on how to achieve success in EM research.[23]

1. Get advanced training.
2. Find a mentor.
3. Collaborate.
4. Make a commitment and be passionate about [the] work.
5. Ask important questions.
6. Be honest and humble.
7. Focus.
8. Plan your research around meetings and publications.
9. The enemy of good is perfection.
10. Learn from your mistakes.

Although these "commandments" are written from the perspective of a "generic" EM researcher, we offer these additional observations more relevant to the novice resident researcher:

1. **Get advanced training**: The opportunity to obtain advanced training with a research fellowship is clearly not an option for those still matriculating through EM residency, although senior residents may benefit from attending the annual Emergency Medicine Basic Research Skills ("EMBRS") course offered by ACEP, or SAEM's Advanced Research Methodology Evaluation and Design ("ARMED") courses. The SAEM Research Learning Series (RLS) also offers targeted training on specific EM research topics, although many topics offered here are also advanced. Residents should seek out available training in research methods from established EM sources, especially if presented in short installments. If your program does not offer institution-specific research training, the project mentor must be prepared to supply such expertise — either by themselves or in collaboration with other faculty members. Consequently, one major function of the RLRSAP mentor is situational awareness of the resources available to the resident, including both local and nonlocal sources.
2. **Find a mentor**: Finding an appropriate faculty mentor is a crucial and necessary step for any resident researcher. Many residents will locate their own mentor via discussions of possible scholarly projects of mutual interest with local faculty members. Others may be matched to a mentor by a designated faculty member who oversees the scholarly project process within the local residency program. Appropriately matching a resident with their RLRSAP mentor is a crucial early (if not first) step in the process of defining the RLRSAP and ensuring the project's ultimate success. Even for those cases in which the resident finds their own mentor, it is advisable for a designated faculty mentor to vet these matches and ensure that the proposed mentor is both available and truly capable of serving effectively in this capacity.

3. **Collaborate**: Consider collaborating with other resident physicians who share a common research interest, as well as any available faculty mentors offering expertise on the area of interest. Collaboration may increase not only the quality of the proposed study, but also the pool of resources available to the study team.
4. **Make a commitment and be passionate about the work**: Motivation, passion, and a commitment to seeing a project completed may be the resident's single greatest contribution to the success of their research project. The resident physician should not expect the faculty mentor to drive the project's progress. Rather, *the resident should provide the enthusiasm to fuel the mentor's guidance.* Residents usually have more time to dedicate to the project's successful completion than the faculty member and may have more personal investment in the project's success — especially if the project is designed and/or developed by the resident. The resident's insight to the clinical problem could be integral to the project's success, as they may have spent more time investigating the problem than their mentor.
5. **Ask important questions**: Important questions will pass the "So what?" test. If a question does not seem important to anyone but the resident proposing the project, it is not likely to generate value for the institution or anyone outside of the institution. A simple litmus test may be employed here: ask someone. Find out who would be impacted by the information derived from the RLRSAP and ask them how they would use the information ultimately obtained from the project. If the information would not be used, it is probably not important.
6. **Be honest and humble**: Humility suggests that an inquiring mind recognizes its limitations and asks appropriately for assistance in executing a scholarly project. Honesty should be the highest priority for anyone executing a scholarly project. Dishonesty in the scientific method will increase the likelihood of presenting incorrect or misleading findings, and may expose future patients to avoidable harm. The importance of honesty and humility in the execution of an RLRSAP cannot be overstated. As a primarily educational exercise, the RLRSAP should impart a sense of academic honesty and humility in the learner; this may be one of the most important lessons that residents can learn from this process. Honesty on the part of the mentor might also need to be brutal — making hard decisions or suggestions about the project's feasibility early in the process will enable the resident to modify or abandon the project if necessary before valuable time and effort are wasted.
7. **Focus**: Focus is crucial. There will be many challenging days after initial enthusiasm for the resident project has waned, especially when project completion appears distant. Establishing a realistic timeline for project completion — informed by capable advice from the project mentor — can help enhance focus during the long journey between project conception and completion. The resident should define meaningful milestones for study success from the beginning of the project, helping them to gauge their progress as the project advances.
8. **Plan research around meetings and publications**: Residents should be fastidiously mindful of the forums that exist to showcase their findings. We suggest that the resident learner should target a specific forum to present their results — even from the beginning of the project. They should visualize which conference or meeting would be the best "home" for the data that they anticipate generating in their study. They should plan the project accordingly, following a reasonable timeframe from the onset of the project until the final presentation of results. Because most resident-level projects will ultimately yield a poster, consider where the poster should best be hung to achieve optimal results. While

some resident-level projects may land in peer-reviewed journals, this is the exception rather than the rule. Act accordingly. Academic journals may have revolving deadlines, but conferences do not.

9. **The enemy of good is perfection**: No research project is perfect. Residents should expect their RLRSAP to be adequate in its findings (as defined by their mentor and other appropriate authorities) but should not be allowed to continuously tinker with the project until they achieve some semblance of perfection. The goal of proper research project planning is not to seek perfection, but to make an honest appraisal of the study's limitations and to learn how to define those limitations to the study audience in an honest and thorough fashion. A wise mentor will allow the resident to settle for less than the perfection they want if the results they have are the best that can be reasonably expected.
10. **Learn from mistakes:** Learning from their mistakes can enhance a resident's personal growth as a member of the community of scientific inquiry while enhancing the efforts of others who subsequently refine the resident's work. Most seasoned researchers have executed a second version of a project, the design of which was informed by learning from unexpected errors and shortcomings noted during the first iteration. Whether the resident subsequently has a clinical career in which they participate in QI efforts, or an academic career in which they publish original research, lessons learned from the resident scholarly project can inform their planning of subsequent projects after leaving EM residency. The wise mentor will allow this evolution to occur.

GETTING STARTED

Some residents may have trouble getting off the starting line when developing their RLRSAP. Some institutions allow residents to join an ongoing departmental research project, merely to satisfy RLRSAP requirements. Other institutions may make a blanket prohibition of this path. The lack of substantive guidance on this point will ultimately engender great diversity in how the RLRSAP requirement is met. But matching a resident to an ongoing research project requires a working knowledge of the institution's inventory of ongoing projects, as well as transparent, specific, and even-handed criteria to govern the joining-in process. Care should be taken in how residents are deployed into existing projects. Chief among the concerns of academic faculty should be whether the project has real and important value to the resident. Goals for the academic output from an RLRSAP should be centered squarely on the needs and contributions of the resident learner — not simply the needs of the department.

The need for useful clinical research to guide the development and evolution of the specialty is so self-evident as to not require further justification. However, when considering QI projects, it should also be self-evident that all clinical care environments can be improved. The skills necessary to identify improvement opportunities and to subsequently effect appropriate change are highly akin to the skills needed to define and execute a meaningful clinical research protocol. We agree that a resident's ability to complete an evidence-based clinical guideline, systematic review, book chapter, or FOAM-ED project could also be of value to future employers with more of a community focus.

DEFINING THE CLINICAL QUESTION (P.I.C.O.T.S. CRITERIA)

To explore this topic, let's consider a theoretical project focused on the need for postreduction wrist radiographs following reduction of a Colles' fracture. The goal is to determine how ED throughput time (EDTT) would be impacted if patients are treated and released *without* obtaining a post-reduction radiograph. One ancillary goal of the project is to figure out whether post-reduction radiographs meaningfully impact the clinical course for the patient, primarily determined by whether a second attempt at reduction occurred after the post-reduction film.

The project definition should start with a **P.I.C.O.T.S.** statement, including:

- **P:** Who/what are the **patients/population** to be studied?
- **I:** What **intervention** will be studied?
  - For a research project: How will the intervention group be treated or handled differently than other groups?
  - For QI: How will the intervention group be treated differently than it would have been in the past (i.e., prior to introduction of the intervention)?
- **C:** What is the **control** group (i.e., the standard for *comparison* against which the "intervention" group will be made)?
  - For research, the identification of an appropriate control group hinges greatly on the study design. Prospective studies will usually randomly assign subjects to either the control group or the study group, with only the intervention differing between groups. Retrospective designs may utilize a historical control or may employ case matching, but assignment is not often randomized.
  - For QI, the comparison or control group is typically a historical control.
- **O:** What is/are the **outcome(s)** to be assessed? From this, the primary and secondary hypotheses can be clearly identified.
- **T:** What is the **timeline** for introduction of the intervention? [25]
- **S:** What is the **setting/study design** selected for the project?

In this example, the P.I.C.O.T.S. elements might be defined as: P = patients with a Colles' fracture, I = not obtaining a post-reduction film, C = patients receiving a post-reduction film, O = EDTT, T = 3 months (i.e., duration of the study), and S = randomized control trial, in the ED setting.

Utilizing these P.I.C.O.T.S. criteria forces the resident to thoughtfully consider and refine the specific clinical question to be answered by the project. Extra effort to precisely define the clinical question at this phase will ensure the project has a clear direction and purpose.

The **primary hypothesis** in this example could be that omitting post-reduction radiographs for these patients will result in a faster EDTT. The **secondary hypothesis** could be that post-reduction films will not lead to repeat attempts at reduction of the fracture in any cases. A well-defined RLRSAP project should have one primary hypothesis, and at least one secondary hypothesis. The primary hypothesis is a statement of belief on the part of the project team regarding the principal matter to be addressed. It must be explicitly stated before data collection begins (i.e., a priori). Secondary hypotheses are statements of belief regarding other matters that also will be studied, in addition to the primary focus of the investigation. Secondary hypotheses must also be formed and explicitly stated before the initiation of data collection to avoid the appearance of data dredging.

The **primary outcome variable** is a comparison of a "virtual" EDTT that would have resulted for patients if they were released shortly after completion of splinting, versus the actual EDTT that resulted inclusive of obtaining of post-reduction radiographs after their Colles' fracture had been reduced and splinted.

The **secondary outcome variable** is the percentage of cases for which the post-reduction radiograph defined the need for revision of the reduction. If there was no second reduction procedure, it would follow that the post-reduction radiograph had no meaningful impact upon the patient's treatment.

This project could be performed at one institution or at several and could be performed either prospectively or retrospectively. A prospective project would be burdened by the probability that it would be difficult to accrue enough patients to provide persuasive and meaningful conclusions. For an RLRSAP, it is likely the project would be performed via a retrospective chart review at a single institution.

ASSESSING THE CLINICAL QUESTION (F.I.N.E.R. CRITERIA)

Once the clinical question has been clearly defined, the project's value and likelihood of success should be evaluated utilizing the **F.I.N.E.R.** criteria:

- **F:** Is the project **feasible** at the institution? This determination requires an honest assessment of the expertise, available time, and other essential resources needed to achieve successful completion. This is often the hardest question to answer accurately.
- **I:** Is the project **interesting**? Does it pass the "So what?" test?
- **N:** Is the project **novel,** or is it simply such a slight modification of prior projects that it won't be perceived as original or noteworthy?
- **E:** Is the project **ethical**? Does it start from a position of *equipoise* (i.e., the outcome of the project cannot be predicted with certainty before data collection begins)? Does it avoid placing its subjects at foreseeable risk of avoidable harm?
- **R:** Is the project delivering information that will be **relevant** to those who learn of its results? [26]

Like most tools used to assess the value of an idea, the F.I.N.E.R. criteria are somewhat subjective. What is feasible at one institution may not be feasible at another. Even the ethical implications of a study may be a subject of some debate, although the local IRB is the final arbiter of what constitutes ethical research. Because this assessment relies heavily on prevailing attitudes and local resources, it is important to solicit input from others outside of the RLRSAP team before making a final determination on the potential value of the inquiry. Of course, the first assessment of a potential study's value should be made by the resident and RLRSAP mentor themselves.

DISTINGUISHING RESEARCH FROM QUALITY IMPROVEMENT

It is often challenging to distinguish clinical research from a QI project. As stated previously, a high degree of overlap exists between these two types of RLRSAPs. However, important distinctions can be drawn regarding their differences, and it is crucial to make this distinction correctly.

Both clinical research and QI efforts involve defining a specific question, learning what knowledge already exists, and proposing an answer or solution to the problem. In devising and subsequently implementing a clinical research project or local QI solution, data will be gathered and interpreted. Thus, clear parallels exist between research and QI. The unifying theme is that whether researching a new idea or improving the quality of the local clinical care environment, a specific research question must be identified, and an attempt made to identify a specific and reasonable answer to that question — potentially including innovative solutions to troubling clinical issues or quandaries.

Because the line between clinical research and QI can seem blurred, we strongly advise that *investigators should not decide alone whether an RLRSAP is research or QI*. Just as medical decisions should be left to medical professionals, investigators should not adjudicate this matter on their own, without local IRB guidance. An IRB or federal agency may have differing views from researchers on whether a project is or is not considered research. Federal regulatory authorities can be very uncompromising when they find, upon audit, that an institution has engaged in what they consider to be research under the guise of QI to avoid the time and effort required to facilitate IRB oversight.

For instance, Hennepin County Medical Center was accused in 2018 by the Food and Drug Administration of lax oversight for at least three studies that involved sedation of patients.[27] It was later accused in 2019 of not stopping these trials when ordered to do so.[28] As a result, the institution was forced to expend funds for the time of its employees and physicians to address regulatory concerns, amidst its role as a financially challenged safety net hospital.[29] In this unfortunate case, the conduct of research at a primary safety net hospital in Minneapolis, Minnesota, became a subject of avoidable public controversy and negative publicity partly due to a difference of opinion on what constituted research versus standard-of-care patient management and quality improvement efforts. It is always best to avoid such controversy.

Rather than allowing investigators to decide on their own whether an RLRSAP is research or QI, institutions typically have predefined, written criteria to guide this differentiation, and most have electronic links to the local IRB. *The local IRB must be relied upon as the final authority to make this determination.* The IRB will make its determination mindful of federal regulation 45 CFR 46.102(d), which defines human participant research (HPR) as, "a systematic investigation, including research development, testing, and evaluation, designed to develop or contribute to generalizable knowledge."[29] All projects deemed by a study's IRB of record to constitute HPR will require IRB approval, regardless of whether the study team agrees with that assessment.

All residents completing an RLRSAP should be cautioned that if they embark on research or QI efforts after graduation, they *must* avail themselves of assistance from their local IRB to avoid costly mistakes (such as time spent defending oneself and or one's institution, which could culminate in financial penalties). If your institution does not have a local IRB, regional IRBs exist to help make such adjudications. Table 2, modified from an instrument employed by the Wayne State University (Detroit, Michigan) IRB, compares the design, execution, and intent of HPR with QI studies.[30]

TABLE 2.

The IRB Perspective on Research Versus Quality Improvement[30]

Characteristic	Research	Quality Improvement
Purpose	To test a hypothesis, answer a research question, or advance the science of the matter under study.	To address a process, program, or system considered internal to a specific institution.
Initiated as	A prospectively designed, formal, written proposal to test a hypothesis via use of human subjects (including their information, participation, and/or bodily tissues).	To assess a process or an established set of standards within the institution, and which necessarily involves study of patient outcomes at that institution.
Benefits	Knowledge for the advancement of the science of the matter; knowledge may not benefit those subjects being studied.	Knowledge sought to improve processes, programs, or systems at that institution; improvements may or may not benefit the patients studied.
Risks versus benefits	May put human participants at risk of physical or nonphysical harm.	No risk to human participants beyond possible patient privacy or confidentiality.
Data collection method	Systematic data collection.	Systematic data collection
Project objective	To answer the research question.	To improve local institutional programs, processes, and/or systems.
Testing and analysis	Involves review of the relevant biomedical literature before initiation of the project; analysis determines the validity or lack of validity of the hypothesis.	Assesses the impacts of a change in a process, or compares a process, program, or system to some established standard.
Intended result	To share the findings of the investigation with persons not directly associated with the investigation; **designed to revise or contribute to broadly accepted knowledge regarding the topic beyond the walls of the local institution.**	To share findings only with individuals associated with the process, program, or system under study; note: **publication of the results of a QI study is permissible under federal statute, so long as the IRB has determined that the project is QI and not HPR.**
If the conditions enumerated above apply to the data collection effort, IRB review and approval is…	**Required**	Not required; the investigator should use the institution's HPR form to confirm this status, and/or contact the local IRB coordinator to determine whether IRB approval is required for the project.

Returning to our example of the Colles' fracture study, the distinctions between a research version of that study and a QI version of the study centers squarely on whether the intention of the study was to change local practice (e.g., as executed by the local ED physician and orthopedic services) or to inform universal management of Colles' fracture in the ED. While these objectives may seem to overlap, this distinction is supremely important in assessments of whether this hypothetical Colles' fracture study would qualify as research or a local QI project. The researcher may wish to include qualitative data regarding orthopedists' acceptance (or lack thereof) of this new paradigm. Such a perspective may be much more important to a QI project (designed to assess the implementation of local institutional changes) than to a research project, where opinions from the orthopedics team would often be more variable.

IDENTIFYING DEPARTMENTAL RESOURCES

One of the first resources needed to help an EM resident get started on their RLRSAP is a list of all clinical research faculty and their specific clinical research interests. All programs should have such a list that can be provided by residency representatives or research administration. The academic productivity of any academic unit, such as a department or division of EM, is a matter of interest to the RRC for emergency medicine when reaccreditation occurs. Thus, it is logical for residents to expect that such a resource listing active and recent research projects already exists. This list should be compiled and maintained by one or more designated members of the departmental faculty.

Once the resident has acquired this list, they should review it with a critical eye toward identifying a suitable mentor. The resident should be able to identify a logical clinical mentor with whom a project can be planned and executed. The mentor should be prepared to help identify and secure necessary other departmental resources. Every institution has a medical library, although medical librarians are often an underutilized resource. In this era of declining resources, the ability to cite a long list of projects for which they provided literature and data search assistance is a form of job security for medical librarians. Thus, it is in the best interests of both the resident and the medical librarian to take advantage of these resources when they are available.

In contrast, not all institutions offer unfettered access to biostatistical support. Most institutions offer faculty members free access to institutional software licenses, such as the Statistical Package for Social Sciences (SPSS). Freely available shareware also exists for simple statistical testing such as chi-square testing, Student's *t*-test, and the like. Most institutions have faculty members through whom statistical guidance and advice can be obtained. If the resident lacks the ability to perform their own biostatistical analyses (as is usually the case), they should identify a faculty member at the beginning of the project who may be able to help or contact their graduate medical education program to see what resources exist.

CONSIDERING FUNDING SOURCES

Most residents working on their RLRSAPs face a shortage of helpful resources, but this does not mean that no resources exist. Access to small grants or other departmental funds may help finance the project's execution or may be used to cover the costs associated with presenting or publishing the study's results. Many residency programs regularly solicit prior graduates for donations to the host institution's charitable foundation, to be accessed for the funding of research projects that would otherwise go unfunded. A newsletter listing departmental accomplishments or a frequently updated web page can be sources of information on the number and types of projects currently being funded. The mentor should be aware of these sources of institutional support, including how decisions are made on which projects to fund. Most departments or divisions that offer internal funding will

have a well-defined review committee that considers and awards small grants for projects that do not require or merit funding from outside the home institution.

Because most RLRSAPs are retrospective data collection projects, there is usually little need for financial support. However, most major EM organizations offer some form of competitive grant award for resident-level research projects. Those with an interest in applying for such grant funding should be supported. However, we suggest that execution of the RLRSAP not be dependent upon receipt of such grants, since only a small proportion of grant applicants will be awarded funding. Ideally, the RLRSAP will be achievable (though perhaps in modified form) regardless of the success of the award application. Otherwise, the RLRSAP may fail simply from lack of funding.

DEVELOPING A TIMELINE

Timeline development for project completion is essential and should be done as soon as possible in the process of defining an RLRSAP. Many institutions consider adherence to this timeline to be a determinant of satisfactory progress toward completing the RLRSAP. Figure 1 provides an example of a hypothetical RLRSAP timeline. The local institution may have a templated timeline that the resident can adopt. If no such template exists, the resident and mentor should work together to define project milestones, including the expected date for project completion.

FIGURE 1.

Sample Timeline for an RLRSAP

Project Week	Task	Person Responsible
0	Finalize study topic.	R, M
2	Complete library/literature search.	R
3	Present study design and research proposal to mentor in P.I.C.O.T.S. format with F.I.N.E.R. criteria.	R
6	Draft proposal shared to members of department's research committee for their critique and approval.	R, M
8	Submit proposal to IRB.	R, M
12	Obtain IRB approval.	R, M
14	Publicize project to others within the academic department to facilitate identification of potential study subjects.	R, M
16	Begin data collection.	R, M
As appropriate	Conduct interim data analysis.	R, M
DC	Complete data collection.	R, M
DC + 4	Draft abstract and manuscript.	R
DC + 8	Revise and submit final abstract to scientific meeting.	R, M
DC + 12	Complete final manuscript revisions.	R, M

Abbreviations: R = resident; M = mentor; DC = data collection.

The RLRSAP must have a customized project timeline addressing the specific tasks required for its completion. For instance, IRB concurrence that a QI project is "not research" may occur more rapidly than IRB approval of an expedited or full review of the research proposal. Close examination of this timeline reveals that research projects may require a year or more between conception and execution. Residents and mentors should be realistic when considering the amount of time needed to complete each project milestone.

CONCLUSIONS

In developing guidelines and specific project proposals to satisfy the RLRSAP, residents and others involved in the process must be mindful of the system in which the project is to be accomplished and the attributes of the individual resident. Great variety in the quality and quantity of resources available to enable these projects exists across the spectrum of EM residency programs.

One unifying theme across EM residency programs is that many operate within resource-constrained environments. Further, time requirements for completing the RLRSAP must be considered relative to the numerous other educational goals of residency training and the resident's near-term career goals. Projects must be feasible, desirable, and valuable to the resident, as well as to their mentor and the local institution.

Mentors and residents should never determine alone whether their project represents research or QI. That determination must necessarily be left to the local IRB. Because the educational objectives of a RLRSAP are not wholly derived from the specific type of project that is undertaken, QI (and other non-research) projects should be viewed as potentially valuable. In fact, a well-designed QI project might ultimately be more valuable than a poorly designed retrospective research project. Not all projects will be published in peer-reviewed journals or even presented outside of the local institution; however, results from all RLRSAPs should be disseminated in a way that advances both patient care and the institution's culture of inquiry.

➲ *KEY CONCEPTS*

- Many RLRSAPs are conducted in a resource-constrained environment.
- Time constraints imposed by concomitant residency activities and requirements mandate that an RLRSAP must not be overly ambitious in its goals.
- A worthwhile RLRSAP does not need to be a research project. Many modes complementary to a program's culture of inquiry can suffice, but that which is acceptable in each residency program must be spelled out in advance by the program.
- Structured mentoring from a faculty advisor, a well-defined timeline, and clear expectations will help ensure the project's successful completion.
- Once the RLRSAP is designed and explicitly stated, it should be submitted to the local IRB for formal adjudication on whether the project is considered by that institution to be research or QI.
- Completion of an RLRSAP does not achieve a recognized milestone in the resident education process, as no such milestones have been defined by the appropriate governing bodies. However, performance of an RLRSAP should develop many important analytical skills that will enhance a trainee's ability to participate in lifelong learning.

Acknowledgements

The contributions of Monica L. Gaddis (MLG), PhD, deserve noting. She is research director for the department of emergency medicine at the University of Missouri-Kansas City (UMKC) School of Medicine (at the Truman Medical Center), as well as associate professor in UMKC's Department of Biomedical and Health Informatics. Together, she and the senior author had several fruitful discussions on these topics. She shared and discussed many ideas that have sharpened the themes expressed in this chapter. The example provided of the difference between a research and QI project for Colles' fracture patients was developed from a discussion about a research project previously initiated at UMKC under MLG's direction.

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HOW TO PROPERLY DESIGN AND CONDUCT A RETROSPECTIVE STUDY

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ABSTRACT

Retrospective chart review (RCR) studies constitute approximately 25% of all peer-reviewed manuscripts published in modern EM journals and are commonly used to satisfy the resident scholarly activity requirement. Despite its popularity, this study design relies upon previously recorded data abstracted from patient medical charts, rendering it susceptible to several types of error and bias. This chapter will serve as a how-to guide for investigators aiming to design, perform, and publish a high-quality RCR study. We have compiled a best practices guide culled from the existing literature that provides suggestions and resources for investigators to use when conducting an RCR study. These recommendations will facilitate a methodical approach to RCR studies that will minimize sources of error and bias, while introducing the learner to some statistical considerations of great importance to retrospective researchers.

INTRODUCTION

RCR studies are commonly used to satisfy the EM resident scholarly activity requirement, allowing even novice researchers to contribute to the medical literature and inform future prospective research.[1] Unlike prospective studies, which follow patients forward in time, RCR relies completely upon data extracted from preexisting medical records to guide the investigation. Data extraction from medical charts can be performed on a variety of sources, including, "electronic databases, results from diagnostic tests, and notes from health service providers."[2] Easy access to a sizeable data set likely accounts for the immense popularity of this study design, with RCR studies account for an estimated 25% of all manuscripts published in peer-reviewed EM journals.[3,4] However, this convenience comes at a cost. Retrospective studies are subject to many inherent limitations, primarily due to their reliance upon patient care data that was not originally created to be used for research purposes.[4] This chapter will provide researchers with a concise background on RCR study design, including recommended methods and statistical concerns that should be considered to produce an RCR study with a high degree of reliability, reproducibility, and validity.

PROS AND CONS OF RETROSPECTIVE CHART REVIEWS

Retrospective research, in a general sense, is the foundation for all new medical inquiry. Investigators must first witness and understand what is known before they can study what remains unknown. Even the most elaborate prospective study begins with the collection of data from existing records and previous studies. Consequently, the value of a well-executed retrospective study should not be discounted.

The greatest advantage of retrospective research is the ability to inexpensively and rapidly collect large quantities of data on many subjects at the same time. Unlike prospective inquiry, retrospective research does not require the investigator to collect their own data. This can greatly accelerate the pace of a study, especially when studying a rare disease or condition that is seldom encountered in clinical practice.[1,5] Although prospective research is generally considered to be the gold standard, RCR studies should be conducted when a prospective study is not feasible, due to limited time, money, or other resources.

Despite these advantages, retrospective research has several limitations, which result from the use of preexisting medical records. Put simply, the data used for retrospective research was not collected for research purposes. Thus, the use of retrospective data is often plagued by missing information, confounding variables, and selection bias.[1] The loss and distortion of information obtained via data abstracted from medical records has been compared to the childhood game of telephone.[4,6] In other words, information provided by the patient is frequently distorted as it is disseminated from one provider to the next, until it is recorded in the medical chart with a final description that is far from the original information.[4,6] Since the reported data are so far removed from their origin, data extracted from medical charts may be distorted by many systemic errors, including those of transcription, inconsistent data, conflicting entries, and missing data elements and charts.[3] If these limitations are not accounted for, the use of retrospective data may lead to study conclusions that lack validity and reproducibility. Missing data are often imputed by investigators, based upon certain assumptions about what the data would likely be if they were available. These assumptions can lead to false data, which may be even more damaging to the integrity of a retrospective study than simply omitting the missing data.

TYPES OF RETROSPECTIVE CHART REVIEWS

Once you have decided to perform an RCR study, the first step is to decide what kind of study to pursue. This decision will depend upon how many patients you expect to include in your analysis, and whether you want to select your study population based upon a specific "outcome" (e.g., development of a disease or an event such as death) or a specific "exposure" (e.g., risk factor). This is an important decision and should be made before deciding upon the study design.

A **case report** is the report of a *single* unique or unusual patient's case, including all associated signs, symptoms, diagnosis, and treatment.[1] The decision to write a case report should be predicated upon the perceived value of the case to the medical community. In general, a worthwhile diagnostic case report will describe either the uncommon presentation of a common medical condition (which should raise awareness in the medical community to atypical disease presentations), or the presentation of a rare medical condition with signs and symptoms that could have been mistaken for a common condition. Beyond diagnostic insights, case reports may also offer "therapeutic" insights, detailing a novel treatment or intervention not been adequately studied in previous reports. The most valuable EM case reports teach a lesson to the reader, by expanding the differential diagnoses for a certain constellation of findings, or by helping the reader recognize subtle clues to the true diagnosis so that they can modify their diagnostic or therapeutic plans. Many case reports fail to pass the "So what?" test by not revealing any new insight or change in patient management informed by the authors' experience. Valuable case reports must impart some additional insight into how patients presenting with the associated signs and symptoms should be managed differently than other ED patients with similar signs and symptoms of disease.

While it may be tempting to "dump" all accumulated patient data into your manuscript, it is important to only include those data points (e.g., clinical features, lab results, imaging studies, etc.) that are truly needed to formulate a clear picture of the patient's presentation. Your goal as the author of a case report, as with any medical communication, is to paint a picture of the clinical scenario that you encountered, including the crucial clues that led you to your novel diagnostic and/or therapeutic strategy. Before deciding to write a case report, ask yourself,

"What do I expect the reader to do differently after they read this report?" If you cannot effectively answer this question in your manuscript, it is likely that your readers (and manuscript reviewers) will fail to appreciate it themselves. Case reports are generally brief (e.g., 1,500 to 2,000 words) and should include an abstract, introduction, case description/summary, and discussion.[7,8,9] Before writing a case report, be sure to perform a thorough literature review to identify previously published case reports that may be like the one you are planning. You will want to reference these previous case reports in the discussion section of your manuscript, including a compelling argument for how your case report adds additional value over what has already been published on the topic.

Case series are subject to the same limitations and considerations as case reports, although they do offer the additional advantage of *multiple* subjects. Although the patients included in your case series must have some common presenting features, you can leverage this design by highlighting subtle differences in your diagnostic findings, outcomes, or the response to your intervention between subjects. This may add a sense of reproducibility (and hence, validity) to your findings. This study design is especially

valuable when studying rare or emerging diseases, but (like a case report) remains subject to selection bias as investigators select specific cases for study inclusion.[1] Some authors have suggested that a case series should include at least five patients, but this suggestion is not uniformly respected and may not be feasible.[10] While a case series may appear to offer improved insight over individual case reports, it is important to remember that case series do not offer comparison with control subjects. This significantly limits the clinician's ability to draw generalizable conclusions from their data, and this limitation should be respected.[11]

While case series do offer the potential for comparison of multiple patients, and even simple statistical analyses, the study of larger populations requires a different approach — including control subjects. If you want to study more than a handful of patients, you will need to switch gears and decide between a "case-control" or a "cohort" study design. These two study designs differ primarily by whether you want to study a specific "outcome" (e.g., development of a disease or an event such as death) or a specific "exposure" (e.g., risk factor). Both study designs can be used prospectively or retrospectively, but this chapter focuses on use of these techniques for retrospective research.

Case-control studies start by identifying patients with a certain outcome (e.g., disease or condition of interest) and retrospectively compare them to a control group of patients that is identical to the study group other than the absence of the outcome of interest.[1] The goal of case-control studies is to search for potential exposures (e.g., risk factors) that may be associated with the targeted outcome.[1] This design is especially helpful when studying rare outcomes, including rare diseases. It also offers the advantage of being able to study multiple exposures at once, which is not possible using the cohort design. Unfortunately, case-control studies only include a limited sampling of those patients without the outcome of interest (i.e., those subjects in your database), so they cannot provide any information about the outcome's **prevalence** (i.e., "commonness") within the greater population. Similarly, case-control studies cannot be used to estimate the **risk** (i.e., likelihood) of developing the outcome following the exposure, because not all subjects with the exposure of interest in the greater population are included.

Although case-control studies cannot be used to estimate risk, they are frequently used to establish an **odds ratio** (OR), which is a measure of association between an exposure and an outcome. This allows researchers to predict the odds of a patient experiencing the outcome following an exposure, compared to the odds of the outcome occurring in the absence of that exposure. This can be especially helpful when one wishes to study multiple exposures simultaneously for the same outcome, as is commonly done in case-control studies. An OR > 1 suggests that the exposure leads to an increased risk for developing the disease of interest, while an OR < 1 indicates that a certain exposure decreases the risk of developing the disease.[1] Lastly, an OR = 1 indicates that the risk of acquiring the disease is neither increased nor decreased by the exposure.[1]

Certain biases have shown to be associated with retrospective case-control studies. Berkson's bias (i.e., admission bias) occurs when a data set includes a disproportionate number of severe cases of the disease or condition of interest. This will ultimately produce skewed results, which are not generalizable to the entire population.[1] For example, antibiograms to predict antibiotic sensitivities that are compiled from an institution's urine culture results may not be applicable to uncomplicated/outpatient urinary tract infections, since urine cultures are generally only obtained for admitted or complicated patients. This bias may be minimized by including a broad representation of the disease state in the proposed study.

Neyman's bias (i.e., prevalence-incidence bias) occurs when patients who have either very mild or resolved cases, or who die from the exposure, are excluded from the data set. This bias is often encountered when a significant amount of time has passed between the exposure and the corresponding outcome, resulting in very sick patients dying and very healthy patients being discharged from the hospital before study patients are identified. This will result in a disproportionate number of average cases, and very few cases at the extremes of the outcome spectrum.[1] Methods to minimize Neyman's bias include selecting study outcomes that are expected to occur very soon following the exposure of interest.

Considering the many sources of bias possible with case-control studies, investigators may wish to improve upon the validity of their data by conducting a **matched case-control** study, in which predetermined patient features (e.g., age, gender, comorbidities, etc.) are matched between study and control subjects. This method makes patient selection more challenging but may also reduce variation in results due to selection bias and other confounders seen in unmatched case-control studies.[1] Including three or four controls per case may also increase statistical power and study precision.[12]

Retrospective cohort studies differ from case-control studies in that patients are selected for inclusion in the study based upon the presence of a specific **exposure** (e.g., risk factor) and then followed forward to identify the associated outcomes (Figure 1).[5] Because its focus is on a specific exposure, this design is preferred when studying a rare exposure or exposures that may have a wide range of potential outcomes. Unfortunately, cohort studies are not optimal for researching rare outcomes (e.g., rare diseases) or outcomes with a long latency period following exposure, since the investigator will likely not capture many such outcomes in the data set. Although most are done prospectively, cohort studies can be performed retrospectively as well. When performing a retrospective cohort study, care must be taken to avoid knowledge of outcomes from influencing patient selection. Because the outcome data are, by definition, already contained in the medical chart, selection bias may occur if investigators do not ignore these outcomes when selecting their study population for inclusion.

Cohort studies typically report their results as **risk ratio** (RR, also known as relative risk) values for individual exposures. The RR is defined as the [probability of an outcome occurring in the exposed group] divided by [the probability of the outcome occurring in the nonexposed group]. Thus, the RR describes the relative risk of realizing the outcome, given the presence of the exposure. It is possible for an exposure to be associated with increased risk of the outcome (RR > 1), decreased risk of the outcome (RR < 1), or no apparent difference in risk (RR = 1). When "x" is the numerical RR value, relative risk should be stated as, "exposed subjects had 'x' times the risk of the outcome compared to nonexposed subjects."

FIGURE 1.

Comparison of Case-Control and Cohort Studies

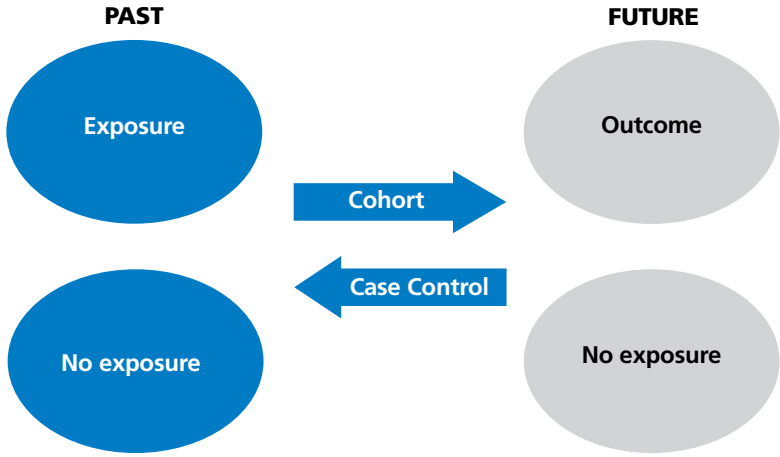

TABLE 1.

Common Types of RCR Studies

Study Design	Key Features
Case report	Single patient
Case series	Two to five or more patients with common features, no control group
Case-control	Population defined by presence or absence of outcome, single (esp. rare) outcome, multiple exposures, cannot establish risk or prevalence, OR
Retrospective cohort	Population defined by presence or absence of exposure, single exposure, multiple outcomes, short latency period, RR

A METHODOLOGICAL APPROACH TO STUDY DESIGN

A methodical approach is required to produce a high-quality RCR study yielding generalizable results.[13] Unfortunately, such rigor is not always found in the medical literature.[3,14] The following section outlines the specific steps necessary to develop a well-designed RCR study, minimizing the potential for error and bias, and producing valid study results (Table 2).

TABLE 2.

Steps To Develop a High-Quality RCR Study

Step 1	Formulate the research question
Step 2	Define the study variables
Step 3	Define the sampling technique
Step 3A	Define the sample size and power
Step 3B	Determine the sampling method
Step 3C	Identify biases associated with sampling methods
Step 4	Create a data procedural manual
Step 5	Determine how to handle missing or conflicting data
Step 6	Create standardized data collection forms
Step 7	Train data abstractors
Step 8	Disclose conflicts of interest and investigator bias
Step 9	Obtain IRB approval (as needed, per local IRB)
Step 10	Conduct pilot study
Step 11	Perform blind data abstraction
Step 12	Monitor data abstractor performance throughout the study
Step 12A	Calculate intraclass coefficient for individual data abstractors
Step 12B	Calculate interrater reliability value for data abstraction

Abbreviations: HIPAA = Health Insurance Portability and Accountability Act

STEP 1: FORMULATE THE RESEARCH QUESTION

The investigator should formulate a clearly defined research question, predicated upon a *predetermined* hypothesis that the authors believe can be answered by analysis of the data provided in the proposed data set.[2] Well-written manuscripts describing the approach to formulating a good research question are already available in the medical literature.[15,16] The three main types of research questions are those of ***description***, ***relationship***, or ***comparison***.[15] Questions of description, commonly investigated in RCR studies, are those that define the variables of the study through establishment of incidence or prevalence, which are reported using percentages, measures of central tendency (mean, median, mode), or measures of variability (standard deviation).[2,17] Questions of relationship describe how certain variables are related to one another and are described by calculating a correlation coefficient.[2,18] Lastly, questions of comparison are focused upon finding differences that exist between groups or subgroups, and are usually reported as measures of central tendency between groups.[2]

STEP 2: DEFINE THE STUDY VARIABLES

The next step is to identify and strictly define the variables that the investigator wishes to study, including the outcome(s) and exposure(s) of interest, as well as any other variables that may be important to consider in the study. A thorough literature review will help to find similar studies that have already explored the proposed variables, and the investigator may also uncover additional study variables that they had not considered.[2] Researchers should learn from the good (and bad) decisions of previous authors to improve the quality of their own study. Agreed-upon definitions for all study variables should be included in the study appendix.[2]

STEP 3: DEFINE THE SAMPLING TECHNIQUE

STEP 3A: DEFINE THE SAMPLE SIZE AND POWER

The investigator should choose an appropriate sampling method to be used during the data collection phase of the study. The two key components of sampling relate to the **sample size** of the study and the **sampling method**.[2] The sample size is important in determining the power of the study, which is the likelihood of detecting that a difference does, in fact, exist from the status quo. It is important to note that a study's power will increase with an increased sample size. Without sufficient power, significant differences may not be detected by the study when differences do exist. Investigators can utilize the free-to-use software program, G*Power, to determine the sample size necessary to achieve a desired power.[2,19] Early consultation with a biostatistician is also recommended, as inadequate power will limit the validity of study results. Despite the importance of power analyses, such calculations are not universally performed with RCR studies.

STEP 3B: DETERMINE THE SAMPLING METHOD

Once the sample size has been determined, a sampling method should be selected. The three most common sampling methods are **convenience sampling**, **random sampling**, and **systematic sampling**.[2] Convenience sampling is one of the most common sampling methods used in RCR studies because it utilizes medical information that is readily available to the investigator.[2] This method is practical for small sample sizes and rare diseases, but is limited when attempting to generalize study results.[2] Random sampling is the preferred method of sampling, as it allows generalization of study results to the patient population of interest and avoids sampling bias.[2] In random sampling, each medical chart has an equal chance of inclusion in the study. However, a large sample size is necessary for this approach.[2] Systematic sampling is seen when every "n-th" medical record is selected for use in the study.[2] Unfortunately, this method also requires a large sample size and is not a truly random selection method. Consequently, it is subject to selection bias.[2]

STEP 3C: IDENTIFY BIASES ASSOCIATED WITH SAMPLING METHODS

Choosing the method of sampling is arguably one of the most crucial steps involved in reducing the possibility of error and introduced bias. The most important potential bias is selection bias, defined as the nonrandom selection of study participants such that the selected study participants are not representative of the general population of interest.[20,21] Due to nonrandom selection, study participants may differ between study groups at baseline and thus also differ with the intervention. This can lead

the investigator to believe that some difference between study groups is due to the treatment given, when the difference is actually attributable to baseline characteristics (e.g., age, gender, comorbidities, etc.) influencing assignment to the treatment or control group.[21] To avoid selection bias, we recommend utilizing random sampling when possible.[21] Investigators should be sure to provide a table in the manuscript detailing the baseline characteristics of each group, hopefully demonstrating that these characteristics are similar between groups.[21] Common biases created by inadequate attention to this step include attrition bias and misclassification bias. Attrition bias is defined as a systematic error occurring due to an unequal loss of study participants.[21,22] Misclassification bias is seen when study participants are assigned to the incorrect study group due to a lack of a standardized data collection methods.[4]

STEP 4: CREATE A DATA PROCEDURAL MANUAL

Once the sampling method has been determined, investigators should create a **data procedural manual** detailing the data collection process — including the inclusion and exclusion criteria and proposed data collection methods.[2] Think of this as a how-to guide for the data extraction team, which will hopefully minimize confusion and variation in individual extractor data collection techniques.

STEP 5: DETERMINE HOW TO HANDLE MISSING OR CONFLICTING DATA

The data procedural manual should detail specific steps that data abstractors should take when data is missing or misclassified. This manual should be updated throughout the study, providing up-to-date guidance on how disputes will be handled during the data collection process.[2-4] Large amounts of missing or conflicting data can prevent an effective conclusion from being drawn, or may cause incorrect conclusions to be inferred from the existing data.[4] Missing or conflicting data should be handled on a case-by-case basis, and the investigator must decide to what degree missing data could compromise the validity of the results. We suggest that authors be transparent regarding the degree of missing or conflicting data, and detail how they have handled the imputation of data during the statistical analysis.[4] It may be appropriate to address this issue by removing those medical charts with missing or conflicting information from the study analysis, although this will decrease the sample size and may reduce the power of the study.[4]

STEP 6: CREATE STANDARDIZED DATA COLLECTION FORMS

Prior to data collection, standardized **data collection forms** (DCFs) should be created to promote uniform data extraction from the medical charts.[2,3,4,14] These forms can be either paper-based or electronic. While paper forms are an easy, cost-effective method of data collection, the use of paper forms can lead to problems with handwriting legibility, transcription errors, and form maintenance and storage issues.[2,4] For this reason, we recommend using electronic forms to ensure accurate central data storage and limit data inputs.[2,4]

STEP 7: TRAIN DATA ABSTRACTORS

Data abstractors should be properly trained to ensure standardization of data collection across multiple abstractors and sites.[2,3,4,14] Data abstractors may be trained on mock medical records to apply study inclusion and exclusion criteria, and should be instructed on the inputs permitted on standardized data collection forms.[2,3] During the early phase of

data collection, investigators should meet with their abstractors to resolve any disputes that may arise and use these discussions to modify the procedural manual as needed.[2,3,4] We recommend refresher training sessions periodically throughout studies requiring a prolonged data collection period.[4] It is important to include specifics on how data abstractors were trained in the methods section of the study manuscript. Investigators may want to include a copy of the data collection form in the appendix of the manuscript, and this instrument should also be adequately detailed in the methods section of your manuscript.[2,4] Inadequate data abstractor training or lack of a standardized DCF (if applicable) should be discussed in the manuscript as a limitation of the study.[2,4]

STEP 8: DISCLOSE CONFLICTS OF INTEREST AND INVESTIGATOR BIAS

Investigators should be sure to disclose any potential conflicts of interest (e.g., financial interests) in the manuscript and identify whether any anticipated biases may have been introduced to the study that could inherently skew the results.[4]

STEP 9: OBTAIN IRB APPROVAL

Any research study that utilizes patient medical records for data collection (including RCR studies) must have approval from the local IRB prior to execution of the study. While chart review for QI purposes does not require IRB involvement, any research study intended to formulate generalizable conclusions (especially if publication is planned) should be submitted to the IRB for a determination before charts are accessed. Although most retrospective chart reviews will ultimately be found exempt from IRB supervision, that determination must be made by the IRB and cannot be made by the study team. Proof of IRB approval or exemption is generally required by most peer-reviewed journals at the time of submission for publication, and a report of IRB approval (or exemption) should be provided in the description of your study methods.[23,24]

In general, it is not considered feasible to obtain informed consent from patients for chart review in entirely retrospective studies. Consequently, the IRB will usually grant a Waiver of Informed Consent for retrospective chart review studies, which also allows investigators to screen charts for possible study inclusion. This waiver should not be confused with Exception From Informed Consent (EFIC), which is a process by which informed consent can be delayed or waived for subjects in prospective emergency care research studies.

STEP 10: CONDUCT A PILOT STUDY

We recommend conducting a pilot study including at least 10% of the size of your proposed study to test the study design and its feasibility, and to evaluate the methodology and planned procedures of the investigation.[2] A pilot study will allow the investigator to test data collection procedures, give the abstractors practice with data collection, and address logistical challenges prior to beginning the formal investigative study.[2]

STEP 11: PERFORM BLIND DATA ABSTRACTION

When feasible, data abstractors should be blinded to the study's research question, hypothesis, and patient group assignments, to reduce bias with data collection.[2,3,4,14] Adherence rates to abstractor blinding as low as 5.4% have been recorded, generally attributed to study investigators being involved in data abstraction with inadequate blinding to the study hypothesis.[4,14] While it may not be possible to blind the abstractors,

investigators should be aware that abstractors may consciously or unconsciously search for particular variables over others based upon the study hypothesis, or may make certain decisions favorable for the outcome of the study when multiple conflicting data entries are encountered in medical charts.[4] When reporting the results of an RCR, the investigator should clearly detail how data abstractors were blinded and how such blinding was preserved in the methods section of the manuscript.[4] If blinding was not adequately established or maintained, this should be reported in the manuscript as a study limitation.[4]

STEP 12: MONITOR DATA ABSTRACTOR PERFORMANCE THROUGHOUT THE STUDY

When additional abstractors are used, periodic abstractor monitoring should be conducted throughout the study.[3,4] This is especially important in studies utilizing multiple data abstractors.[4] We recommend monitoring of the performance of data abstractors at predetermined intervals throughout the data collection process.[4,25]

STEP 12A: CALCULATE INTRACLASS COEFFICIENT FOR INDIVIDUAL DATA ABSTRACTORS

When using more than one abstractor, you can calculate intraclass correlation coefficient (ICC) values by reviewing a recommended 10% of all abstracted medical charts.[2] This is done by reabstracting data from previously abstracted charts and comparing the results of these two data abstractions.[2] These ICC values can be calculated using a statistical software program such as the IBM® SPSS® program, R software provided by the R Foundation for Statistical Computing, or Microsoft® Excel®.[2,26] Expected ICC values will range from zero to 1, with values below 0.5 generally regarded as poor, 0.5 to 0.75 as moderate, 0.75 to 0.9 as good, and values above 0.9 as excellent.[27]

STEP 12B: CALCULATE INTERRATER RELIABILITY VALUE FOR DATA ABSTRACTION

When using multiple abstractors, it is recommended to provide an abstractor **interrater reliability** value to quantify the degree to which different data abstractors across different sites have agreement, confirming that identical data were abstracted from the same medical charts.[28] The interrater reliability can be reported as the percent agreement, or by Cohen's Kappa value.[28] Percent agreement provides a percentage value indicating the degree to which identical data is abstracted by different abstractors, although this may fail to account for agreement occurring purely by chance.[2,28] Consequently, we recommend using Cohen's Kappa to calculate the interrater reliability, as it also takes into account agreement occurring as a result of probability.[28] Cohen's Kappa will provide a value ranging from -1 to +1, with -1 indicating 100% disagreement between abstractors and +1 indicating 100% agreement — although values below zero are almost never seen.[2,28] In theory, Cohen's Kappa values lower than zero indicate no agreement, 0.01 to 0.20 indicates slight agreement, 0.21 to 0.40 indicates fair agreement, 0.41 to 0.60 indicates good agreement, 0.61 to 0.80 indicates substantial agreement, and 0.81 to 1.00 indicates essentially complete agreement.[28] Unfortunately, there have been no evidence-based studies defining what Cohen's Kappa value is acceptable for RCR studies. Therefore, we recommend that the acceptable (preferably > 0.60) Cohen's Kappa value should be set and appropriately justified in the

discussion by the investigator.[4] Interrater reliability measures need to be conducted for all variables of high importance to the study hypothesis, with a recommended sampling of 10% of all charts included in the study.[4]

In the methods section of the manuscript, investigators should describe how and by whom abstractors were monitored, the frequency with which monitoring occurred, and how interrater reliability calculations were conducted.[4] Specific ICC values and interrater reliability values (preferably Cohen's Kappa) should be added to the appendix of the study to further increase validity. If no data abstractor monitoring was conducted, this should be included as a limitation of the study.

STATISTICAL ANALYSIS TECHNIQUES

The choice of specific statistical analysis methods to be used in an RCR study will influence the study's validity. Depending upon specific circumstances, investigators may choose to conduct a stratified analysis, matched pair analysis, or multivariate adjustment analysis. Investigators should expect to utilize at least one of these three statistical methods to minimize bias. However, we suggest that investigators seek assistance from a biostatistician prior to finalizing the data analysis plan.

STRATIFIED ANALYSIS

Stratified analysis is often utilized when dealing with the effects of a single confounding variable. In statistics, a confounding variable is defined as an unaccounted-for variable that influences the outcome of both the dependent and independent variables, and ultimately affects the outcome of a study.[21] Investigators may overlook the presence of confounders, resulting in erroneous conclusions being drawn regarding the relationships between independent and dependent variables. In this statistical test, new subgroups or strata are formed, and an adjusted RR (aRR) value is calculated. The aRR value is then compared to the unadjusted RR, which was calculated prior to creation of the different subgroups. When confounding variables are present, investigators will notice that the aRR is lower than the unadjusted RR value.[21] If the aRR is < 1, this may lead the investigator to conclude that no true association is present, regardless of the unadjusted RR value.

MATCHED PAIR ANALYSIS

If more than one confounding variable is present, investigators may use a matched pair analysis. This type of analysis individually pairs study subjects with control subjects with similar characteristics. The corresponding data collected from these paired groups allows investigators to calculate relative risk ratios and determine whether a correlation exists between the variables free from the potential effect of confounding variables.

MULTIVARIATE ADJUSTMENT ANALYSIS

Multivariate adjustment analysis is used to simultaneously account for the impact of multiple confounding variables at once.[21] When conducting this type of analysis, investigators can analyze the association between a dependent and independent variable after considering the effects of multiple confounding variables.[21] The output of the multivariate adjustment analysis will be a list of relative risk values for each confounding variable, taking into account the role that the various confounding variables have on each another.[21]

CONCLUSIONS

In this chapter, we have provided investigators with the tools needed to properly conduct a retrospective chart review study through three key aspects: (1) establishing the proper methodological criteria; (2) providing a complete list of steps to be considered in an RCR study to minimize errors and biases; and (3) detailing common statistical analysis methods utilized in RCR studies that can minimize erroneous conclusions based upon flawed data analyses.

➲ *KEY CONCEPTS*

- Retrospective studies are a commonly used approach to resident and fellow scholarly activity and constitute a valuable outlet for scholarly productivity, especially for junior researchers.
- A methodological approach to retrospective research is required, including strict compliance with accepted standards for this type of retrospective research, to ensure valid, high-quality results.
- The selection of appropriate statistical analyses can help to minimize bias and avoid common errors.
- Confounding variables should be considered and accounted for in the design of retrospective studies.

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HOW TO CONDUCT A LITERATURE REVIEW

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ABSTRACT

Whether one is a researcher or "just" a consumer of research, physicians are expected to possess specific skills required for the critical evaluation of medical literature. These information literacy skills include how to conduct a literature search and select relevant articles, how to evaluate and summarize the selected literature, and how to communicate research findings. This process is important, whether one is critiquing gathered research literature or writing a literature review as a primary research project. A well-formulated literature review requires critical synthesis and analysis of a defined body of literature. This chapter will describe different types of literature reviews (narrative, systematic, meta-synthesis, meta-analysis, and integrative) and provide a roadmap for the steps involved in performing a literature review and reporting its findings.

INTRODUCTION

A literature review can be defined as a concise critical summary of published research literature relevant to a topic. *The goal of a literature review is to identify, select, assess, and synthesize the findings of similar but separate studies.* The process is the same whether the purpose is critiquing or writing a literature review. Primary researchers may use a literature review for background material to plan a study protocol of an original research proposal or grant application, or for independent summary and synthesis (a systematic review). For consumers of research, literature reviews provide the evidence base for practice development or quality improvement activities.

Classifying by methodology, a literature review can be narrative, systematic, or integrative. Narrative review and meta-synthesis involve synthesis of existing literature without investigation for statistical significance of the collective findings. Subtle differences exist between them. **Narrative reviews** can synthesize quantitative studies that have used diverse methodologies to evaluate numeric relationships, while a **meta-synthesis** integrates only qualitative research.[1] Both types of review carry significant risk of bias inherent in their design. The most relevant biases for reviews are publication, time lag, location, citation, language, outcome reporting, and analysis reporting biases. Invaluable tools for measurement and visualization of bias include the Risk of Bias (ROB 2),[2] Risk of Bias in Non-randomized Studies of Interventions (ROBINS-I),[3] and the visualization tool for risk of bias assessments in a systematic review (robvis).[4]

Systematic and integrative reviews follow strict scientific design based on explicit, pre-specified and reproducible methods. By their inherent design, they decrease the risk for biases when compared to less rigorous review types. **Systematic reviews**, in the strictest sense of the term, quantitatively combine results from studies examining similar relationships using similar constructs to devise a replicable answer with an associated statistical significance and heterogeneity. **Integrative reviews** are a combination of both qualitative and quantitative reviews. The term, integrative review, is frequently used interchangeably with systematic review.

Every physician must possess information literacy skills enabling them to competently evaluate the medical literature. These information literacy skills include how to conduct a literature search and select relevant articles, how to evaluate / summarize the selected literature, and how to communicate resultant findings. This systematic process is important, whether one is critiquing or creating a literature review. A literature review requires critical synthesis and analysis of a defined body of work. Research librarians can be an invaluable resource early in the process of conducting a literature review.

In this chapter, we provide a roadmap for conducting a systematic review using the example topic of exploring "smoking cessation programs for adolescent males utilizing cell phone-based communications."

GETTING STARTED

Any literature review should begin with proper framing of the review topic. This framing, in the **Population/patient, Intervention, Comparator, Outcomes, Timing, Setting/ study design (P.I.C.O.T.S.)** format, helps to create an answerable question.

- **Population** includes a description of the nature and burden of the condition and a description of subpopulations, when appropriate.
- **Intervention** describes the anticipated treatment, including drugs, radiation, or behavioral therapy, and their known dosages, frequency, and method of administration.
- **Comparator** is the treatment to which we compare the intervention to be studied, thus acting as a control or placebo.
- **Outcomes** denote those that we want to evaluate, those that are important to the stakeholders, and those that have already been studied in the literature.
- **Timing** denotes the period of time over which the intervention and comparator are applied to the sample of the population that was studied.
- **Setting** (i.e., the locale from which subjects were recruited) and the **study design** may also play major roles in determining the reliability of results.[5]

While some study designs are more robust than others, the range of possible study designs will vary according to the question being addressed.

Applying this framework to the example topic described above, the **population** would be *adolescent male patients*, and the **intervention** is *cell phone-based communications*. The **comparator** might be those *subjects who did not receive cell-phone based communication*, and the desired **outcome** is the *smoking cessation rate*. Timing would be whatever time periods are utilized in the included studies, which remains to be determined. The preferred **study design** could be systematic reviews or randomized, controlled trials reported in English language sources over the last 20 years. Thus, the question becomes, "In adolescent male smokers, does initiating cell phone-based interventions result in smoking cessation?" It is a good practice to frame the question clearly and concisely before advancing to next steps.

IS THE REVIEW MERITED?

Before undertaking one's own systemic review, it is imperative to assess whether a new review is justified. One should attempt to determine whether anyone else is in the process of conducting a similar review, or if a similar review has recently been completed and disseminated. Various protocol registries exist for this purpose, and it is always advisable to check them for duplication. The most commonly used registries are the Cochrane Collaboration,[6] International Prospective Register of Systematic Reviews (PROSPERO),[7] and the Campbell Collaboration.[8] If a similar review already exists, the next step is to assess its quality to determine if it is sufficient to answer the research question, or to guide policy and practice. A good review will have addressed a well-defined question with appropriate methods that are both transparent and reproducible. If existing reviews are of poor quality, or a sizeable number of relevant articles were not included, a new review may be justified.

THE SEARCH

Depending on the scope of the study, the next step is to either register the study protocol or proceed to databases to conduct the search. Databases store citations, abstracts for articles, and links to articles themselves. The Cochrane Library, PubMed Central® (PMC) or MEDLINE® and Google Scholar are the largest databases and should be searched first to economize efforts. The **Cochrane Library** includes six databases: the Cochrane Database of Systematic Reviews (CDSR),[9] the Cochrane Central Register of Controlled Trials (CENTRAL),[6] the Cochrane Methodology Register (CMR),[10] Database of Abstracts of Reviews of Effects (DARE),[11] Health Technology Assessment (HTA) database,[12] and the National Health Service Economic Evaluation Database (NHSEED).[13] Technically, the Centre for Reviews and Dissemination (CRD) has maintained the last three databases since 2015.[14] The next place to search are the MEDLINE®, PubMed® and PMC databases,[15] all of which are accessed through the free PubMed search engine. Medline is the National Library of Medicine® (NLM) journal citation database, started in 1960, while PMC launched in 2000 as a free archive for full-text biomedical and life sciences journal articles.[16]

Google Scholar allows free searches across a wide range of academic literature and is not limited to biomedical literature. It draws on information from journal publishers, university repositories, and other websites that it has identified as scholarly.[17] However, the reproducibility of searches on Google scholar is sometimes erratic.[18] There are many specialty specific databases available, such as Elsevier's Embase® (drug information-focused) and American Psychological Association's PsychINFO®[19] (for behavioral interventions). Paid interfaces (e.g., EBSCO, Ovid) utilized by academic libraries provide the capability to search all major databases from a common landing page.

SEARCH STRATEGIES

An enduring principle underlying any kind of search is to first cast the widest net possible and then narrow down the results by controlling the "noise." A coherent search strategy begins by listing the key words for the search. This process involves first brainstorming the most significant P.I.C.O.T.S. keywords offline. For each element of the P.I.C.O.T.S. statement, one should list as many terms and their synonyms (and sometimes antonyms) as possible to facilitate the location of all relevant articles. Figure 1 provides a sample list of search terms relating to the P.I.C.O.T.S. elements for our example question regarding smoking cessation among adolescent males.

FIGURE 1.

Sample P.I.C.O.T.S. Element Search Terms

Patient/Population (P)	Intervention (I)	Comparator (C)
Male Adolescent Smoker Tobacco Nicotine Vaping	Cell phone Mobile phone Phone app	None (control)
Outcomes (O)	**Timing (T)**	**Setting/Study design (S)**
Quitting Smoking cessation Quit rate	20 years	Meta-analysis Systematic reviews Randomized control trials

Once the search term list is prepared, one must connect them using the appropriate syntax, namely Boolean operators and phrase restriction. **Boolean operators** are of two types, "and" and "or." An easy way to remember is "OR" is "more." It is used to link synonymous (or antonymous) terms. "AND" is used to narrow down the results to include only overlap of each of the P.I.C.O.T.S. concepts together. To frame it differently, think of a Venn diagram including two overlapping circles. "And" specifies the area where the circles overlap. "Or" specifies all the area in both circles.

Phrase restriction of the term list is also an important part of the search strategy because it makes searching more efficient. For example, conducting a search for articles about the general topic of smoking cessation by searching for articles with the words "smoking" or "cessation" in the title would return *all* articles with the terms "smoking" or "cessation" within their titles. But forcing a phrase-restricted search, in which the key words are linked and *must* appear together, such as "smoking cessation," would yield only articles that have these words linked together in their title.

If one searches terms relevant to the question posed above by utilizing (smoking cessation cell phone) in the PubMed database, approximately 280 articles are located. Even at first glance, these articles do not all seem relevant. But if one begins by searching (smoking cessation) *and* (cell phone), this alternative, more focused search yields 135 articles.

A more fully developed search derived by combining some concepts from Figure 1 with proper Boolean operators and phrase restrictions works out to be:

{(Smokers OR smoking OR tobacco OR nicotine OR cigarettes) AND (phone OR iPhone OR Droid OR mobile OR app OR apps OR texting OR smartphone OR mhealth OR m-health OR cellular) AND (quit OR cessation OR reduced OR reduction OR abstinence) AND ("systematic reviews" OR "randomized controlled trials" OR "meta-analysis")}

From among the articles located, it is a good idea to closely examine those that are systematic reviews to learn *their* search strategies. This process can elucidate terms or syntax which could make one's own search more comprehensive and can decrease the chance of missing relevant data or manuscripts.

PubMed® has a highly robust infrastructure for indexing, which provides both the indexer and the searcher with a controlled terms list. Every time an article is added to a database, indexers review the article and assign applicable terms from a controlled vocabulary list. Subsequent searches for these terms will enable researchers to locate this article every time, lending uniformity to the search process. In the case of PubMed®, the list of controlled terms is called the **Medical Subject Headings (MeSH®)**. It may be helpful to search the index of MeSH terms to evaluate the yield from the list of controlled vocabularies that one plans to use for a search. For example, if one searches for "smoking cessation" while specifying "MeSH" in the pulldown menu, one can learn when this term was introduced and how it may have previously been indexed. Under "Entry terms," a list of 10 other terms is provided that would yield similar results.[20] Before beginning a PubMed® search, it is recommended that the investigator register for a National Center for Biotechnology Information (NCBI) account. Use of "My NCBI" allows the user to save searches and receive automatic email alerts, display formal preferences, and show recent activity searches and records for up to six months. Traditionally, researchers have used NCBI-managed user credentials to log in at NCBI, but this transitioned to federated account credentials (those set through eRA Commons, Google, or a university or institutional point of access) in June 2021.

Other databases, such as the American Psychological Association's PsycINFO® or Elsevier's Embase®, may offer slightly different controlled term listings enabling the same search. Multi-database interfaces, such as Wolters Kluwer's Ovid® platform, can simultaneously access multiple databases. If one inputs the term "smoking cessation" into Ovid's advanced search filter, a controlled vocabulary list appears containing the number of results a certain term would obtain. One can repeat this for each of the databases used. This helps translate the exact search terms from one database to the exact terms for another, which is especially important for systematic reviews. A high-yield search strategy consists of combining MeSH® and title/abstract searching for keywords with all the P.I.C.O.T.S. elements represented.

Apart from these bibliographic databases utilized as previously referenced, a comprehensive search must also attempt to locate other sources of content. For instance, whether it has appeared in print or electronic media, **grey literature** is defined as content not controlled by commercial publishers, yet produced at any level of government, academics, print, and/or industry. Examples include clinical trial registration information, conference proceedings, government publications, or health association recommendations. One can find this content in specialized databases, conference websites, trial registries, association websites, and national/international health organizations. A particularly useful resource for locating grey literature is the "Grey Matters" tool provided by Canadian

Agency for Drugs and Technologies in Health.[21] Similar resources are "OpenGrey"[22] and "Grey Literature Report."[23] These tools direct researchers to the content sources but do not host the content.

Clinicaltrials.gov is a good place to search for clinical trials registration information.[24] Its advanced search function features P.I.C.O.T.S.-type searchability for keywords.

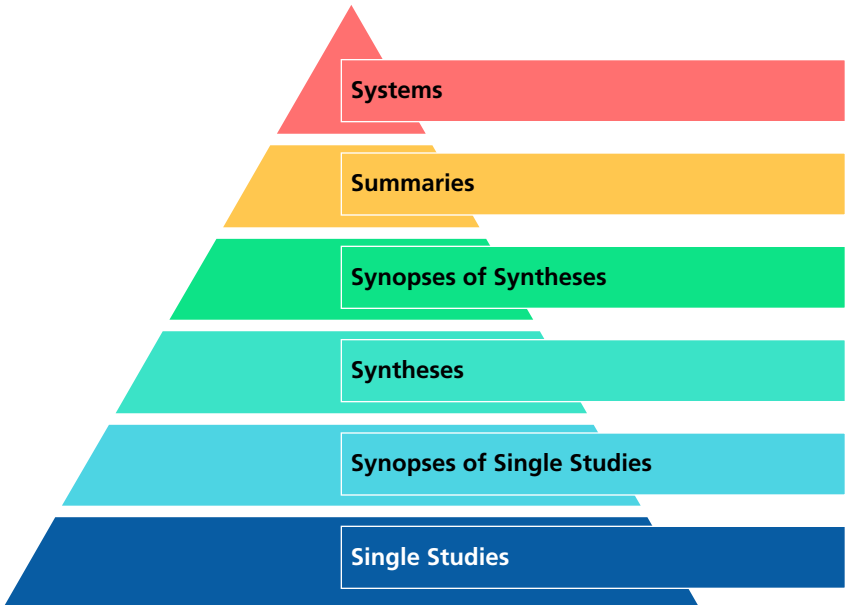
A good resource for conference proceedings and abstracts specific to EM is **EMedHome.com**.[25] The most current and broadly interesting topics covered in conference proceedings are almost always disseminated electronically before formal publication and can also be useful for generating new research ideas. **Hand-searching**, defined as the task of searching through medical journals or conference abstract books for papers that are not indexed in the major electronic databases, is another way of finding grey literature.[26]

STRENGTH OF EVIDENCE

One must critically evaluate the sources of literature when executing a literature search. One particularly useful tool that can be used to rank the quality and believability of evidence is the "**information pyramid**," shown in Figure 2.

FIGURE 2.

The Information Pyramid[27]



The pyramid features six tiers, beginning from the top:

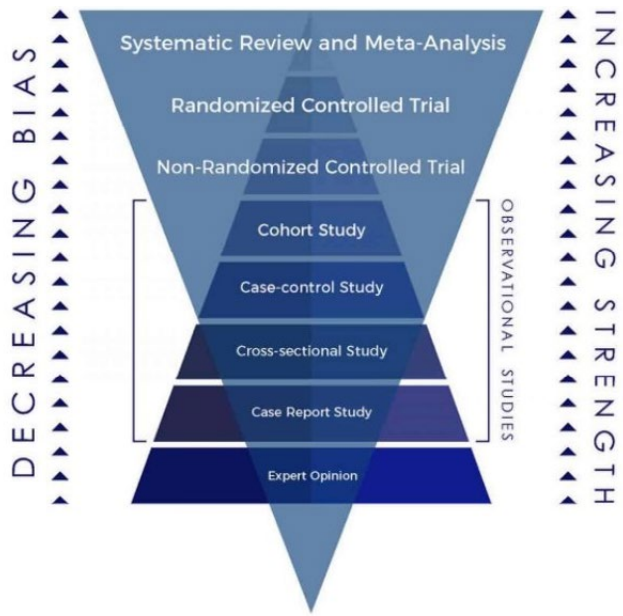
- **Systems**
- **Summaries** (e.g., UpToDate®, DynaMed®)
- **Synopses of syntheses** (e.g., The Database of Abstracts of Reviews of Effects)
- **Syntheses**
- **Synopses of single studies**
- **Single studies**

This model portrays different levels of evidence for clinical decision-making as levels on a pyramid, with the volume of content decreasing (and strength of evidence increasing) as one moves from the bottom towards the top of the pyramid.[27] In other words, **single studies** (on the bottom level) are common, but offer poor support for evidence-based decision-making as they report outcomes pertaining to only a single population of subjects. A **synopsis** (e.g., condensed outline) of a single study summarizes and interprets the data from that study, offering additional insight into the clinical application of the study's results. Journal club is one example of a synopsis, in which the facilitator attempts to apply results from the single study to clinical practice. **Syntheses** (e.g., systematic reviews) provide a comprehensive summary of included studies. The inclusion of multiple studies in a synthesis is believed to provide greater evidence to support clinical decision-making than what is available from a single study. In the information pyramid model, **summaries** are defined as regularly-updated clinical guidelines or textbooks. Finally, **systems** offer the highest level of evidence for clinical decision-making, as they integrate point-of-care decision-making tools into the electronic medical record. In this way, clinical decision-making tools can be customized for application to a specific patient.

A review rating system also exists for the **hierarchy of evidence**, which rates a review's strength of evidence on a scale of one to seven (see Figure 3). The highest level of evidence consists of systematic reviews of randomized controlled trials (RCTs) because of their rigorous methodology, while the lowest level (level seven) is comprised of opinions of authorities and/or reports of expert committees. The Evidence-based Practice Center (EPC) Program of the Agency for Healthcare Research and Quality (AHRQ) recommends using the approach from the Grading of Recommendations Assessment, Development and Evaluation (GRADE) working group for grading strength of evidence.[28] Assessment, Development, and Evaluation The GRADE tool can be found at www.gradepro.org.

FIGURE 3.

Hierarchy of Evidence[29]



STUDY SELECTION

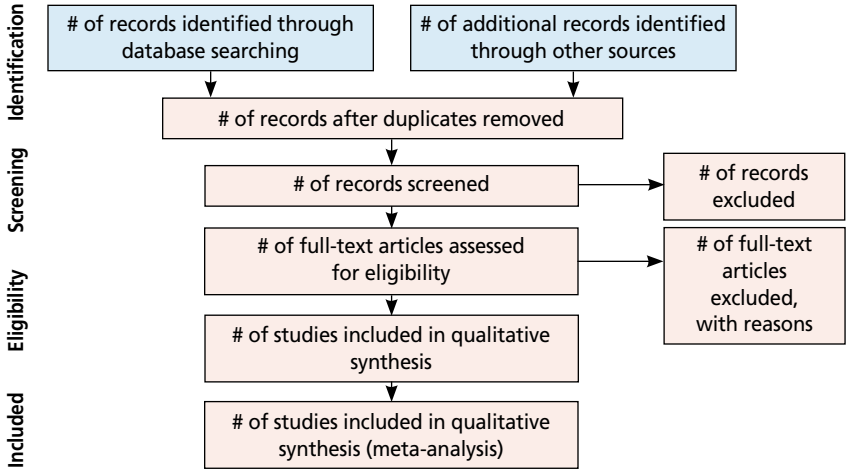
Managing the results of a literature search starts with formation of a search protocol. This is necessary to ensure transparency and replicability of the search. The Methods Guide for Effectiveness and Comparative Effectiveness Reviews[30] from AHRQ recommends specifying clear inclusion and exclusion criteria in a protocol, with enough detail to avoid inconsistent application in study selection. Ideally, two independent reviewers who are in consensus about P.I.C.O.T.S. elements and design of the search should be involved in this process to minimize bias. Study selection is usually conducted in two stages: an initial screening of titles and abstracts against the inclusion criteria to identify potentially relevant papers, followed by screening of the full papers identified as possibly relevant by the initial screening. Both reviewers should be involved in both steps. One alternative strategy is for the second reviewer to limit their role in the second step to simply confirming that the studies excluded by the first reviewer met the exclusion criteria.

Reporting of the review should include the number of studies identified, screened, assessed for eligibility, and included in the review. This is ideally represented in a flow diagram, as recommended in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement (PRISMA),[31] depicted in Figure 4. Use of a PRISMA diagram is the gold standard for citation tracking during the search and selection process. The report should also include a listing of those studies that were excluded, including specific reasons for their exclusion.

The review protocol must state the procedure to be used for data extraction, including the number of researchers who will extract the data and how discrepancies will be resolved. Dual extraction using individual studies as the unit of interest is the preferred option. Instances of disagreement between reviewers should be resolved by open discussion, third-party mediation, or by contacting the study author. Typical data to be extracted include study size, characteristics of the patients, details about the intervention, and the outcome. If a meta-analysis is planned with the review, the parameters for effect size calculations should also be extracted.

FIGURE 4.

PRISMA Flow Diagram[31]



MANAGING THE SEARCH

A few tools are worth mentioning that can help researchers manage their search results. **Citation management software** is imperative to every review. Those most frequently employed are EndNote™, RefWorks™ and Zotero™. The first two resources require a subscription fee but are available at no charge to end-users at academic libraries. Zotero™ is available without a subscription fee.[32-34]

Once a list of citations is created from a database, one must export them to a citation manager where they are all stored in one place for easy exclusion or inclusion and removal of duplicates. In PubMed®, the "send to" tab in the upper right has a citation manager option. Choosing this option creates a Medline®-tagged format (.nbib) file from the list, which can be saved into Endnote™ or RefWorks™ as a collection. The process in Zotero™ is much easier. Simply by clicking the tab on the web browser, one stores the whole collection. The "export" tab in Ovid and "import to" tab in Google Scholar perform the same functions. After importing from multiple databases into a particular library in the citation manager, one must sort the records and de-duplicate them.

Research collaboration tools like Covidence® may also prove useful when working in groups.[35] This software allows all users to review the title and abstract screenings, full text screenings, and extraction. It also records the number of studies selected for inclusion and exclusion in the PRISMA flow diagram in real time. It enables voting, displays articles about which search team is conflicted, and subsequently helps export extraction results back to the citation manager.

Finally, depending on the time-scale of the review, an update of the literature search (performed toward the end of the project) may also be required. If the initial search was performed greater than six months prior to the final analysis, it may be necessary to rerun the searches to ensure that no recent literature has been overlooked. Additionally, Article-based PubMed Search Engine (APSE™) can enable location of recent articles that were added during the study process, simply by adding the PubMed™ ID of selected articles.[36]

DATA SYNTHESIS

Effect size, the currency of meta-analysis, is a value of the difference of outcomes between different treatment conditions, or the strength of the relationship between two variables. Effect sizes usually take the form of risk ratios, odds ratios, or risk differences when study outcomes are binary. Correlations and standardized mean differences are used when the reported outcomes are continuous.[37]

Many systematic reviews include meta-analyses. **Meta-analysis** is the use of statistical methods to summarize the results of independent studies. By combining information from all relevant studies, meta-analyses can provide more precise population estimates of effect sizes than can estimates individually-derived from the each of the studies included within a review. As depicted in Figure 3, meta-analyses are considered the highest level of evidence. Summarizing results of a meta-analysis is a two-step process. In the first step, an effect size and a variance are calculated for each study considered. Next, a weighted mean of these effect sizes is calculated to produce a summary estimate of effect size. More precise studies will have greater weights.

Under the **random effects model**, the magnitude of true effect sizes (as reported by the individual studies included in the meta-analysis) is assumed to have been sampled from a distribution of all possible values for true effect size estimates. Thus, there are two types of variances — the **within-study error** and the **between-study error**. These concepts can

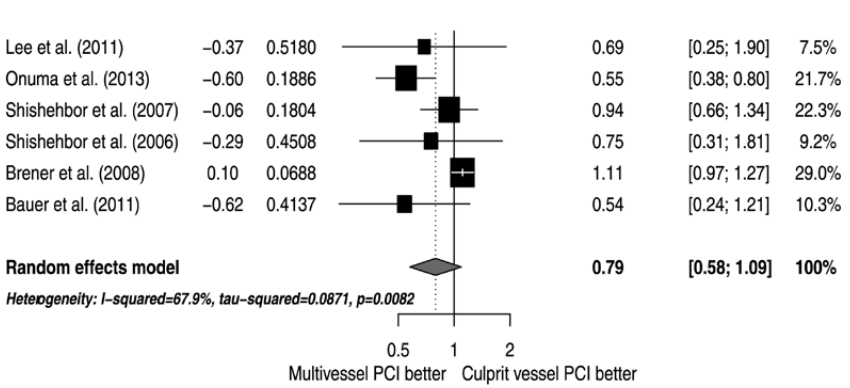
be portrayed by a discussion of the weight of puppies. All puppies in a litter should have approximately the same body mass at any fixed time after birth, yet the exact mass of the littermates will vary somewhat. This exemplifies within-study error. However, puppies of different breeds can be expected to differ more markedly, due to between study error.

Most meta-analyses are based on either a fixed effect model or a random effects model. Under the **fixed effects model**, all studies in the analysis are presumed to share a common true effect, and the dispersions of all the numeric, sample-derived estimates of population effect size are assumed to be the result of sampling errors. Weights are assigned to the various studies included, with the goal of minimizing this within-study error. Study weights are assigned with the goal of minimizing both sources of variance[37] in a manner similar to how a "least-squares" analysis derives the equation of a linear regression line. This between-study error is also referred to as **heterogeneity**, and is measured by weighted sums of squares and variance of true effects.[39] In defining a regression line for a linear relationship, the solution to the regression is the line that minimizes the sum of the squared deviations along the y-axis for the data points that were observed, versus the values of ŷthat would be expected if all data points fell exactly on the line of best fit.

Information derived from a meta-analysis is pictographically represented by forest plots and funnel plots. A **forest plot**, as shown in Figure 5, depicts the results of a meta-analysis designed to assess the **effect size** of multivessel versus single-vessel angioplasty in non-ST elevation acute coronary syndromes.[40] One can see that the meta-analysis included six studies, which are listed on the left side of the figure. These studies form the basis of the random effects model. The effect size depicted in this example is an odds ratio because the vertical axis in the diagram, which represents the null hypothesis, is located at one. The midpoint of each square is the effect size of the study it represents, while the size of the square is proportional to the weight attached to the study. The two horizontal bars on both sides of the square represent the confidence intervals. The rhombus at the bottom represents the summary estimate of effect size. The midpoint of the rhombus is the summary odds ratio derived from considering the results of all six studies, while the left and right corners represent the boundaries of the confidence interval for the odds ratio estimated for the populations.

FIGURE 5.

Example of a Forest Plot[40]

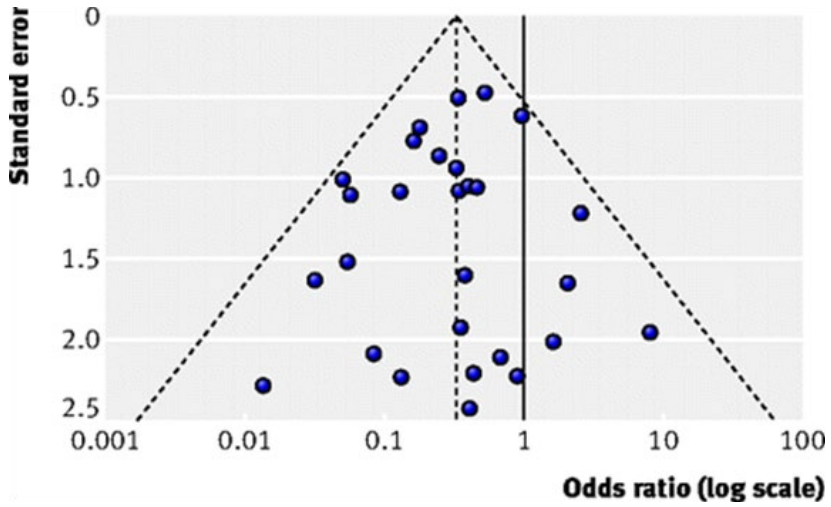


Abbreviation: PCI = percutaneous coronary intervention

Funnel plots are used in meta-analysis primarily as a visual aid for demonstrating publication bias or systematic heterogeneity. Ideally, 95% of the plots should lie within the funnel, with equitable distribution on both sides of the midline.[41] The Funnel plot in Figure 6 depicts the degree of heterogeneity of effect size estimates from another meta-analysis. Note that the **log** of the odds ratio forms the x-axis — not the raw odds ratio. The y-axis is the standard error for the proportions obtained in each study. When more than 5% of all points (representing each individual study contributing to the analysis) fall outside of the funnel, one concludes a presence of bias among the studies identified in the literature search. Recognition of the presence of bias in this manner merits appropriate commentary in the discussion section of the meta-analysis report.

FIGURE 6.

Example of a Funnel Plot[41]



Another important concept is that of **meta-regression**. This type of regression is used for a meta-analysis, with the unit of analysis being a study. For example, if two studies measured the effects of the same treatment applied to subjects of different age groups, one can summarize those studies if one adjusts for the confounding variable of age, by implementing meta-regression.[42] Software exists to make the work of meta-analysis much easier. **RevMan 5™** is a Cochrane collaboration software that is free to academic users.[43] **Comprehensive Meta-Analysis™** is another software that requires a paid subscription, but has point-and-click ease of use.[44]

REPORT WRITING

The last step in the review process is writing the report. Writing up a thematically organized literature review generally consists of four steps:

- **Step one**: Create an annotated bibliography by listing the studies selected for the meta-analysis and writing a short capsule summary for each manuscript included.
- **Step two**: Categorize each article into sub-themes of the main topic through thematic organization. One then writes concise paragraphs about each subtheme,

including statements of how the articles in each subtheme relate to each other and to the overall subject matter.

- **Step three**: Write individual sections of the final manuscript by discussing articles relevant to the theme of the section. A guiding principle is to use the articles to critique a particular theme, rather than using the theme as an angle to discuss each article.
- **Step four**: Integrate the individual sections with some revisions, to show how they relate to each other and to the overall subject matter.

Several tools exist to help assess quality of documentation for the review. The most important one is the PRISMA statement (see Figure 7). This statement consists of a checklist of 27 items under different sections — all of which must be reported in a review of good quality.[31] Another widely used tool for critical appraisal of systematic reviews is **AMSTAR 2™**, developed by Shea, et al.[45] The AMSTAR checklist scores the review according to answers to 16 different questions, with better reviews receiving a higher score.[47]

Finally, one generates the bibliography, while utilizing citation manager software to append to the report. The most common styles of formatting are the American Psychological Association (APA), Modern Language Association (MLA), and Chicago manual of styles. Zotero™ has a Microsoft® Word® plug-in that makes adding citations and bibliographies much easier.

FIGURE 7.

Checklist of Review Elements Required by PRISMA Statement Guidelines[31]

Section/Topic	#	Checklist Item
TITLE		
Title	1	Identify the report as a systematic review, meta-analysis, or both.
ABSTRACT		
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.
INTRODUCTION		
Rationale	3	Describe the rationale for the review in the context of what is already known.
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (P.I.C.O.T.S.).
METHODS		
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information inducing registration number.
Eligibility criteria	6	Specify study characteristics (e.g., P.I.C.O.T.S., length of follow-up) and report characteristics (e.g., Years considered, language, publication status) used as criteria for eligibility, giving rationale.
Information sources	7	Describe all information sources (e.g., databased with dates of coverage, contact with study authors to identify additional studies (in the search and date last searched.
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.

continued on next page

FIGURE 7. *continued*

Section/Topic	#	Checklist Item
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systemic review, and, if applicable, included in the meta-analysis).
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forums, independently, 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 (e.g., P.I.C.O.T.S., funding sources) and any assumptions and simplifications made.
Risk of bias in individual studies	12	Describe methods used of assessing risk of bias of individual studies (including specification of whether this was done at the study or outcomes level), and how this information is to be used in any data synthesis.
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I2) for each meta-analysis.
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meat-regression), if done, indicating with were pre-specified.
RESULTS		
Study selection	17	Give numbers of studies screened, assess for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, P.I.C.O.T.S., follow-up period and provide the citations.
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome-level assessment (see Item 12).
Results of individual studies	20	For all outcomes considered (benefits of harms), present, for each study: (a) simple summary data for each intervention group and (b) effect estimates and confidence intervals, ideally with a forest plot.
Synthesis of results	21	Present results of each meat-analysis done, including confidence internals and measures of consistency.
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).
Additional analyses	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regressions (see Item 16).
DISCUSSION		
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcomes; consider their relevance to key groups (e.g., health care providers, users, and policy makers).
Limitations	25	Discuss limitations at study and outcomes level (e.g., risk of bias), and at review level (e.g., incomplete retrieval of identified researcher, reporting bias).
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.
FUNDING		
Funding	27	Describe the sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.

doi:10.1371/journal.pmed.100097.t001

CONCLUSIONS

A well-formulated literature review requires critical synthesis and analysis of a defined body of literature. Systematic reviews identify, select, assess, and synthesize the findings of similar but separate studies and help to clarify what is known and unknown about the potential benefits and harms of drugs, devices, and other health care interventions. Researchers conducting systematic reviews must use explicit methods aimed at minimizing bias to produce more reliable findings that can be used to inform decision-making. The review question can be framed in terms of the population, intervention(s), comparator(s), outcomes, timing, and settings of the studies (P.I.C.O.T.S.) that will be included in the review. These elements of the review question, together with study design, will then be refined to determine the specific inclusion criteria that will be used when selecting studies for the review. Study selection is usually conducted in two stages: an initial screening of titles and abstracts against the inclusion criteria to identify potentially relevant papers, followed by a screening of the full papers identified as possibly relevant in the initial screening.

➲ *KEY CONCEPTS*

- The review protocol should state the procedure for data extraction, including the number of researchers who will extract the data and how discrepancies will be resolved.
- By combining information from all relevant studies, meta-analyses can provide more precise population estimates of effect sizes that can be provided from the individual studies included within a review.
- When writing up the results of a systematic review for publication, one should include details about the methods followed and the decisions made regarding which studies to include and exclude from the review.
- When publishing an analytical review, one should follow the PRISMA guidelines for reporting of included and excluded studies.

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FUNDING MECHANISMS FOR RESIDENT RESEARCH PROJECTS

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ABSTRACT

Some resident-level research projects do not require internal or external funding to complete. However, in many instances, once a research question has been identified, it becomes necessary to secure funding and other support to enable the completion of that project. This can be a challenging experience for any investigator, particularly for the novice emergency physician clinician-scientist. The process of obtaining funding for biomedical research has become increasingly competitive, and various factors make this especially so for emergency medicine researchers. Being a relatively new discipline, fewer financial resources exist for EM than for most larger and more established specialties. However, many EM investigators have found success in obtaining grants by identifying important areas for research that also involve other disciplines, and then by developing collaborative relationships with established investigators (mentors) from those disciplines. With such mentors, they can leverage common interests to begin generating a track record of research productivity. This chapter will emphasize a practical approach to the identification of funding sources for EM researchers.

INTRODUCTION

For the early-career researcher, be they a resident or junior-level faculty member, identifying a topic area may represent only the beginning of the journey to completion of peer-reviewed, published, and impactful research. For some resident research projects, the scope of the project is so limited that no internal or external funding is needed. However, once a research question has been identified and a draft study methodology written, some projects may require financial support to enable their completion. This is especially true if the scholarly project is the first in a series of planned investigations, as the novice researcher seeks to define the focus of their future research career.

Finding external sources of funding is often a challenging experience for any new investigator. This chapter outlines a practical approach for residents interested in an academic research career to develop a research track record likely to be competitive for external funding, including methods of identifying funding sources suitable for emergency care research projects.

GAINING SKILLS AND ACCESS TO EXTERNAL FUNDING VIA MENTORSHIP

Unless the researcher is independently wealthy or their clinical department is well-endowed with discretionary funding, obtaining external grant funding is crucial to the development of a productive focus of research scholarship. Even when internal funding is available for initial efforts, obtaining external grant funding for projects typically contributes to the success of more extensive and impactful future efforts.

Funding for biomedical research has become extremely competitive. Even well-established investigators with proven track records of research productivity may encounter difficulty in obtaining extramural funding. With limited resources earmarked to fund EM research, investigators may find it necessary to explore funding opportunities outside of their own medical specialty. Collaboration with colleagues from other disciplines when studying a problem of common interest can also be fruitful. Many successful emergency care researchers have identified research topics along their paths to success that are important not only to EM, but also to other medical specialties. By working with a more established investigator from another specialty, early-career emergency physician-scientists might gain more ready access to funding opportunities that might not otherwise be available to them.

Mentorship can be especially important for early investigators and building collaborative relationships with established investigators from other specialties can provide valuable mentorship opportunities. Investigators should identify mentors with a track record of success at competing for external funding and publishing peer-reviewed research. More than likely, successful research mentors were once mentored themselves in reaching their goals. Similarly, novice researchers should strive to develop a skill set that will ultimately make them valuable mentors to the next generation of researchers. Such a cycle of mentorship can help ensure continued and greater success for the departmental research mission while simultaneously increasing the likelihood of funding success for individual researchers.

Grant proposals typically undergo a rigorous peer-review process in which content experts adjudicate the quality of the research plan, as well as the qualifications of the investigator and their proposed collaborators. The hallmarks of a competent researcher, in the eyes of most reviewers, include a track record of research productivity, previous grant funding, and the successful completion of previous projects. Novice researchers would thus

be wise to attempt to enhance their application by collaborating with a mentor who has these credentials. Reviewers are more likely to support funding a research project if they believe that the funded effort will result in successful completion of the project and a peer-reviewed publication.

It is usually difficult for a beginning researcher to strike out on their own and quickly become competitive for large, interdisciplinary grants. However, even if one "starts small", it is still possible to develop an attractive track record of research productivity and funding over time. One of the authors' mentors terms this approach, "little steps for little feet."

DEVELOPING A TRACK RECORD

Gaining Research Training and Experience

The critical first step for any investigator is to develop expertise in a focused area of research. Unfortunately, the clinical training of most emergency physicians does not incorporate development of the basic research skills needed to achieve this goal. Therefore, resident researchers must generally seek this training outside of their formal residency curriculum. Acquisition of these specialized research skills can be done through formal advanced research coursework or training (i.e., M.S. or Ph.D.) or by training with an established investigator. Other non-degree research courses that can provide practical skills in this area include the Emergency Medicine Basic Research Skills (EMBRS) workshop, offered by the American College of Emergency Physicians (ACEP), the Society for Academic Emergency Medicine (SAEM) Grant Writing Workshop, and coursework offered at individual institutions [often through the institutional Clinical and Translational Science Awards (CTSA) Program].

Collaboration with a mentor who is an established investigator conducting research in the area of interest will usually aid the novice researcher. The skills, techniques, and approaches they can impart are generally needed to be successful in a particular area of research. Such collaboration also facilitates meeting and teaming with those institutional support personnel most likely to be helpful to the overall enterprise, such as a medical librarian, a biostatistician and research methodology expert, and support staff adept at helping the team negotiate the IRB approval process. More details about finding a useful mentor are noted below.

Initiating a Publication Track Record

Once the requisite research skills have been obtained, it is important to begin publishing manuscripts in one's chosen area of research. One successful approach is to have beginning researchers write a critical review article on their selected research topic. This exercise ensures that a complete literature search has been performed and initiates the writing process. An outcomes review or methodology paper describing a new experimental model or technique developed for the project is sometimes publishable. Some research leaders suggest using an existing database to identify secondary reports that might point to a hypothesis or project.

Initiating a Funding Track Record

It is also important for investigators to establish a track record of research funding. Funding sources can be intramural, foundational, governmental, or corporate. In addition, funds can be unrestricted or directed toward training of investigators or specific diseases or conditions. Investigators should expect to progress from local institutional (i.e., intramural) funding sources to extramural funding at the regional/state level, and finally, to national foundational and federal sources of funding.

SELECTING A MENTOR OR MENTORS

As noted above, collaboration with a mentor is often a requirement for success. The ideal mentor should have a strong publication record, a track record of receiving prestigious, national, interdisciplinary, grant funding (i.e., NIH R01 or center grants) and a track record of training investigators. Thus, an appropriately selected mentor or group of mentors can be helpful not only in developing a research project, but also a successfully funded grant application.

Early-career researchers should remember that they also have something of value to offer to their mentor; benefits of the mentor-mentee relationship flow both ways. Although virtually all mentors are usually extremely busy, they may be receptive to new research opportunities that enable them to extend their previous body of inquiry. EM researchers can often provide access to new and unique clinical settings not previously exploited by non-EM mentors. This access can greatly benefit mentors, by complementing or extending the mentors' prior and/or ongoing research efforts. In this way, both the mentor(s) and the mentee can gain from the mentor-mentee relationship.

LOCAL FUNDING SOURCES

Most universities and academic medical centers have programs to support research efforts of new investigators. These research programs are usually open to junior faculty and emphasize investigators who propose studies that have the potential for expansion that will enhance the probability for extramural funding. Collaborators can serve as an excellent entry into these funding programs because they have already demonstrated successfully completed projects that result in extramural funding.

Most universities and academic medical centers have an office dedicated to grants and contracts. These offices support extramurally funded research and should be able to provide information on an array of institutional, governmental, and foundational sources of grant funding.

Another means of finding funding information is the internet. One great place to start is on university websites dedicated to grant and funding resources. For example, the University of California at Los Angeles (UCLA)[1,2] and Duke University[3] maintain online grant resources pages that can serve as useful starting points.

REGIONAL FUNDING SOURCES

Once projects have been completed and the results of even preliminary studies have been published, the next step may be to approach foundations or state agencies that support EM research. For example, the American Heart Association (AHA) has many regionally distributed research programs run by each AHA affiliate (regionalized by state or metropolitan area) that are directed toward early investigators or fellows in training.

In addition, many state (and some local) agencies have funds earmarked for research projects designed to address specific public health or policy needs. For example, several states have dedicated research funds earmarked to assess the impact of tobacco-related disease (e.g., heart attack and stroke) and recently, many states have directed funding of marijuana-related research, including behavior effects and impairment. Early-career researchers should dedicate ample time in planning their research project to identify such local and state funding sources. Time spent investigating these resources may yield significant gains for the novice EM researcher.

FOUNDATION AND FEDERAL FUNDING SOURCES

Within the field of EM, the main sources of private foundational grants are the Emergency Medicine Foundation (EMF) and the SAEM Foundation. These funds are directed solely toward EM investigators, and offer a competitive advantage to emergency physicians who seek to complete emergency care projects.

The National Foundation of Emergency Medicine (NFEM)[4] provides career development awards that couple awards for scholars with those for a dedicated mentor. In addition, NFEM has developed EM-specific programs for training in translational medicine based upon the principles of the Eureka Institute for Translational Medicine, a transnational organization founded by leaders in translational medicine and incorporated in Italy in 2008.[5]

Many foundations direct programs for training or career development or toward specific disease states, such as the AHA's focus on cardiovascular disease. However, it can be difficult to find information on these foundations. The internet sites listed in this section can be useful in identifying potential foundations and programs that may be willing to fund novice researchers.

The federal government serves as the largest source of funding for biomedical research. The bulk of federal biomedical research funds come from the NIH, although emergency physicians have become increasingly successful in obtaining funding from other federal sources.

Emergency Medicine Foundation

ACEP has provided direct support for research and new investigators via the development and support of the EMF. The EMF was established in 1973 as the research and education arm of ACEP. The EMF's aim is to advance the practice of EM by sponsoring research projects and training programs spanning the breadth of EM, from the laboratory to clinical and population research.

Historically, the EMF's primary focus was on funding training grants for medical students, residents, and fellows in EM research. Indeed, many of the current generation of EM investigators successfully competing for NIH dollars come from the first cohort of young scientists supported by the EMF. The EMF receives its funding entirely from private sources, including donations from academic and private practice emergency physicians, and from industry sponsors, including large practice groups and pharmaceutical companies. Since 1981, the EMF has sponsored over 400 research projects, with awards totaling more than $4 million.

In addition, an EMF grant program that currently awards one $10,000 grant per year has been developed exclusively for participants in the ACEP / EMF Emergency Medicine Basic Research Skills (EMBRS) workshop.[6-7]

Society for Academic Emergency Medicine

The SAEM was formed in 1989 from the amalgamation of the University Association for Emergency Medicine (UAEM) and the Society of Teachers of Emergency Medicine (STEM). For more than 20 years, STEM and UAEM helped shape the specialty of EM, particularly in the areas of education and investigation. This organization is dedicated to the care improvement of the acutely ill and injured patient by improving research and education in emergency medicine.

The SAEM Foundation, established in 1998, provides funding to help develop the research and educational careers of young EM academicians. The emphasis of

this foundation is to support training grants rather than individual topics. The SAEM Foundation has been built primarily with the support of SAEM reserves, but also from member contributions. This fund has awarded millions of dollars to EM researchers. Specific descriptions and application details are available on the SAEM Foundation grant website.[8]

National Institutes of Health

The NIH is by far the largest source of governmental funds for biomedical research. The NIH is split into institutes, centers, and offices. The NIH's Office of Emergency Care Research (OECR) coordinates research that involves multiple NIH institutes and centers. This OECR, created in part because emergency medicine has no institute within the NIH, can be of special value to emergency physician researchers. The OECR can help match researchers with NIH funding opportunities in their area(s) of interest across the various NIH institutes.[9] The OECR has led to a remarkable increase in federal funding of EM research, but funding rates for new EM investigators remain low.

The NIH offers many grant programs, including those for career development of clinical investigators, disease-directed grants, and investigator initiated grants. Detailed information on NIH career development grant programs, including NIH research career development awards, including K awards, can be easily accessd.[10]

The NIH Office of Financial Management has a homepage[11] that provides detailed information on NIH budgets and spending priorities. This site features charts detailing NIH spending by disease and program initiatives, as well as data about almost every key NIH indicator, including grants, peer review, research centers, training, research management and support, contracts, intramural research, and construction. In addition, much of the data available for NIH is also available for individual institutes, centers, and offices.

Agency for Healthcare Research and Quality

The AHRQ sponsors research in health care services. Emergency physicians have successfully obtained AHRQ-funding, especially in the area of EMS for children. General information about AHRQ funding opportunities[12], as well as specific information about current AHRQ grant proposals, are available at their website.[13]

Centers for Disease Control and Prevention

The Centers for Disease Control and Prevention (CDC) has become an excellent source of funding for EM investigators. The CDC has sponsored EM-based studies of injury control and surveillance of infectious diseases. Because the CDC usually sponsors work that is in the data collection phase, investigator experience is not emphasized in application scoring. In addition, the CDC provides extensive support for data analysis. A compendium of CDC grant opportunities can be located on the CDC's website.[14]

American Heart Association

The AHA is one of the largest private foundations for biomedical research grants and has sponsored many emergency physician researchers in the past. The AHA has national and regional (affiliate) research programs for students, fellows, and beginning and established researchers. Detailed information on AHA research programs is readily available on the AHA website.[15]

Robert Wood Johnson Foundation

The Robert Wood Johnson Foundation (RWJF) is the nation's largest philanthropy dedicated solely to health. It was funded in 1972 through the bequest of the late Robert Wood Johnson, the man who built the small family firm of Johnson & Johnson into the world's largest medical supply company. The foundation has given over $2 billion in grants, including grants to emergency physicians. Details about the foundation's grant programs can be accessed via their website.[16]

REPORTS ON RESEARCH DIRECTION AND FUNDING

There have been many reports[17-22] on future research directions and funding in EM. These reports provide broad perspectives on the value of EM research, current challenges, and suggested approaches to the further development of EM investigators.

These reports were developed by the research committees of ACEP and SAEM, and convened by the OECR at the NIH. These reports, included in the reference section, also provide background for grants and discussion points on methods of assessing outcomes and informational management strategies.

CONCLUSIONS

Funding is not always required for resident-level research projects. Fewer financial resources exist for EM researchers than for investigators in larger and more established specialties. However, many EM investigators have successfully obtained grant funding by identifying important areas for research and developing collaborative relationships with researchers in other fields. The major EM associations, including ACEP and SAEM, have developed grant mechanisms to support EM research, including resident-level research projects. Funding is also available from public sources, including the NIH, CDC, OECR, and other governmental agencies, although these may be less accessible for resident-level projects. Multiple private funding sources have also emerged over the last few decades. Researchers who wish to be competitive for large grant funding should develop a track record for smaller grant funding and publication in their area of interest. This process can begin during residency, and resident-level researchers should consider how their resident-level projects can contribute to the development of their career research portfolio. The selection of an appropriate mentor, who can help in seeking out sources of research funding, can be integral to the process of acquiring adequate resources for the project.

➲ *KEY CONCEPTS*

- Once a research project or series of projects has been conceived and planned, it may be necessary to search for and gain funding support to enable completion of the project.
- Many EM investigators have been successful in obtaining grants by identifying important areas for research, developing collaborative relationships with established investigators (mentors), and carefully generating a record of research productivity.
- There are significant funding opportunities for EM investigators through EM-focused foundations and the OECR at the NIH.

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PUBLISHING AND PRESENTING RESIDENT RESEARCH AND SCHOLARSHIP

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ABSTRACT

The Accreditation Council for Graduate Medical Education (ACGME) mandates that emergency medicine residents participate meaningfully in scholarly activity. For those who successfully complete such activity, whether in research, in quality improvement, or by other acceptable means, conveying the findings of their project can be a "capstone" event. The results of scholarly inquiry can be presented or published utilizing a variety of methods, and in myriad different venues. Selection of the preferred venue depends upon a variety of factors, including the priorities of the target organization or journal and characteristics of the target audience. The venue should be carefully chosen, to maximize the project's impact. Results are often initially presented in the form of an oral or poster abstract at local venue, before being further presented at regional or national professional conferences. Publication of results in a peer-reviewed journal often represents the highest goal for a resident research project.

This chapter guides the learner through the process of presenting and eventually publishing the results of their research study, including considerations important to the selection of a venue and methods for results reporting. Emphasis is made on the importance of skilled written and verbal communication, authorship considerations, and best methods for promoting effective and timely dissemination of results, including tips on the proper use of social media and Free Open Access Meducation (FOAMed) platforms. Learners are also offered insight into how and when their research or other scholarly activity should be added to their *curriculum vitae*.

INTRODUCTION

All residents must acquire the competency of "life-long learning". Engaging in scholarly activity, especially research, enhances this competency. Scholarly activity can also be an educational and fulfilling experience for emergency medicine residents, offering unique insights into the processes by which new medical information is derived and disseminated to practitioners. It can also be valuable to learners and mentors as a means of contributing to the advancement of their field, and potentially as a means of career advancement.

Residents should be strongly encouraged, if not required, to not only complete their scholarly project at some point during residency training, but also to present it to audiences that include those who were not "team members" who collaborated to develop the project. This is true, whether the project was original research, a quality improvement project, or other scholarly endeavor. Such presentations can be made not only to local, but also to regional or even national audiences.

Presenting results from the scholarly project supports the institution's expectation of scholarship, while providing an opportunity for positive reinforcement for residents' accomplishments. The media submitted by presenters (e.g., posters or slide decks) can be posted on residency websites or published in institutional newsletters. When conducted correctly, events featuring presentations of locally-conducted scientific inquiry can cultivate an environment of research support from program leadership and demonstrate that value is seen in residents' work. Appeals for research funding to alumni or other supporting organizations can be disseminated along with summaries of recently presented projects, with the goal of soliciting contributions from prior graduates toward a fund aiding future scholarly activities.

Previous chapters have focused upon the infrastructure required to facilitate resident research or other scholarly projects, as well as the process by which useful scientific inquiry can be conducted. This chapter focuses upon the work that must be done after the data have been collected, when the investigator is planning how to best present their findings. Many factors must be considered when determining the ideal means by which results should be reported, including the type of presentation, the "target audience" (both for "live" presentation at a conference, and for publication in a peer-reviewed journal), the available presentation venues, and considerations of authorship.

TYPES OF PRESENTATIONS

Submission types for live scholarly activity presentations vary in format, length, and presentation media (see Table 1). Selection of the type of presentation to be delivered should complement the scholarly project topic and protocol. For example, it may be more appropriate to submit an innovation abstract, as opposed to a scientific research abstract, to communicate the outcomes of a new curricular development and implementation. For clinical case presentations, it may be more appropriate to submit a clinical images report than a full case report to teach learners about an interesting finding noted on imaging.

TABLE 1.

Common Scholarly Presentation Submission Types

Alongside standard requirements for initial submission, and at-the-conference requirements for presentation (if accepted).

Submission Type	Description	At the Conference
Abstract: Innovation	Concise 2,000-2,500-character abstract with standard sections (e.g., Background, Methods, Results, Conclusions), sometimes with figures / tables	Slide deck or poster, small-group verbal presentation
Abstract: Oral		Slide deck and oral presentation
Abstract: Poster		Poster, with or without small-group verbal presentation
Clinical Image	Very brief written vignette with image(s)	Initial submission displayed; no verbal presentation
Clinical Vignette	Concise case report paper with optional images	Poster with a short small-group presentation
Didactic	Proposal with narrative, objectives, format, speaker bios	Slide deck and <1 hour talk with at least one speaker
Other	Proposal to follow guidelines	Presentation to follow guidelines

Most conferences offer multiple presentation forums, matching authors' various presentation format preferences. Larger national conferences usually offer the widest variety of forums. This variety offers multiple formats to complement researchers' unique strengths. An excellent public speaker can submit an oral abstract presentation. If the presenter does not enjoy or excel at public speaking, they can express preference to present a poster abstract. If they have an excellent visual stimulus to share, they can opt for a clinical image submission.

TYPES OF VENUES FOR PRESENTATION

There are many different conference sizes, venues, target audiences, and conference *foci* (e.g., subspecialties) available for resident-level researchers to present their findings. Target audiences range from the broad community of all physicians, to the general community of emergency physicians, to very-focused subspecialty conferences such as those devoted to toxicology, critical care, pediatric emergency medicine, or other focus areas. When a subspecialty is shared between emergency medicine and other medical disciplines, a resident's research findings can merit submission for consideration for presentation at a conference convened by another specialty. For example, pediatric EM research can be submitted to the American Academy of Pediatrics National Conference & Exhibition, under the Section on EM. Table 2 lists commonly-attended conferences at which EM research is often presented. General / academic conferences are specified as international or national, with regional and state offerings noted. This list is meant to be illustrative, and may not include all relevant conferences.

TABLE 2.

Conferences that Frequently Accept Scholarly Work for Presentation by Emergency Physicians

General / Academic Emergency Medicine		
Region	**Name**	**Acronym**
International	Asian Conference for Emergency Medicine	ACEM
	International Conference on Emergency Medicine	ICEM
	International Symposium on Intensive Care & Emergency Medicine	ISICEM
	Mediterranean Emergency Medicine Congress	MEMC
	Red Sea Emergency Medicine	RSEM
	World Academic Congress of Emergency Medicine	WACEM
National	American Academy of Emergency Medicine	AAEM
	American Association of Medical Colleges	AAMC
	American College of Emergency Physicians *(Also offers state chapter conferences)*	ACEP
	American College of Osteopathic Emergency Physicians	ACOEP
	Council of Residency Directors in Emergency Medicine	CORD
	Society for Academic Emergency Medicine *(Also offers regional conferences)*	SAEM
Subspecialty / Special Interest		
Focus	**Name**	**Acronym**
Cardiovascular	American Heart Association	AHA
Critical Care	Society for Critical Care Medicine	SCCM
Disaster EM	World Congress for Disaster Emergency Medicine	WCDEM
Pediatric EM	American Academy of Pediatrics-Section on Emergency Medicine	AAP-SOEM
Simulation	International Meeting on Simulation in Healthcare	IMSH
Toxicology	North American Congress of Clinical Toxicology	NACCT
Ultrasound	World Congress on Ultrasound in Emergency & Critical Care	WINFOCUS
Wilderness EM	Wilderness Medical Society	WMS

The smallest presentation venues are often research laboratory or institutional conferences. One common institutional practice is to organize an annual "resident research day" to showcase scholarly works (which need not be limited to research projects) that have been completed by resident-level investigators. These events typically incorporate a friendly competition, with prizes for the presentations judged to be the best in certain categories. This format can provide additional motivation for resident presenters.

When presenting in this type of venue, residents gain the opportunity to communicate their findings without the added pressure of appearing at a national or regional conference. Also, residents generally find it less stressful to present to a panel of judges that include local content experts with whom they have worked clinical shifts, rather than to judges who might seem more intimidating because there has not been prior informal contact and collaboration between the resident and the expert. The sponsoring department also benefits by publicizing research efforts to faculty and residents who might not otherwise be aware of research efforts being undertaken within their own academic community. Critiques by faculty members or fellow residents, when shared back to the presenting resident, often help the presenter to refine the content or delivery of their presentation, before sharing their findings at subsequent regional or national conferences.

Medium and large conference venues may be on the local, state, regional, national, or international scale. Conference size influences the type of experience that presenters will have, and benefits may be derived on both sides of the scale. Smaller-scale conferences at or near the resident's "home" institution can offer a more personal experience, facilitate networking with nearby programs, and provide a good chance of acceptance (or even an award) for high-quality submissions. These local conferences often have fewer presenters, allowing judges to spend more time sharing constructive comments with each participant. On the other hand, larger-scale conferences may be more prestigious, and can facilitate networking with professionals from all over the country or world. This can facilitate rapid and widespread dissemination of information about the scholarly work, and may also offer new and diverse perspectives from conference attendees. Large conferences may also allow the resident to travel somewhere fun or exotic for the presentation, providing an additional reward for the resident's hard work on the project.

Presentation of scholarly project findings to others outside of the research team (at local, regional, national, or international conferences) provides an opportunity for additional "peer-review" of the project's results. As the learner will be busy presenting the project, another member of the study team should be asked in advance to record useful questions or comments from the audience, including insightful critiques. This may help to improve the quality of the final written manuscript or subsequent presentations.

In the post-COVID-19 era, virtual conferences are becoming more commonplace, and modern technology makes this option increasingly practical. There are pros and cons to this platform for scholarly presentations. "Virtual" presentations are undeniably more time- and cost-effective for researchers. Presenters are usually asked to submit a recording of their presentation before the event, rather than presenting live, which may allow them time to perfect their talk beforehand. However, the virtual platform can be much less personal, and provides fewer face-to-face networking opportunities, such as the interest group meet-ups that are commonly available at traditional in-person conferences.

HOW TO SUBMIT AND WHAT YOU WILL NEED TO PRESENT

Once the scholarly work has yielded results suitable for presentation, authors should decide upon the target conference and be cognizant of relevant deadlines. Calls for abstract submissions to the major EM conferences are released well in advance, with deadlines that are typically four months or more before the conference, allowing for adequate peer review. Further, the more desirable local, regional and national conferences tend to fall

at about the same time every year, facilitating the planning process. Resident researchers should sign up for organizational "listservs" and follow organization handles and topic "hashtags" on social media for important announcements and instructions.

In most cases, major EM conferences will only consider submissions that have not been previously presented or published, but there are nuances to this. For example, both CORD and SAEM hold national assemblies in spring, and SAEM allows presenters to have also been accepted for presentation at CORD. International conferences may consider submissions previously presented or published nationally. If submitting the same work to multiple venues simultaneously, the submission may ultimately need to be withdrawn from one or more symposia to adhere to eligibility rules. When in doubt, researchers should seek guidance from the conference organizer(s).

Guidelines for abstract submission will differ between organizations, and residents should clarify the requirements for their venue of choice in advance of submission. However, most national or international organizations will accept submissions that have been previously presented at the local or regional level. The opportunity to present at a more local venue can be valuable in refining the presentation prior to submission to a national or international venue, and should be considered.

Organizations provide explicit guidelines for initial conference presentation submissions. As detailed in Table 1, research abstract submissions are concise and have standardized sections. Variations of this format apply for oral, poster, and innovation abstract submissions.

Generally, there is a unique submission portal for each organization. It can take time to become accustomed to each portal, so researchers should create a user account and sign-in to the account as far as possible in advance of the submission deadline to acclimate themselves to the website and familiarize themselves with the site's submission requirements. There may also be a limit on the number of authors that can be listed, commonly 10 authors for research abstracts. It is important to ensure that all (but only) significant contributors are included as authors. If the maximum number of authors is reached for the submission portal, it is worth reaching out to the conference organizers to see if an exception can be made. As a courtesy, each author should be notified of the submission well in advance and be given the opportunity to contribute to writing and revising the abstract prior to final submission. It is expected that each of the listed authors will have the chance to review and revise the final abstract prior to submission.

COST AND THE LOGISTICS OF PRESENTING

The cost of scholarly presentation ranges widely, depending primarily upon the proximity of the selected venue to the resident's home institution and the need for accommodation (i.e., lodging). It is not uncommon for total costs to exceed $1,000. The costs of presentation can include travel, lodging, dining, conference registration, organizational membership dues, competition entry fees, and media costs (e.g., poster printing fees). The resident's home institution may provide funding for a portion of these costs, sometimes in addition to a small shift differential for conference attendance. This funding practice is a win-win for both residents and residency programs, because scholarly activity enhances the reputation of the residency program and is a program requirement in the view of the Accreditation Council for Graduate Medical Education (ACGME). If the research is being presented on

behalf of a research lab or senior investigator, it may be possible to apply grant funds earmarked for research presentation or, in some cases, funds allocated to the project mentor. Another way to manage the cost of presenting at conferences is application for travel grants and scholarships from the conference's hosting organization or another EM organization. Many EM organizations offer multiple travel awards to their conference annually. These may be either need- or merit-based.

Even if local or organizational funding is available, presentation expenses may, in some cases, require residents to pay "out-of-pocket." Fortunately, residents can still find ways to minimize costs while effectively showcasing their work. State and regional conferences may offer research symposia nearby their institution. Travel should be booked early, and consideration should be given to shared lodging with other residents. Residents can also opt to pay for and attend only one day of the conference (i.e., the day of their presentation), rather than the entire conference. Many conferences offer discounted registration fees to abstract presenters. Some conferences waive registration fees entirely as a courtesy to presenters. Early-bird registration can offer reduced fees, and discount codes may be found in organizational newsletters or emails.

AFTER PRESENTING

Ideally, the findings of research or other scholarly projects are published in a peer-reviewed journal as an abstract or conference proceeding. One example is that all national ACEP Research Forum abstracts are published in the *Annals of Emergency Medicine* journal meeting supplement each year. Some organizations may publish only a subset of the accepted abstracts. The research presentation and any associated abstract publication should be added as separate entries on the resident's *curriculum vitae* – the former as a research presentation at a conference, and the latter as an author.

TYPES OF PUBLICATIONS

There are many types of written publications and, like presentation submissions, the key requirements of each must be understood before selecting which to target. Acceptable categories vary between journals, but most journals include variations on the categories listed in Table 3. Author guidelines, readily available from each journal's website, will detail their unique requirements for each type of submission.

TABLE 3.

Peer-reviewed Emergency Medicine Journal Manuscript Categories

Manuscript Types	Details
Clinical Cases	Traditional case report, case series, clinic-pathological case, or clinical image report
Clinical Controversy	A two-part piece in which opposing authors each offer their discussion of a controversial issue in medicine
Clinical Review	Evidence-based review, answering a specific question or issue relevant to medicine
Commentary or Perspective	Peer-reviewed venue for topics not discussed elsewhere
Concepts	Descriptions of problems and novel solutions to both clinical and non-clinical problems
Correspondence or Letter to the Editor	Solicited or unsolicited; response to a piece recently published in the journal, including discussion, opinion, corrections, etc.
Educational Advances	Brief or full-length; educational case conference, or educational case report
Evidence-Based Medicine	Use simplified methodology of systematic review
Expert Opinion	Usually solicited; short review of the optimal approach to clinical or non-clinical challenges
Innovations Report	Introduction and preliminary evaluation of a novel possible solution to a challenge facing the wider medical community
Original Research	Brief or full-length
Systematic Review	With or without meta-analysis

Original research can be submitted as a brief- or full-length report. Brief research reports usually have a word limit of 1,000–2,000 words with restricted figures and / or tables. Full-length research reports usually include a word limit of 3,000–5,000 words, but allow more figures and / or tables. Exact word limits will vary between journals. Some journals encourage authors with voluminous data sets to electronically cache data summary tables or figures in an on-line repository.

Clinical cases can be published as traditional case reports, clinic-pathological cases (CPC), or clinical images. Traditional case reports usually have a word limit of 1,500 words and two figures. Reports of CPC have a more liberal word limit of about 4,000 words because of their unique format, walking readers through the case, clinical reasoning, and diagnostic take-home points.

Reports of clinical images are usually quite abbreviated (e.g., 300 words), and require 1-3 clinical images. Generally, signed patient consent should be obtained whenever saving any clinical image for potential publication, whether it is a clinical photograph, imaging, ultrasound clip, or even an EKG. It is much easier and less awkward to simply document this permission from the patient or family at the time of the ED visit, rather than attempting to locate them for consent later. Some journals require patient consent, even when no patient-identifying information is included. Most hospitals have a process to obtain and document informed consent to use a "likeness." Some institutions require Institutional Review Board (IRB) approval before publication of a case report. It is best to verify local rules and expectations before submitting a work for publication.

FACTORS IN JOURNAL SELECTION

Publication in a peer-reviewed journal is considered the highest form of scientific communication for research findings. The process of peer-review imparts a high degree of objectivity and trustworthiness that is not always associated with lesser forms of research communication. Publication in a peer-reviewed journal also enables indexing and referencing via a DOI (i.e., digital object identifier), a link to the authors' ORCID (i.e., open researcher and contributor identifier), and indexing in PubMed™.

Peer review is not an immediate process. Effective peer review can take many months to complete, beginning with submission of the initial manuscript to the appropriate journal, and ending with acceptance of the final revised version, following adjudication and comments by reviewers and decision editors. Because of the high standards for acceptance, authors may have their work rejected from the first journal to which they submit their work. Authors may be asked to revise and resubmit the work based on initial feedback from peer reviewers and journal editors. The revision process can be lengthy, and there is no guarantee that making the recommended changes will ultimately result in acceptance.

The good news is that thoughtful feedback, offered by reviewers who review a manuscript that becomes rejected for publication by one journal, can become instrumental to improving the manuscript for revision and submission to another journal. The suggested or required revisions will likely make the work more refined, impactful, and effectively communicated. Table 4 lists several peer-reviewed journals that publish EM-related works. Shorthand journal acronyms are included here, as applicable. Subspecialty and special interest journals include topics such as emergency medical services and pediatric emergency medicine.

A peer-reviewed journal's **impact factor (IF)** and **Hirsch-index** (**H-index**) are commonly-referenced measures of the journal's productivity and importance in the medical field. The impact factor is equal to the [sum of the number of total annual citations linked to articles published in the journal] divided by the [number of publications within that journal] during the preceding two years. Impact factor values are conventionally expressed to the third decimal point. Controversy can arise regarding the computation of impact factors, especially as it relates to what is meant by an "article."

Although the H-index was initially developed as an author-level metric, it can also be used to estimate the productivity and impact of journals. When used for a journal, the H-index is computed as the maximum value that can be obtained describing how often the given journal has published *h* papers that have each been cited at least *h* times, where "h" is the H-index value. For example, a journal that has previously published 52 papers that have been cited at least 52 times each by other authors would have an H-index of 52, regardless of how many papers the journal has published with fewer (i.e., ≤ 51) citations by other authors. For this reason, two journals could have the same H-index but very different impact factors. The H-index captures not only an average number of citations, but also reflects whether the articles that a journal publishes are highly impactful.

The H-index or IF can be informative when selecting a target journal, but authors should recognize that these indices represent only one factor to be considered when determining the "target journal" desired for publication of one's findings. Journals with a higher impact factor are believed by some to be more prestigious and to have a greater impact on the medical field than those journals with a lower value. However, these are imperfect measures and are vulnerable to manipulation.[1-2] The H-index and impact factor are re-calculated for each journal annually. **Table 4** shows the impact factor and H-index associated with various journals that commonly publish emergency medicine-related content. The reported H-indices are current as of December 2020 (www.scimagojr.com), and the impact factors are for 2018-2019 (Journal Citation Reports, Clarivate, 2020). Newer journals that do not have at least 2 years of citation data available to calculate an H-index are marked with "n/a."

TABLE 4.

Examples of Peer-reviewed Journals that Frequently Publish Emergency Medicine-related Studies

	General Medicine		
Full Name	**Short Name**	**Impact Factor**	**H-Index**
The Lancet	Lancet	60.392	747
New England Journal of Medicine	NEJM	74.699	987
	General Emergency Medicine		
Full Name	**Short Name**	**Impact Factor**	**H-Index**
Academic Emergency Medicine	AEM	3.064	117
American Journal of Emergency Medicine	AJEM	1.911	82
Annals of Emergency Medicine	N/A	5.799	148
Canadian Journal of Emergency Medicine	CJEM	1.656	44
Critical Care and Resuscitation	CC&R	2.493	31
Emergency Medicine Australasia	EMA	1.609	49
Emergency Medicine Journal	EMJ	2.491	77
European Journal of Emergency Medicine	EJEM	2.170	43
Injury	Injury	2.106	115
International Journal of Emergency Medicine	IJEM	1.640	27
Journal of Emergency Medicine	JEM	1.224	73
Journal of the American College of Emergency Physicians Open	JACEP Open	n/a	n/a
Resuscitation	Resuscitation	4.215	129
Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine	SJTREM	2.370	46
Shock	Shock	2.960	113
Western Journal of Emergency Medicine	WestJEM	1.807	31
Western Journal of Emergency Medicine Clinical Practice and Cases in Emergency Medicine	WestJEM CPC-EM	n/a	n/a
	Medical Education		
Full Name	**Short Name**	**Impact Factor**	**H Index**
Academic Emergency Medicine Education & Training	AEM E&T	0.356	N/A
Academic Medicine	Acad Med	5.354	143
Journal of Education and Training in Emergency Medicine	JetEM	n/a	n/a
Journal of Graduate Medical Education	JGME	0.649	19
Medical Education	Med Ed	4.570	129
Medical Education Portal	MedEd Portal	n/a	n/a
	Subspecialty / Special Interest		
Full Name	**Short Name**	**Impact Factor**	**H Index**
Burns	Burns	2.066	96
Journal of Point of Care Ultrasound	POCUS Journal	n/a	n/a
Pediatric Emergency Care	PEC	1.170	63
Prehospital and Disaster Medicine	PDM	1.315	45
Prehospital Emergency Care	PEC	2.192	61
Traumatology	Traumatology	0.728	32
Ultrasound Journal	N/A	n/a	21
Wilderness and Environmental Medicine	WEM	1.426	40

Selecting the most suitable journal has a significant impact on a manuscript's chance of acceptance and audience reception. Editors look for works that will benefit their unique readers and contribute to their journal's specific objectives. Authors can learn the theme, objective, scope, and target audience of journals by visiting the journal's website and reading the general information about the journal, as well as reading previously released issues. Resident researchers should also reach out to mentors who have published similar works. Consideration should also be given to the access options offered by the journal. Some journals publish their works as "open access" as the default (with or without extra costs to the author), some allow this option for a processing fee, and some offer only traditional publication (without cost but with likely higher standards for publication). As for types of media used by journals, many publish online only while others release print versions to their subscribers as well.

NON-PEER-REVIEWED PUBLICATIONS

For publication of scholarly activity, the medical / scientific community generally views non-peer-reviewed publications as inferior to peer-reviewed journals. The peer-review process, though imperfect, is designed to inspire and ensure higher standards for research publications, and readers seek out peer-reviewed primary literature for this reason. Therefore, it is usually not recommended that researchers target non-peer-reviewed venues unless there is a specific reason for doing so.

Nonetheless, there is still value in publishing in non-peer-reviewed publications, especially for manuscripts such as commentaries, perspectives, current events, and other news. Some case reports, clinical images, and teaching posts can be valuable in non-peer-reviewed journals, especially with rigorous citations of primary peer-reviewed literature. Effective teaching posts in this venue may include ultrasound techniques, procedural methods, etc. Many EM organizations have both a peer-reviewed and a non-peer-reviewed venue for publication. For example, ACEP publishes both *Annals of Emergency Medicine* and *JACEP* (peer-reviewed), as well as *ACEPNow* (non-peer-reviewed). The practice of sponsoring both types of publications reflects the inherent value in both venues.

PREDATORY JOURNALS

Resident researchers should be cautious when receiving emails from obscure organizations soliciting material for publication in their journals. Oftentimes, these emails originate from groups attempting to extort researchers, promising them easy publication opportunities and later imposing a hefty submission or publication fee. On the other hand, there *are* legitimate peer-reviewed journals that require a processing fee (which help to cover expenses for open access publishing), and thus it is difficult for the novice researcher to differentiate between predatory and legitimate low-circulation journals. Generally, legitimate journals will not send emails to individuals soliciting submissions, although they may use organizational message boards and listservs when seeking material for publication. The resident should always do a thorough online investigation into the legitimacy of the journal before spending time writing a piece for them. When in doubt, ask an experienced, published researcher about the specific scenario.

HOW TO SUBMIT AND WHAT YOU NEED

As with presentation submissions, each journal provides detailed author guidelines describing submission format and requirements. Although some requirements may be uniform among journals, each journal publishes an "Instructions for Authors" section. The manuscript must meet all the stipulated formatting requirements prior to submission. These often include: manuscript type, structure of writing, reference style, word limits in the main manuscript, and whether it should be blinded (all identifying information is redacted) for peer review. Figure and table formatting rules tend to be strict and unique; and an abstract may or may not be required.

After the final drafting is near-complete, authors should access and create a user account on the journal's submission portal and review all requirements for manuscript submission. Submission requirements may include any of those listed in Table 5, and authors should follow the journal's specific guidelines.

TABLE 5.

Standard Journal Submission Requirements for Publications

Document	Details
Author contributions	May require specific list of how authors met ICMJE criteria
Conflict of interest disclosures	Each author must disclose any financial conflicts of interest
Cover letter	Narrative to the editor and journal representatives with a brief description of the work and submission
Detailed author information	Full names, degree(s), title, department, institution, institutional address, email, ORCID, social media sites, etc.
First author photo	May be used alongside manuscript weblinks online
Funding	Must list any funding source, recipient, purpose of funds, and other details
Institutional review board approval notice	If research involved human subjects, indicate positive review by institutional review board or equivalent committee
List of prior presentations and publications	Including all conference presentations, peer-reviewed or non-peer-reviewed journal publications, online publications, etc.
Main manuscript	May require both blinded and un-blinded versions
Supplemental media	Additional material beyond appendices (may include full curricula, raw data, or other items)
Tables and figures	Often require each as a separate file; must be formatted and sized exactly as required
Title page	Full working title; author byline with full names, degree(s), titles, and institutions; corresponding author contact information

The content and tone of the text in the cover letter are important. Authors should assume that the journal editor will be one of the first to read it. The letter should concisely convey how the submission would benefit the journal's target audience and main objective. The tone should be humble and reflect that it would be a privilege to have the work peer-reviewed by the journal's team. **Figure 1** shows a cover letter template that can be used. It is recommended to confirm in this letter that each author has met the International Committee of Medical Journal Editors (ICMJE) standards for authorship, as below. Providing a hand-written signature adds a personal and professional touch.

FIGURE 1.

Sample Template for Manuscript Submission Cover Letter

Dear [EDITOR NAME] and [JOURNAL NAME] editorial staff,

On behalf of our research team, I am pleased to submit our manuscript, [MANUSCRIPT TITLE], to [JOURNAL NAME] for your consideration for publication. In our study, we addressed [STUDY OBJECTIVE] and found that [STUDY RESULTS]. We believe this would benefit your readers as they encounter similar situations.

Each author has met the ICJME standards for authorship and has contributed meaningfully to the study design, execution, analysis, and/or drafting of the manuscript.

Thank you for your consideration,

Signature

[YOUR NAME, CREDENTIALS]

Corresponding Author

The author contribution list should convey exactly which tasks each author contributed to the project, including submission drafting and revision. Some journals provide a list of codes to denote each author's specific contributions, e.g. project conception, subject recruitment, data collection / analysis, initial drafting, critical revision, etc.

AFTER SUBMITTING FOR PUBLICATION

After peer review, the journal's initial decision could be acceptance (rare on first pass), revision-reconsideration, or rejection. If accepted, the authors should respond to requests for final review of the proof and any additional requirements from the editors. This also may include a processing fee, which is typically disclosed to authors much earlier. For legitimate peer-reviewed journals, the processing fee may cover such expenses as open access publishing. If the authors are unable to pay the processing fee, they may inquire about a fee-waiver. In some cases, one's local institution may have purchased a membership for submissions with a publisher and affiliated authors may be eligible for reduced or waived fees. There is often a sliding scale for authors from countries based on the World Bank Group Income Classification of Countries.

If a decision of "revision-reconsideration" is rendered, the authors should meticulously examine the feedback from the reviewers and editor(s) and consider making the recommended changes. It should not be assumed that reviewers are correct in their

recommendations for revisions, so the authors should be thoughtful when making these decisions about suggested revisions. If the authors choose not to implement a suggested change, they will need to disclose the reasoning process supporting their decision to not make the requested change. Authors should respond promptly to a revision-reconsideration decision, and should address all reviewer and editor comments, even if no change was made. A point-by-point list is usually required, and the authors should carefully follow resubmission instructions. A new cover letter with the authors' response is often required, and this is a good time to express gratitude to the reviewers and editor(s) for their consideration and valuable feedback. The process of manuscript review takes time and effort for these individuals, and is often underappreciated.

If the manuscript is ultimately rejected from a peer-reviewed journal, the researcher can re-submit the work to another journal. The deciding factor in a rejection may be a trivial issue such as timing and popularity of the topic at the time of review. However, if the editor and reviewer feedback unmasks a significant flaw in the research, the authors should attempt to remedy the issue or address it in their limitations section when they resubmit to another journal. They should regroup and consider the strategy for the next submission. The authorship group should strategize, answering questions such as, "Should a journal with lower impact factor be targeted?" and "Is a smaller or subspecialty journal more likely to respond positively?"

AUTHORSHIP CONSIDERATIONS

Each name-listed author should have participated sufficiently in the work to take public responsibility for the content. Regarding the author byline, it is considered inappropriate authorship to 1) add an author's name when they have not contributed significantly and agreed to the final product; or 2) leave an author's name out when they have contributed significantly. To ensure ethical authorship listing, most peer-reviewed journals follow the International Committee of Medical Journal Editors (ICMJE) guidelines for authorship. Table 6 lists the four ICMJE criteria, all of which should be met by all authors.[3]

TABLE 6.

International Committee of Medical Journal Editors Criteria for Authorship

	Criterion
1	Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work
2	Drafting the work or revising it critically for important intellectual content
3	Final approval of the version to be published
4	Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Contributors who do not meet all four criteria for authorship should be listed in the acknowledgments section. Examples include individuals who allowed their clinical experience to be included or provided purely technical assistance. "Ghost writing" (i.e., hiring an individual to write a submission for money while receiving none of the credit) is not acceptable. No one, other than the authors listed, should have contributed substantially

to the writing and revision of the manuscript. Author Contribution Forms are reminders of who can be an author. Each author of an accepted manuscript must read and sign the statements on 1) Authorship Responsibility, 2) ICMJE Uniform Disclosure Form for Potential Conflicts of Interest, 3) Copyright Transfer Agreement. In addition, the corresponding author must sign a statement on 4) National Institutes of Health (NIH) funding, and if necessary, copy this document to distribute to co-authors.

The author byline order is important. The specific roles of each author and the order in which they are listed should be spelled out early in the project to set clear expectations, and adjustments should be promptly made if expectations are not met. The first author typically does the most work on the project and manuscript, often also serving as corresponding author, assuming responsibility for communications with the journal and fielding readers' questions. For junior faculty (particularly for those on tenure track), it is important for career advancement to serve as first author on manuscripts, but co-authorship also fulfills ACGME scholarly activity requirements. The second author typically has taken on the second-heaviest workload, and the remaining authors are similarly listed in order of descending workload with the exception of the last author. The last author is typically the senior author, project sponsor, or mentor. Regarding overall author order, there are occasionally special circumstances in which an alphabetized author list is utilized instead, such as a consortium publication, public statement, or publication on behalf of many people where no one team member did more work than others. Most Institutional Review Boards require a faculty member to sponsor the research or to be a co-author. The order of authors on research abstracts need not be the same order on the project's final manuscript. This can benefit the team as a whole by allowing multiple authors to have first- and second-author opportunities on different reports of study results.

The last/senior author responsibilities are important to understand because it is implied that they are the supervising "last set of eyes" on the scholarly work. They take overall responsibility for all aspects of the study oversight and, along with the first author, for the manuscript. The last/senior author most often participates in all aspects of the study.

For publications with a long author list, creating a research consortium is also an option.[4] In this setting, all project team members belong to the consortium which is included on the official author byline, and consortium members not meeting ICMJE criteria are omitted from the named author list. This may seem awkward, but early communication about name-listed authorship expectations can help to navigate this. Relying on the senior mentor for guidance is helpful. Similar to presentation submissions, as a courtesy to all team members on the author list, it is important that they all be notified well in advance of the plan to submit for publication and have ample opportunity to contribute to the drafting and revision.

MEDIA ADVICE: TECHNICAL COMMUNICATIONS

After deciding on the best-fit venue and format for communicating your scholarly project's findings (e.g., conference poster presentation versus clinical image publication), the nitty-gritty details of effective technical communication should be considered. Pay careful attention to any "Guidelines for Authors" documents available from the target organization. These can be very detailed and include answers to frequently-asked questions. Also, some technical communication principles ring true no matter the presentation/publication format: 1) clear and concise language; 2) conveying concepts with visuals whenever possible; and 3) use of high-quality graphics.

Both written and spoken language should reflect the audience's level of expertise on the subject, with the assumption that the average audience member does not know as much as the researchers about the project's specific focus. Language should also consistently reflect the researcher's desired take-home messages for their audience. If you want them to make a change to their practice, be consistent in your argument for this throughout the piece - every sentence should be written to accomplish this goal. Appropriate visuals are frequently more effective and more concise than just words and should be used whenever possible. Graphics should be high-quality in terms of content, format, and resolution. The content should be as simple and graspable as possible, the format should be reader-friendly and adhere precisely to the platform's requirements, and the resolution should be high (i.e., 300 dpi or greater).

DELIVERY ADVICE: HOW TO PRESENT

Oral presentations are generally moderated by an expert in the field and have different formats depending on the venue and format. Research presentations often follow a formal structure, with an introduction, methods, results, and conclusions section. Lengthy background information is not necessary, as the point of the presentation is to share the methods and results. As with all presentations, knowing one's audience can help one to craft a message that will be impactful. Knowing the audience's specialty and training level (as well as the conference region, membership demographic, and important current issues) can help target information to the appropriate level of technical detail. Pay attention to language - consider the audience's level of expertise and avoid jargon. As with any kind of presentation, pay attention to good slide design- avoid cluttered, text-heavy slides that are simply read aloud, and avoid distracting or decorative animation or font effects. Practice presenting one's work to colleagues to make sure that the information is conveyed effectively, and that the technical media functions correctly.

Following the presentation, there is usually an opportunity for the audience to ask questions. When asked a question in this format, it is a good idea to: 1) restate the question to allow the whole audience to know what was asked, and 2) confirm understanding of the question. This will allow time to formulate a response. If you do not know the answer to the question, it is appropriate to say that you will look it up and get back to the questioner. Avoid the temptation to say that you are ignorant of large sections of relevant content related to your presentation (e.g., the statistical analysis) in response to any question- this undermines your overall credibility. At some meetings, a speaker may be allowed to call upon colleagues present in the audience to help answer questions posed by another attendee. It is understood that in any collaboration, there will be differing levels of expertise. One should try to anticipate questions that may be asked in a Q&A session, and practice the answers. It can be helpful to create supplemental slides at the end of one's presentation to facilitate the answers to anticipated questions.

Presentations should also be viewed as an opportunity for a free "peer review" of one's scholarly project, and insightful inquiries from those who attend the presentation should be recorded by a colleague who is also present. In this manner, the point(s) which led to the question(s) (e.g., an unclear part of the presentation, a point of scientific controversy; etc) can be addressed and clarified before attempting to have the work published in a peer-reviewed journal. It is safe to assume that if an audience member had a question about one's presentation, then one or more of those who perform peer review of the project (once it is written up for submission to a scientific journal) will have a similar question.

PROMOTING YOUR ACCOMPLISHMENTS

Venues such as social media and organizational message boards can be used to promote and amplify scholarly accomplishments. Twitter, Facebook, Instagram, Slack, and blog posts can have particular utility, in addition to professional social media platforms like LinkedIn. Personal and organizational website posts (e.g., Researchgate), EM organization message boards (ACEP Sections, CORD Communities, SAEM Academies), and EM organization e-newsletters (i.e., On the reCORD, SAEM Pulse) can be effective mechanisms to further the reach of one's work.

Several techniques can be utilized to create effective, engaging social media and message board posts. Posts should almost always include an attention-grabbing graphic. Summarizing the work in a well-constructed infographic or multi-post "tweetorial" can make these posts more noticeable and interesting. Including links to online publications or presentation recordings makes them easily accessible to readers. Adding tags for special interests (like #MedTwitter and #MedEd) and events **(**like #ACEP**)** alerts followers. Adding handles for individuals and groups (like @ACEPNow and @SAEMOnline) may result in the post being re-shared. Many journals send authors a useful "Promotions Toolkit" document after acceptance. Authors should consider setting their posts to "public" instead of "private" to enable content sharing, but as always with use of social media, caution should be taken not to release any protected health information.

Blogs and FOAMed are popular and potentially effective promotional platforms as well. For example, The Skeptic's Guide to Emergency Medicine and Ultrasound G.E.L. reviews recent publications in this way, with the goal of analyzing and amplifying the work. There may even be invitations for authors to contribute to podcast episodes on their project, so it is important that the corresponding author's email be checked regularly for such opportunities.

Beyond the initial presentation or publication of one's research, consider whether the findings would also make for an interesting conference didactic, workshop, panel presentation, peer-reviewed commentary, simulation conference, CME-bearing educational journal article, or educational website. Significant time and effort go into completing any research project, and resubmitting material via multiple modalities allows researchers to both promote and capitalize upon their work. Finally, all authors must make sure to disclose prior publications and presentations of the work with any new submission.

UPDATING ONE'S CV AND TEACHING PORTFOLIO IN REAL TIME

The list of academic and professional accomplishments in one's *curriculum vitae* (CV) contains clues regarding the planned career trajectory for current and future employers. A well-composed CV is crucial for new academic appointments and promotions within one's institution, as well as for seeking new positions. All faculty and trainees should keep their CV updated in real-time. Relevant items to add include all grants, abstracts, presentations, didactics, and publications. A more extensive list of CV sections and items is shown in Table 7. Formatting should adhere to any specific institutional guidelines and always include date ranges when applicable.

TABLE 7.

Standard Curriculum Vitae Content and Detailed Notes

Entry	Details
Identifying information	Full name, degrees, professional contact information
Educational History	Undergraduate, medical school, residency, fellowship, other training
Licensure	States, years
Board Certification	Include years, include board eligibility if applicable
Professional Experience **1. Academic Appointments** **2. Leadership Roles** **3. Prior employment**	Important to show continuity of professional engagement 1. Instructor, Assistant Professor, Professor etc. 2. Chief Resident, PD, APD, Research Director, etc. 3. Particularly in the medical workplace
Committee Service	International, national, regional, local, and institutional committee membership
Professional Association Membership	Organization, years
Editorial Services	Peer reviewer, editor
Honors and Awards	Award title, organization/institution, year
Research Grants	Include role in project (principal or co-investigator) and grant amount
Research Presentations	International, national, regional, local, and institutional research presentations
Invited Presentations	International, national, regional, local, and institutional speaking engagements
Community Service	Include entries showing commitment over time (not usually single-day events)
Publications	Can include peer-reviewed and non-peer-reviewed, book chapters, letters to the editor, etc.
Language Proficiency	Honesty is important
Hobbies	Brief, appropriate (e.g., do not include controversial pastimes like gambling)

Many experienced faculty recommend keeping a readily accessible document to draft CV entries in real-time, so that nothing is forgotten, and adding these to the actual CV at least monthly. Others periodically review their personal calendar events to ensure that all items qualifying as a CV entry are noted. Many institutions require annual "activity reports," and if these are updated regularly, they can be used as a summary for periodic update of one's CV. Whatever the mechanism, it is important to be systematic and to update one's CV regularly. It can also be helpful to create an academic teaching portfolio[5-6] to highlight accomplishments that do not fit neatly into a CV category, such as mentorship activities references to personal online websites such as Github and blogs.

INNOVATIONS AND NON-TRADITIONAL PROJECTS

Novel creations such as innovations, inventions, and new clinical or simulation devices also offer research opportunities as these creations are tested. Oftentimes, reports on these non-traditional projects can be submitted to peer-reviewed medical journals as a concept paper, or later in their development, as a research paper. Some researchers go to further lengths to obtain a patent for their inventions or intellectual property. Patents are highly valued by promotion and tenure committees. Other forms of non-traditional scholarship, such as humanities pieces, films, and artwork, can be submitted to peer-reviewed medical journals or other venues. Regardless of venue of presentation or publication, these projects should be included on any academician's CV, and considered as a form of scholarly work.

CONCLUSIONS

Results from a resident's research or scholarly activity project can be presented in a variety of venues, including face-to-face conferences, virtual presentations, and published reports. The precise venue selected by the research team should be based upon a variety of factors, including the desired audience and the likelihood of acceptance for publication. Decisions about the venue sought for release of project results should be made by the resident author, with input from the project mentor and other interested parties. Research into the optimal venue for reporting of study results is essential to the success of acceptance, and residents should consider presenting at local or regional venues in advance of presenting at national or international venues. This will allow the learner to refine their presentation prior to participating in high-profile reporting. While publication in a peer-reviewed journal should be considered to be the gold-standard for release of study results, other forms of publication or result reporting may be more feasible and equally capable of achieving the desired results.

➲ *KEY CONCEPTS*

- There is a presentation venue to match everyone's preferences, whether large or small, international or local, general or subspecialty.
- Dedicated resident scholarly and/or research project presentation days are fun and engaging ways to both set the expectation for resident scholarly activity and to reward hard work.
- Presentation categories include research or innovation abstracts (oral or poster formats), clinical vignettes or images, didactics, or even interactive displays. Presenters can select a type that complements their project and showcases their professional strengths.
- Funding sources are available for cost-conscious residents seeking to present at conferences.
- Peer-reviewed journals should be the goal when submitting written research works for publication.
- Publications can be original research, innovation reports, a variety of case presentation formats, systematic review with or without meta-analysis, or other types.
- Members of the research team should meet the ICMJE standard guidelines for ethical publication if they are to be listed as authors.
- Regardless of the selected venue and format, skilled technical communication is the key to conveying research effectively, including the use of clear and concise language and high-quality graphics.

- Once all the hard work is done, researchers can use platforms such as social media, message boards, FOAMed, blogs, and personal and organizational website posts to promote their work.
- Researchers should update their *curriculum vitae* and teaching portfolio in real time to ensure that nothing is forgotten, and that their hard work is showcased to current and future employers and other interested parties.

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EMERGENCY CARE RESEARCH FELLOWSHIPS

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ABSTRACT

Research fellowships may be more important than ever before, serving to jump-start academic achievement for novice researchers despite ever-increasing challenges. Mentored training in the setting of a rigorous research fellowship program enhances the overall quality of emergency medicine research, as well as the likelihood that trainees will achieve success as a funded clinician-researcher. In this chapter, we will discuss reasons for pursuing a research fellowship, including the role of such fellowships in career development, the promotion of scientific inquiry, and providing insulation from career burnout. This is followed by a description of the differing structures and formats of existing research fellowships, including the role of formal degree programs and strategies for defining a successful fellowship project. An overview of the fellowship application process, as well as the key elements in making the transition from fellow to research faculty, are also described. Additional considerations are provided regarding fellowship training for nontraditional applicants.

INTRODUCTION

As careers in research become more challenging, research fellowships may be more important than ever before in promoting early academic achievement. Research fellowships can provide a rigorous, highly-structured training environment for motivated clinician-researchers, under the mentorship of qualified senior researchers. Such programs provide not only a sound foundation in scientific training, but may increase the likelihood that trainees can secure adequate funding and achieve career success in acute care research. Research fellowship programs are also important to the advancement of our specialty, as high-quality research training enhances the quality and impact of the research produced by fellowship graduates.

WHY PURSUE A RESEARCH FELLOWSHIP?

Research fellowships are a critical step in accelerating academic achievement and launching a career in EM research. Emergency physicians are markedly underrepresented in federally funded research. In fact, our specialty accounts for less than 1% of all NIH funding (despite being 4% of all U.S. physicians) and has the fewest average grants per faculty member among all medical specialties. This underrepresentation is particularly concerning given recent trends reflecting a decline in the proportions of physicians of all specialties engaged in research — from 4.7% in the 1980s to just 1.5% today, as described in the recent *New England Journal of Medicine* report on the "Endangered Physician-Scientist." [1]

EM needs more high-quality science to inform rapidly evolving practice**.** Research fellowships enhance the quality of research that the field of EM produces. The number of U.S. ED visits continues to increase, as does the complexity of care provided in ED settings. Coupled with advancements in biotechnology and clinical medicine, there is an increasing need for high-quality research that is designed and tested with the unique environment of the ED setting in mind. In addition, the ED serves as a safety net to traditionally marginalized populations. To improve their care, high-quality clinical research should ideally be produced by those with experience caring for these patients at the bedside. Thus, high-quality research performed by well-trained investigators could have a substantial and lasting impact on emergency care.

Completing a research fellowship has long-term professional benefits. Fellowship graduates have, "increased career satisfaction, as well as success in obtaining increased grant funding, academic promotion, and an increased number of publications" over time.[2] This increase in career satisfaction has been attributed to a greater sense of autonomy, mastery, and purpose.[3] Thus, a research fellowship can enhance the career satisfaction of academic emergency physicians.

FELLOWSHIP STRUCTURES

Variation exists in the structure of EM research fellowships, which are not ACGME-accredited fellowships. However, some are approved by SAEM. Most are two to three years in duration, with competitive salaries (from $60,000 to $100,000 per year) and variable moonlighting policies.

Most fellowships offer an advanced degree. Many programs offer opportunities to pursue an advanced degree, such as a Master of Science in Clinical Research (MSCR). Programs may agree to cover the cost of tuition. This is a valuable benefit, but should not be assumed. The type of degree (e.g., MS, MSc), schedule, and institution may vary, and virtual

or distance learning options are becoming increasingly prevalent. Obtaining an additional degree can be prestigious and may increase the likelihood of extramural funding or securing an academic research faculty position upon fellowship completion.

Additional formal didactic coursework is essential — specifically in biostatistics and epidemiology — regardless of degree attainment, because the methodology curricula in U.S. medical schools are not intended to prepare physicians for a research career. Fellowship trainees should complete their fellowship with a solid grasp of study design, descriptive statistics, and regression approaches in at least one commonly used programming language (e.g., SAS® software, Stata®, R). Depending on the area of interest, coursework in qualitative analysis (e.g., survey design, interviews) and mixed methods may be needed. Supplemental coursework in scientific writing — specifically for manuscripts and grants — can be helpful, although it will need to be supplemented with real-world writing. Formal training in the responsible conduct of research and ethics is required.

Experiential and didactic curricula may differ. High-quality fellowships should include an experiential curriculum encompassing activities such as literature synthesis (i.e., systematic review); secondary data analysis of an existing dataset; and novel, patient-oriented data collection and analysis projects leading to at least two first-author, peer-reviewed manuscripts in the area of the fellow's interest. One indicator of the quality and comprehensiveness of fellowship training programs is SAEM approval, which requires programs to meet specific criteria related to the didactic and experiential curriculum.[4] There are currently 27 non-SAEM approved and 18 SAEM-approved research fellowships in the SAEM directory.[5]

NIH-funded T32 (institutional training grant) fellowships represent another unique opportunity for rigorous, high-quality research training. There are currently two NIH-funded T32 programs based in departments of EM focused on emergency care research (Mount Sinai and University of Pittsburgh). T32 programs based in other departments (e.g., substance use disorder, critical care) may also accept EM residency graduates.

Other non-EM research fellowships, funded internally or through foundations, may be ideal for fellows with specific research interests. For example, the National Clinician Scholars Program offers high-quality health policy and health services research training for young physicians, including residency graduates of any medical specialty. There also may be other transdisciplinary programs inside or outside of EM, including those in injury control, gender-based medicine, and social EM.

Finally, most clinical EM fellowships (e.g., ultrasound, simulation, palliative care) offer limited research training. If a research career is desired, we recommend seeking out formal didactic research training through an advanced degree or, at minimum, a one-year certificate program at an academic medical center. Other training opportunities include the EMBRS workshop offered by ACEP and the ARMED course offered by SAEM.[6, 7]

PROS AND CONS OF A RESEARCH FELLOWSHIP

Rigorous, mentored training through a research fellowship program increases the likelihood that a physician will achieve success as a researcher. Fellowship training of some sort (e.g., ultrasound, EMS, medical education) is helpful in pursuing an academic career, especially for graduates of three-year residency programs.[2]

Research fellowship with a formal research degree is **highly recommended** for those pursuing an academic research career with extramural funding. Nearly all academic EDs expect research faculty to seek out extramural (e.g., foundation or federal grant) funding to

support their time and direct research costs (e.g., coordinator time, analytic support, etc.). Physicians who envision themselves pursuing research as part of their full-time job should pursue a research fellowship.

Fellowship may involve financial tradeoffs. Like other types of training, completion of a research fellowship should be considered as an **investment in one's future**. Successful academic research careers have the potential for significant fulfillment and opportunities that may outweigh short-term financial tradeoffs. However, financial pressures are a genuine concern, given the rising student loan burden among U.S. medical graduates.

The NIH Loan Repayment Programs are one option to reduce the financial loss associated with lower income during fellowship.[8] This program is available to fellows and attending physicians to offset the potentially lower salaries of academic (versus community) positions. Applicants must commit to pursuing research for a prespecified period of time. Many research fellows have been successful in receiving large amounts (>$100,000) of educational loan repayment through this program. In addition, successful application to this program may increase the likelihood of receiving future funding, as it is considered an award and an externally validated indicator of one's commitment to pursuing a research career.

FELLOWSHIP APPLICATION TIMELINE

Those interested in applying for a research fellowship should expose themselves to research as a medical student or junior resident, including (if possible) a variety of different research projects and / or mentors. A successful fellowship application requires significant preparation. We suggest the following timeline in preparing for the application process:

12 to 18 months before graduation

1. Compile a list of prospective fellowships based on desired location, practice setting, and adequate faculty with compatible research interests who might be suitable mentors. Note their application requirements and deadlines.
2. Contact the fellowship directors at each program of interest to identify the focus (if any) of the department's existing research portfolio. If attending SAEM or ACEP conferences in the year prior to graduation, establish in-person contact with preferred fellowship directors and attend the fellowship fair.
3. Speak to fellowship graduates about their subsequent academic positions and promotions, research productivity, and funding success. Fellowship directors should be able and willing to make these introductions.

9 to 12 months before graduation

1. Prepare the formal fellowship applications. Most require a personal statement describing the candidate's research interests and proposed project (or at least an area of interest), a CV, and letters of recommendation from the candidate's current departmental chair and residency program director. Candidates who have a strong interest in working with a specific mentor should reach out to that individual (if they have not already done so) and express this interest in their cover letter and / or personal statement. Ideally, the fellowship director should arrange for potential mentors to meet with the candidate during their interview.
2. Applications are often accepted on a rolling basis. Most programs offer only one to two positions, so candidates should apply early to those programs that they are most interested in attending. Most are only modestly competitive, so candidates should only apply to institutions that they are serious about attending.

3. Candidates should send follow-up emails to those programs that they are most interested in two to four weeks after submitting their application, even if they did not receive a response. Candidates should consider enlisting their residency program director or other faculty contacts to leverage any existing connections with preferred fellowships.

6 to 8 months before graduation

1. By this time, candidates should be interviewing and receiving offers. Fellowship applications are unlike residency applications in that offers may be informal and acceptances may be on a rolling bases — meaning timelines for notification may vary widely between programs.
2. When attempting to decide between programs, candidates should speak to past fellowship graduates (if they have not already done so) about their subsequent academic positions and promotions, research productivity, and funding success. It may also be helpful to speak with faculty in the targeted departments with similar research interests who might ultimately serve as mentors — especially if this was not possible during interviews. We recommend identifying research mentors in the candidate's content area of interest before beginning fellowship, when possible. Fellowship directors should be willing to make introductions.
3. Candidates should keep fellowship directors who have offered them a position notified if they are still interviewing for other programs or if they have accepted an offer from another program. It is unprofessional to hold two or more offers for more than a few days and extremely unprofessional to accept and subsequently rescind. The world of academic EM is not large, and it is very likely that candidates will encounter almost everyone who interviews them again at some point in their careers. It is best to communicate honestly and act with integrity.

3 to 6 months before graduation

1. Candidates should hopefully have decided on a fellowship by this time.
2. Candidates should spend the rest of their time in residency absorbing as much clinical knowledge and experience as possible. Most research fellows are expected to work clinically as attending physicians.
3. Wrap up any outstanding projects (e.g., papers, analyses) with mentors from residency, as it may be difficult to do so after graduation.

USING FELLOWSHIP TIME WISELY

Perhaps the most important question to answer at the start of a research career is, "What will I study?" Spending a few weeks or months contemplating this is a worthwhile use of one's time if one has not already answered this question prior to fellowship. Discussing various potential ideas with your mentor (and other more senior researchers) is advisable, as they will have valuable input regarding promising avenues of investigation that a research career can be built around.

When considering one's area of interest, several factors should be considered:

- What am I passionate about?
- What disease or population is available at my institution?
- What content or methodological expertise do I have around me, particularly among mentors?
- What is fundable in the short term, and in the long term?

For example, one of our authors (Dr. Probst) spent several months mulling over different research questions before deciding to study palpitations as an ED chief complaint. This topic was chosen because it involved acute cardiac disease, an understudied area of interest, and because it was fundable in the short term by institutes such as National Heart, Lung, and Blood Institute (NHLBI). It was also a topic that his mentor was interested in investigating; thus, the mentor could provide additional resources to support the project.

Meet regularly with mentors. This is a critical component of fellowship. The appropriate frequency of meetings will depend upon the mentor's availability. Generally, one to two meetings per month with the primary mentor is appropriate, with each meeting lasting at least one hour. Making time for meetings with secondary mentors is also important, albeit with lesser frequency.

Protected research time should be a priority. Research fellows usually have clinical responsibilities, typically from eight to 15 hours a week. Moonlighting is generally at the discretion of the fellowship director and should be kept to a minimum, financial situation permitting, to allow adequate time for research activities.

Conference attendance is important. Carving out a few days to attend certain key national EM conferences, such as the SAEM annual meeting and the ACEP Research Forum, is generally recommended. This will offer the fellow an opportunity to present their research, meet other researchers, and expand their professional network. Joining a research committee is an excellent way to form relationships with other leaders in the field. Fellows should consider attending at least one non-EM professional conference in their area of interest (e.g., critical care, cardiovascular disease, health services research) to expand their professional networks. The fellowship should provide adequate funding to attend at least one conference per year; many will support attendance at any meeting to which the fellow has an abstract accepted.

Secondary data analysis is useful. Data collection takes a lot of time. One way to save a substantial amount of time is to use previously collected data to jump-start an avenue of inquiry. Publicly available datasets, such as NHAMCS or NEDS, can be accessed (sometimes for free) and analyzed to expedite a project. Mentors often have existing data sources ripe for secondary analysis. Using already collected data does require some compromise but can significantly accelerate the path to publication and offer an opportunity to practice statistical coding and analytical skills.

Peer-reviewed manuscripts are valuable. Once the data are obtained and analyzed, time should be devoted to writing manuscripts for peer-reviewed publication. Fellows should aim to have one to three high-quality, first-author papers by the end of fellowship (ideally accepted prior to applying for faculty positions). Publishing papers provides evidence that one can carry a study to completion. Starting new projects is easy – finishing them is hard, and takes persistence. More publications are always beneficial, so consider collaborating with other investigators in a meaningful way to meet criteria for coauthorship on their papers.

Practice writing a research grant. Adequate time, on the order of months, should be reserved for grant preparation and writing. Learning how to write a grant, such as an F32 grant from the NIH, is an invaluable skill that should be developed during fellowship. Other funding sources available to fellows are the EMF and the Society for Academic Emergency Medicine Foundation (SAEMF), which are structured in the NIH format to provide firsthand experience similar to the federal grant application process. NIH offers F32 grants specifically for research fellows.

Grant preparation should begin in the first year and invariably takes longer than expected. Successful grant writers start well in advance of deadlines and always obtain input from funded researchers prior to submission. Grant writing is an iterative process and should not be rushed.

Ideally, the fellowship will provide the researcher with the skills and resources to write a successful career development grant (e.g., K23, K08, or equivalent). Asking how many graduates of a fellowship have obtained K-level funding is an important metric when seeking a fellowship program.

Time management is key. When working on a master's degree, one should try to align one's coursework with one's fellowship work. Since coursework toward a degree can be quite time-consuming, it is wise to be strategic and efficient when choosing both courses and topics for class assignments or projects. Fellows should consider using their ongoing research projects as the focus of their coursework, when permitted, and try to pair courses with needed skills. For example, if given an exercise on regression, a fellow can use a dataset that they are interested in using as part of their research to perform the regression analysis. If the fellow is planning on conducting a survey study, selecting a course on survey design would be logical. To minimize commute time, it is also wise to think about logistics regarding scheduling shifts and classes (e.g., scheduling an evening shift to follow an afternoon class).

Striking the right balance between personal life, clinical shifts, meetings, conference travel, and writing is a constant process of assessment and reassessment that will continue throughout one's professional career. Time management is an important skill that should be honed during fellowship. However, the flexibility and control of one's schedule offered by a research career is hard to beat.

APPLYING FOR FACULTY POSITIONS AFTER FELLOWSHIP

Research fellows should start thinking about where they would like to work after fellowship toward the end of the first year, at the latest. Adequate time early in the second year should be reserved for job hunting and interviewing for faculty positions. Many fellows will apply for a faculty position within an academic department, but research positions are available at community hospitals as well. Health policy research fellowships may open avenues to administrative, governmental, and nongovernmental jobs.

Keep track of your accomplishments. During (and before) fellowship, candidates should build and maintain a complete and accurate CV. This is an important part of the job application process. Keep track of all research, teaching, and mentorship activities, as well as all presentations and lectures given. Reference letters from influential people in the field are also important. Networking at research conferences and through professional contacts is advisable.

Follow the timeline. We suggest the following timeline for those engaged in a research fellowship, to ensure a smooth transition to their post-fellowship faculty position:

12 to 18 months before completing fellowship

Candidates should prepare a list of departments (in cities where they would enjoy living) where they would like to serve as faculty.

9 to 12 months before completing fellowship

Candidates for a faculty position should prepare their application, including a polished CV and cover letter. Having a strong cover letter that describes one's professional background and career goals is expected. In practice, prospective employers will use their professional networks to informally evaluate candidates, often more so than the formal application package.

Consider your options. Many factors influence the selection of a new position, including geography, research infrastructure, potential future mentors, track record of research funding and achievement, and the amount of protected time offered for research. Candidates should speak to research faculty already employed within the department for advice, especially those who were recently hired. A negotiation is sometimes required to obtain a start-up package of funds to help candidates launch their research career. Applying to several positions is thus important to understanding one's best alternative to a negotiated agreement (BATNA). It is important to speak with many unbiased research faculty to understand the "market," and what one is "worth" as a research faculty member.

Research fellows should apply to and interview for at least two faculty positions, preferably more. This will help them better understand their options and find the place that will be the best fit for them. One should only interview for positions that one is genuinely considering, to be respectful of everyone's time.

The interview process is not unlike applying to a residency program. Common sense applies, including remembering to dress professionally, arrive early, be informed about the program, and project confidence.

NONTRADITIONAL APPLICANTS

Certain applicants to a research fellowship will have already completed residency training many years prior to their fellowship. These so-called "nontraditional" (e.g., mid-career) applicants will likely have other considerations in mind. For example, after earning a full faculty salary, adjusting to a fellow's salary may require a few lifestyle modifications. Because a fellow's salary can vary between programs, these nontraditional applicants should evaluate several different programs to see which ones makes the most financial sense for them. Similarly, enquiring about the moonlighting policy for fellows would also be wise. It is important to remember that this financial sacrifice is only for a two-year period and can create other opportunities, such as eligibility for the NIH Loan Repayment Programs.

Nontraditional applicants will generally have acquired other skills prior to fellowship, such as leadership, time management, networking, or administrative skills that can be parlayed into a research career. Those entering a research fellowship with more clinical experience will not have anxiety about making the transition from resident to attending physician. A research fellowship is an investment that one can make not only immediately post-residency, but also after having worked in another capacity for a few years.

CONCLUSIONS

Research fellowships can help launch a successful academic career in EM research. These fellowships may be especially important in addressing the current underrepresentation of emergency care researchers within the medical community. Completion of a research fellowship has shown to be associated with enhanced job satisfaction, increased grant funding, and an increased number of published manuscripts. Many different structures exist for research fellowships, with some offering opportunities to simultaneously pursue

advanced degrees. Candidates should become familiar with the application process for these fellowships early, as advanced preparation is recommended. Research fellows should take advantage of the opportunities provided by their program, including time spent with mentors, protected time for academic projects, and supervised experience with writing grants.

➲ KEY CONCEPTS

- EM research fellowships provide a path to a research career with academic achievement and future career opportunities.
- Despite some variation in fellowship structure, all programs provide a curriculum encompassing formal didactics in research methodology, structured mentorship, and research projects that lead to first-author, peer-reviewed manuscripts and opportunities to submit proposals for extramural grant funding.
- Research fellowship substantially increases the likelihood of successful extramural funding and should be considered a near-term investment that creates opportunities for academic advancement and fulfillment over the course of one's career.
- Given the variation in fellowship programs, prospective applicants are encouraged to contact faculty at prospective programs to assess the fit between the applicant's research interests and the program's existing expertise and research portfolio.
- Fellowship is a time of learning and growth, not only with respect to research methodology and communication skills, but also professional skills such as time management, networking, and leadership.
- Fellowships open pathways to clinician-investigator positions within EM departments. Identifying supportive departmental leadership and experienced mentors whose research interests align with one's own are important determinants of success.

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THE PROS AND CONS OF IMPLEMENTING A MANDATORY RESIDENT RESEARCH ACTIVITY REQUIREMENT

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ABSTRACT

The ACGME has mandated that all EM residents engage in scholarly activity, but has not provided a clear definition of that requirement. Consequently, great diversity exists in how EM residency programs have chosen to satisfy this requirement. Most residencies have chosen not to institute a mandatory resident research requirement, but some have done so successfully. This chapter will describe some of the potential benefits and challenges of instituting a strict resident research requirement, including the resources that must be allocated to properly achieve successful implementation.

INTRODUCTION

Scholarly activity has been a required component in many medical residency programs for decades. Since our specialty's earliest days, pioneers in EM have recognized the need for research and academic output to define the emergency physician's scope of practice and espoused the benefits of engaging residents in this scholarly work.[1,2] Ideally, the purpose of implementing a scholarly activity requirement for EM residents is to fuel

their desire to pursue an academic career and promote lifelong, self-directed learning. When implemented well, a research experience can help residents understand research methodology and develop their own critical understanding of the scientific literature.[3] However, the dissemination of scientific knowledge has evolved in ways that would have been unfathomable to the pioneers of academic EM. For example, virtual platforms such as YouTube®, Twitter®, podcasts, and online blogs have expanded to provide FOAMed.[4] Considering such evolutionary trends, modern residency programs have struggled to update their scholarly activity requirements.

All EM residents must engage in scholarly activity, per current ACGME training requirements. However, the ACGME does not specifically define how this scholarly activity requirement should be met.[5] This allows EM residency programs to be flexible and creative in how their residents fulfill this requirement. In this setting, scholarly activity can take many forms and does not necessarily require residents to engage in original investigative research. Most EM residencies do not have a strict resident research project requirement to graduate or to satisfy this scholarly activity requirement. However, some EM residency programs have chosen to implement a strict resident research requirement. Approaches to this requirement range from purely resident-driven models to more collaborative models in which residents may take a less prominent role in the development and execution of the research project.[6,7]

The goal of encouraging resident participation in scientific efforts to advance the EM specialty is laudable. However, the practical application of this goal can be challenging for resource-poor programs. The additional task of developing and completing multiple resident research projects can be a drain on already-scarce resources for faculty members and residents alike. Some residencies may find a universal resident research requirement impractical, especially those that currently lack the resources of time, money, manpower, and bandwidth necessary to successfully implement and maintain such a requirement. The prospect of developing an infrastructure to support resident research where such an infrastructure does not already exist is daunting. Even residencies with adequate resources may feel that those resources could be better utilized by focusing on individual residents who already have a strong personal motivation to engage in research and pursue a career in academic EM. Even for highly motivated residents, the typical three-year residency period may not be enough time for a resident to initiate, perform, complete, and present a meaningful research project.

In the following chapter, we will provide arguments and evidence supporting both sides of the argument relating to a universal resident research requirement. We feel that both perspectives are valid and add to the rich diversity of thought on this important educational topic. Given the currently ambiguous state of resident research requirements on a national level, the decision to require resident research remains a local, institutional decision. However, for those new or evolving residency programs that have yet to decide which stance they prefer, such discussions may have unique and meaningful impact on how educational content on research topics is delivered.

IN SUPPORT OF A MANDATORY RESEARCH REQUIREMENT

Some EM residencies self-identify as academically oriented and strongly encourage their residents to consider academic careers. These residencies may feel that a mandatory research experience greatly serves the academic mission of their educational program. Implementing a mandatory research requirement ensures that all residents are exposed to research activity, so they can better assess their level of interest in an academic career. It can also provide a stepping stone for those who desire an academic career, even if they do not

intend to engage in research activities after residency. One recent study demonstrated that scholarly tracks in EM residency programs were highly associated with a predilection toward an academic career path. The authors analyzed data from 113 programs, including 51 (45%) with scholarly tracks. Scholarly tracks were found to be most associated with four-year EM residency programs (odds ratio [OR]=4.8;[2.0 – 1.9]) and programs with a large number of residents. Residents commonly participate in a dedicated track during their final two years, and programs with dedicated tracks are more likely to graduate residents to an academic career (OR - 1.8; [1.3-2.4]).[8]

Even less academically focused residency programs may feel that the process of engaging in research activity provides substantial educational value for residents. The argument has been made that a direct, hands-on, personal research experience is the best method for teaching the principles of critical appraisal of the literature, including study design, data analysis, and EBM.[9,10] This exercise also satisfies the core measure of teaching practice-based learning during residency.

Learning the scientific method by applying it directly to a research project is an excellent way to teach critical thinking *in general*. Beyond serving the individual research project, exercises in applying the scientific method can make residents better clinicians by teaching them how to properly define a clinical question, generate a hypothesis, gather data, and systematically analyze that data using objective and reliable methods. In theory, the critical thinking process required to rigorously apply the scientific method has universal value outside of clinical medicine and can continue to provide benefit to learners throughout their lives. Although these principals can be taught in a classroom, there is no denying that education best occurs with direct, hands-on involvement of the learner.

One EM residency program with a longstanding resident research activity requirement surveyed publications of their graduates over a 10-year period.[11] They found that the clear majority of residency graduates, even those who did not ultimately pursue an academic career, did find value in their research experience. The 90 projects completed by residents over a 10-year period included 42 (47%) prospective data collection studies, 38 (42%) retrospective chart reviews, five (6%) surveys, four (4%) animal or basic science projects, and one (1%) educational computer program. Most (72) were single-center studies, and the median number of patients included in the retrospective studies was 214 [interquartile range 71,1828]. Despite the wide variety of study designs and methods used, surveyed residents often reported that their project had more value *in retrospect* than they felt at the time they were engaged in the activity.[11] Thus, resident satisfaction with the research experience may evolve after graduation.

There is no single best way to involve residents in research activities. Different specialties and individual residencies have tried various approaches, ranging in intensity from very simple retrospective projects to dual-degree MD/PhD programs.[12] Each approach has its own advantages and disadvantages. For this reason, it is best to grant some measure of control over the direction and extent of the research activity to the resident. Some residents may simply wish to publish a case report or small chart review studies and submit them to local- and regional-level conferences. Others may seek to achieve publication of their first peer-reviewed manuscripts or secure their first competitive grant. This diversity of goals and end-products achieved with the research experience should be encouraged, so long as the project serves its primary purpose of enriching the resident's educational experience. A mandatory research experience does not necessarily translate to requiring a specific type of research activity, or even a specific end-goal for the project.

Progressive research experiences — growing from small studies to larger-scale studies — can provide the building blocks for an academic career, but this process can take many years. Offering EM residents the chance to begin their research careers during residency can allow them to hit the ground running after graduation and may accelerate their professional advancement and research success after graduation.

Some four-year EM residency programs include the option of an academic or research track.[13-15] A few have even incorporated an advanced degree program that helps residents learn the fundamentals of epidemiology and biostatistics. This institutional investment in resident research has shown to benefit both resident learners and the broader research community. Stern et al have shown that greater commitment of departmental funds to support research is associated with more residents choosing to pursue a research career.[3]

Offering research opportunities for residents who seek training, career guidance, mentorship, and preparation for an academic career is intuitively valuable. But exposing nonacademically minded EM residents to hands-on research activities also has value and may influence a trainee's choice of a research or academic career upon completion of residency. It may also encourage them to pursue advanced research training.[13] Pioneering researchers, reflecting upon their career trajectories, frequently cite mentorship and the pursuit of an advanced research degree as the cornerstones of their own successful research career. EM also offers one- or two-year research fellowships for residency graduates, giving them the opportunity to participate in rigorous research training while continuing to work clinically to maintain their clinical acumen.[14] This may help budding researchers to begin seeking the necessary balance between their clinical and research obligations in a more sheltered environment before joining the workforce.

AGAINST A MANDATORY RESEARCH REQUIREMENT

Although there are many potential benefits of instituting a mandatory research requirement, implementing such a requirement can be challenging. Maintaining a strict resident research activity requirement is labor intensive and requires a minimum number of available faculty with a reasonable level of research expertise. It also requires the program to provide adequate protected time for faculty to directly teach and supervise residents in their research efforts. Not all programs have these essential resources.

The ACGME requires an adequate number of experienced research faculty to serve as mentors. It would be impractical for only a few faculty to advise all the residents in a residency program. Ideally, a faculty member should serve as a research mentor for no more than two residents at a time. Therefore, programs lacking sufficient faculty experienced in research are cautioned against trying to implement a strict resident research activity requirement.

The authors have heard anecdotal stories of well-intended program administrators implementing a strict resident research activity requirement with few experienced faculty mentors and achieving little more than frustration. That process can lead to burnout for the few faculty with true research expertise in a program. It can also frustrate the residents. Several programs have started such a requirement only to abandon it within a few years.[16]

Many residencies have decided that the effort needed to facilitate research for all their residents is not worth the outcome, and that introducing a mandatory research experience would require a significant change in the departmental culture and the prevailing attitude toward resident research projects. Culture changes on a departmental level may be difficult

to achieve for even the most highly motivated faculty members. Even if other faculty can be convinced of the value of such a requirement, current residents may be dismayed to learn that they are now required to complete additional tasks beyond what they were expecting when they joined the program.

One argument against mandatory resident research is that the products of said research activities are often of poor quality and rarely result in publication. Rushed or poorly designed and executed projects do not lend themselves to publication; even if published, the overall value and impact may be so low as to not warrant the effort. However, one residency with a strict requirement tracked all its resident research projects over a 10-year period and found that results from 36 (40%) of the 90 projects were eventually published in good-quality, peer-reviewed EM journals, with the resident as first author in 17 (47%) of them.[11] Thus, the theory that all resident research projects are unworthy of publication may not be universally valid.

Developing critical thinking in residents is important and performing research is a great learning tool. The research curriculum has become more robust in medical school education over the last decade. Students are increasingly learning research methodology and epidemiological and biostatistical concepts and applying study results. This prepares them for an improved understanding of research papers and EBM principles. The increasing availability of research training in medical schools may decrease the value of a residency research experience for those who are not planning a career in research.[17]

Science continues to evolve, and access to epidemiology and biostatistics advanced training is easier to find than ever before. This may seem to undermine the perceived importance of dedicated research training for all residents. Furthermore, personal exposure to research methods during residency may spark an interest, but certainly does not ensure a successful academic career. Even for those who have an interest in becoming active researchers, training can be obtained after graduation. Training programs such as ACEP's EMBRS course or SAEM's ARMED course are tailored for junior faculty or fellows who want to learn research skills, although senior residents can participate as well. Many dedicated researchers have successfully completed post-residency graduate degrees related to research while working a clinical schedule.[18]

Undertaking a direct research experience early in one's medical training is a challenging task. Studies have shown that medical students or residents taking a hiatus from their clinical training can be associated with a decay in their clinical skills.[19] This may lead some to interpret research experiences as detracting from the clinical training that should be the primary focus of an EM residency. Finally, many programs already have existing ways to teach research concepts during residency training. A well-designed journal club can foster critical thinking and help residents learn how to apply EBM concepts, such as how to identify and interpret evidence and identify knowledge gaps in the existing literature.[20]

Some of the pros and cons of a mandatory resident research experience are provided in Table 1.

TABLE 1.

Pros and Cons of a Mandatory Resident Research Requirement

Pros	Cons
Educates residents in the fundamental concepts of epidemiology and biostatistics.	May lead to frustration due to lack of adequate mentorship or other resources.
Helps residents develop an ability to critique research reports, including flawed methodology.	May generate poor-quality data, due to inappropriate or inadequate study design and execution.
Can help residents develop their own academic/research path by working closely with qualified mentors.	May distract residents and faculty from their clinical and other academic obligations.
Can advance the academic mission of the specialty.	Requires a substantial resource investment to succeed.

RETHINKING SCHOLARLY ACTIVITY

Resident scholarly activity has taken many forms in EM residency programs over the years. In the past, residency programs only assigned credit for research papers that were published in peer-reviewed journals. But recently, the paradigm has shifted. Today, budding educators and scientists are sharing scholarly work in new ways, including online platforms, publishing peer review via the EMRA textbook series, and creating YouTube® videos of live patient encounters or procedures. These new venues are increasingly being accepted as "scholarship," and several residencies currently use a point-based weighting system for assigning credit to residents for such scholarly activities.[21, 22]

Depending on the type of study completed, resident research projects can take several months or even years to complete. They require a great deal of advanced planning. While a case report may take three to six months to write, a simple cohort study often requires a year or more to complete. The process of conducting a study involves identifying an area of interest (which may potentially align with the resident's future goals), reviewing the literature for existing data, developing the research proposal, identifying a funding source (if needed), submitting a research proposal to the IRB, collecting and analyzing the data, drawing conclusions, and finally, communicating one's findings as an abstract or paper. Of course, projects such as case reports or surveys are not as challenging as prospective studies and can usually be completed much faster. Failure to have a realistic timeline, combined with the busy clinical hours of residency and limited mentorship from faculty, is a formula for resident frustration.

CONCLUSIONS

Resident research is not required to meet the scholarly activity requirement for graduation from EM residency, and is likely impossible for many programs to provide to all residents. Proper implementation of a resident research requirement involves a substantial commitment of resources. Unfortunately, many programs lack adequate experienced research faculty to serve as mentors, and this deficiency can cripple efforts to implement

a mandatory research requirement. However, when implemented well, such programs have shown to work and can result in a substantial number of good-quality publications. Research experiences have shown to be valuable to a wide range of residents, including both those who will go on to pursue academic careers and those who will not. Research activities can also provide training in critical thinking and application of the scientific method, which may benefit residents far beyond the completion of a project. Facts evolve over time, so the most important skill to teach a resident is how to be a critical thinker. A better understanding of research methods may help residents to better apply research findings to their patient population throughout their medical careers. Despite the significant investment of time and effort required to implement a successful program, resident research exposure can enhance resident scholarship and help move the scientific base of our specialty forward.

➲ KEY CONCEPTS

- The ACGME does not specifically define what qualifies as scholarly activity for EM residency programs. Thus, scholarly activity can take many forms. It does not need to involve original investigative research and it does not require an actual resident research project.
- Most EM residencies do not require completion of a resident research project to graduate or to satisfy the ACGME-mandated scholarly activity requirement. However, a few programs have chosen to implement this research requirement and have done so successfully.
- Potential positive impacts of a resident research requirement include an increase in the number of EM researchers, providing all residents with a common stepping stone to an academic career, augmentation of practice-based learning, and greater insight into the practical application of the scientific method.
- Potential challenges of a resident research requirement include lack of adequate resources, difficulties identifying qualified faculty mentors, and compressed time for clinical training.

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THE VALUE OF A MENTOR

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ABSTRACT

Defining and executing a research project can seem to be an insurmountable task to the novice researcher. Defining a research project is only the first step in what can be an arduous journey toward project completion, and the road to research success is fraught with myriad pitfalls and wrong turns. Timely and adequate advice from an experienced guide is paramount to the success of any research project, especially those undertaken by a junior investigator. Guidance from research mentors can be instrumental in appropriately focusing a research question, providing essential start-up resources, identifying appropriate funding mechanisms, and guiding a project to completion and appropriate reporting. This chapter outlines a practical approach for junior investigators to use when seeking out a suitable mentor, leveraging the mentor-mentee relationship to ensure the success of their current research project, and establishing a solid foundation for a fruitful career in EM research.

INTRODUCTION

Identifying a research mentor can be a daunting task. Junior investigators (especially resident physicians) may be new to the research process and may not have an adequate understanding of the resources available to them within their academic department. Gaining an awareness of these resources will necessarily inform good decision-making regarding of the selection of a mentor, and this is an essential first step in the process of mentor selection. Although the junior investigator may be placed in the path of an appropriate senior research mentor serendipitously, this is the exception rather than the rule. The informed junior researcher understands the qualities of a mentor who is likely to

lead their project to success and will seek out mentors with a strong track record of research success. In this chapter, we offer guidance to the resident researcher on how to select an appropriate mentor for an RLRSAP.

IDENTIFYING A SUITABLE MENTOR

The hallmarks of research success include multiple first-author and senior-author publications in high-quality journals and previous research grant funding in the area that the junior investigator wishes to explore. For those seeking a long-term career in research, it is important to connect with a research mentor with a track record of extramural grant funding success, especially with high-level (e.g., R01) grants from the NIH, or other important funding organizations in their area of interest.

Junior researchers should also consider the mentorship history of their potential mentors. Most resumes of senior researchers will report on the individual's prior mentees. When considering a mentor, one should take a deep dive into the careers of their previous mentees — do they seem to be successful? It may be helpful to speak with prior mentees to ask them about the level of involvement that the mentor had in their research efforts. Was the mentor's guidance instrumental to their success? One should look for a history of giving credit to mentees. Successful mentors should already have had a successful research career, and they should be willing to allow mentees to take credit or recognition for work done under their guidance. One should beware of mentors who seem to always be the first author on publications that also included their mentees. A practical way to identify these successful mentors is to evaluate the grant and publication sections of their CV. Valuable mentors often have career development or training grants (e.g., NIH T32 or K12 grants) listed in their CV in their role as mentor or faculty. Another clue in the mentor's CV might be a series of papers with the same mentee listed as the first author, with the mentor reported as a senior (i.e., last) author.

Another important consideration when selecting a mentor is the personal relationship. The ideal mentor will take a personal interest in the mentee's development as a researcher and will seek to promote the mentee's career development. It is difficult to describe an ideal mentor's personal characteristics as this may vary from person to person. Nonetheless, certain basic expectations should be fulfilled. A mentor should challenge, but not overwhelm the mentee. Selecting a high-profile mentor is a two-edged sword — one may get a well-known mentor with name recognition, but may also get no personal investment in their career. Mentees should be aware of the limitations of pairing with the "distant scholar" who provides occasional insight into their research endeavors but fails to connect with them on an individual level. Sometimes, it may be better to accept a less experienced (but still scientifically qualified) mentor who cares about the mentee's personal advancement over a higher-profile academic who gives them name recognition without any personal investment. Mentees should feel comfortable interacting and communicating with their mentor regularly.

No research mentor is perfect. The best possible situation is to establish a personal relationship with someone who is well-known in their field. However, a more practical approach for the junior investigator is to find someone who shares their enthusiasm for a research topic. This person does not necessarily need to be in the field of EM, or even at the mentee's home institution. They should, however, have training in research methodology and a track record of publications and grant funding. The mentor-mentee relationship, like all other relationships, is predicated on an exchange of value. Less established mentors may be willing to exert more effort to promote the mentee's vision than those who have already

realized their research ambitions. After all, mentors must start with a first mentee at some point, and one must decide if key qualities such as a research track record in the mentee's area of interest outweigh their limited mentorship experience. When choosing a mentor, the mentee must decide how much they need their mentor's support, and to what degree the mentor's established influence can advance the mentee's research objectives.

WHO SHOULD BE A RESEARCH MENTOR?

Mentors provide many resources to their mentees. First, they can provide research training in practical approaches to scientific methods and data analysis. They can provide resources for additional formal training or specific guidance related to a specific project. A successful project must have a good foundation and a vision of a finished project. Mentors can help provide these, as well as a directed path from project start to completion.

Mentors can also help their mentee appropriately focus their efforts. One common mistake of early researchers is to take on too broad of a topic (e.g., all emergency medical services care) or too big of goal (e.g., to cure cancer). Developing a sharp focus is key. Research mentors can help their mentee overcome this obstacle by focusing the scope and scale of the RLRSAP project.

Mentors can help the resident navigate the field of research, including both the research environment within an institution as well as the broader national or international perspective. Possessing an understanding of the available support resources can be an immeasurable advantage in research. Mentors should have the knowledge and experience to identify institutional resources and navigate around barriers. For example, if there is a problem with a financial or regulatory (e.g., IRB) issue, it is likely that the mentor has experienced this problem before and can be a guide to successful resolution. Mentors may be able to use their seniority and experience to directly garner departmental or institutional support for an idea or project. Mentors also can help identify available national or regional resources or funding opportunities. In clinical research, these resources could include a research network, a national committee, or other investigators working in a similar area.

Research mentors should also be able to help the mentee develop an optimal approach to presentations and publications. Mentors can identify appropriate meetings and conferences for presentations and target highly regarded journals for publication. Frequently, these mentors publish regularly or serve as an editor for such publications. They can also help identify appropriate funding opportunities and write grants. Grant writing is a unique skill and mastering this skill almost invariably requires a mentor with experience in this unique aspect of research.

WHAT TO EXPECT

Mentees should be able work effectively with their mentor, which may require the mentee to adapt their approach to collaborating with others and completing tasks. Junior researchers should consider their own personality when selecting a potential mentor. But there may be value in selecting a mentor who doesn't think exactly as they do. While one should not settle for a suboptimal match, mentees must realize that their potential mentor has followed their own approach to success, and that success was one of the reasons that the mentee reached out to them in the first place. Mentees may learn a lot from a mentor's unique style and approach to project completion, especially if that approach differs from their own.

Mentors should have expertise in the area for which one is seeking mentorship. Mentees should not be discouraged if no one in their department is on their wavelength about the project they are considering. In the modern world, the right mentor does not have to be working in the same department, or even the same institution. Virtual meetings have become the norm, and communication between individuals who work in different geographical areas is easier than ever before. Mentees should respect and consider the expertise that exists within their own department but should not discount others outside of their department who may be able and willing to give them the needed guidance. One should consider all their options. If the ideal mentor seems to exist at an outside institution, one should seek out that guidance remotely. One should never compromise the success of their research endeavor for proximity or personality.

Mentors should demonstrate the available time and willingness needed to be a mentor. Forcing mentorship on someone who is not interested or not willing to dedicate the time to a long relationship will inevitably lead to failure. Most successful people are busy, but those who value mentor-mentee relationships will always make time for mentees. Mentees should query mentors to determine if they have a regularly scheduled time allotted for interacting with mentees (e.g., weekly research meetings). If they do not have the time to be an effective mentor, it is wise to look elsewhere.

WHERE ARE MENTORS FOUND?

As mentioned previously, finding a research mentor can be a daunting task. There are many databases available to identify potential research mentors. Mentors can be found through national organizations, locally at one's institution, or through groups focused on those with similar interests. One approach is to scan the leading EM journals or research meetings for potential mentors who are active in the mentee's field of interest.

Finding a research mentor at one's home institution would be ideal. This can facilitate access to the mentor, optimize coordination within the research team, and help provide specific guidance through local institutional resources and barriers. However, some may need to consider searching outside the field of EM for a mentor. Even non-EM mentors may offer unique insight into research ideas and methodologies not familiar to EM researchers.

It is important to consider geographically distant mentors. Distant mentors may offer unique insight into projects or career advice due to different experiences or local practices. They also may provide national recognition, presentation requests, networking, and insights for generalizability of ideas to other institutions or health systems. This can be done regionally, nationally, or internationally at meeting or conferences. Presenting early work can be a great way to find other researchers with similar interests. A research fellowship is an excellent method for networking, but it can be time intensive.

Novice investigators should use all the resources available to them to identify optimal mentors. It is important to be prepared when approaching potential mentors. Writing down one's idea, while not necessary, will help flesh out the idea, ensure its novelty, identify its strengths and weaknesses, and most importantly, show preparation and commitment. The project proposal should include as much detail as feasible. One way to start is with an outline for the project, including the background (emphasizing the importance of the topic), research question (consider a hypothesis), suggested methods of investigation, anticipated results, and potential conclusions.

THE VALUE OF MENTOR-MENTEE RELATIONSHIPS

Mentors have the knowledge, resources, and connections needed to succeed in the competitive environment of EM research. They may also have access to required scientific equipment, support personnel, and financial resources. It is also likely that they have connections to and understanding of important research infrastructure, including journals, funding agencies, and grant review committees.

The mentee also brings a lot to the relationship. Mentees should have the interest, enthusiasm, and time needed to see a project to completion. For those mentors outside of EM, the mentee also provides a highly valuable connection to our field, which is a broad-based and impactful area of medicine and health. Mentees should let their enthusiasm and dedication shine through when they interact with potential mentors from other departments.

A MENTOR-GUIDED APPROACH

It is important to have a research focus and idea that is understandable and presentable. The mentor and mentee should work together to determine which type of research study is most helpful to advance the field in the resident's area of interest.

One key component of any successful research project is the development of a well-designed hypothesis (i.e., the key question asked in the study). Based firmly in their understanding of a given topic, the research team should hypothesize that a given intervention will lead to a given outcome. Understanding how to frame the hypothesis requires experience and a sound scientific approach. The RLRSAP mentor should be prepared to help develop this hypothesis. However, they may also offer expertise and specific knowledge focused upon a certain type of research or scholarly activity. Thus, the mentor's previous experience may offer unique and valuable insight into not only the topic of the investigation, but also into the form of inquiry that should be attempted.

Treatment studies in humans are usually built upon a sound understanding of the pathophysiology of disease. Indeed, many research topics in EM involve aspects that may be poorly understood and require more mechanistic and pathophysiologic information. These may be able to be mechanistically done in vitro or in vivo. It should be obvious that animal or cell culture studies require mentors who have experience in these modalities and who can facilitate access to laboratory resources to perform such studies. Human studies will also be subject to the limitations of patient-based research and will require access to facilities and other resources needed for subject recruitment and testing.

Replication studies are also an important part of research, although such studies are sometimes viewed as less impactful. This type of investigation seeks to replicate the findings of earlier research studies, often utilizing the same study methods in a different patient population or from a new perspective. If disparate results or conflicts persist within the existing medical literature, a large, well-done study may help clarify the answer to the clinical question. It also can be helpful to see if the findings of initial studies apply to broader populations or additional settings. Systematic reviews or meta-analyses may also be useful, especially when disparate results have been identified in previous studies, but a large study is not feasible.

Diagnostic research studies are another important part of EM, as we see so many undifferentiated patients. This may include development and evaluation of a new diagnostic test, evaluation of an existing test for the emergency setting, or clarifying the diagnostic criteria for a new disease process.

Whatever type of inquiry is ultimately selected for the RLRSAP, the previous experiences and skill set of the mentor should be leveraged to ensure that the resident will benefit from the mentor's access to valuable knowledge and essential resources. Thus, the selection of a mentor may help guide the format used for the scholarly project, in addition to its subject matter. When feasible, the resident should seek to align the current RLRSAP with previous projects that the mentor has executed or facilitated, both in topic and format — thus optimizing the expertise that their mentor brings to the project.

CAREER GUIDANCE

For those interested in a career in academics, the RLRSAP may be one element in a career-spanning trajectory for the resident learner. The residency experience is intended to prepare residents for their eventual career as a practitioner in EM, and the RLRSAP should serve a complementary purpose for residents. Rather than selecting a seemingly random topic and study design for their project, residents should spend time considering what their long-term career goals are, and tailor their project (and associated mentor selection) to suit those goals. Residents should prioritize the selection of a mentor who is already doing what they would like to be doing in their future career. The mentor is then likely to be able to offer guidance beyond the individual project, extending also into the resident's future career and academic goals. The RLRSAP will offer a chance for the resident to work closely with the mentor, which can facilitate opportunities for the resident to develop a close relationship with the mentor and gain greater insight into the career trajectory that has resulted in their mentor's professional success.

One of the earliest discussions between the resident and a potential mentor should focus on the resident's career goals and the degree to which they are interested in developing a skill set in scholarly pursuits. Because many residents may have received limited exposure to scholarly activity prior to pursuing their RLRSAP, the mentor's insight and guidance may help establish and strengthen a career path that will eventually lead to an academic career. Thus, the mentor should help the resident consider their long-term academic goals as a precursor to RLRSAP development, with the ultimate goal of defining an RLRSAP that integrates well into the resident's intended career trajectory.

CONCLUSIONS

Critical for evolving investigators interested in an academic career, the RLRSAP should be part of a well-developed career research plan. A plan of logically sequenced studies, from basic science to large human trials, could be the foundation for an entire research career. This flow of studies can lead to multiple publications and a track record of success in research, topic expertise, and potentially, long-term funding. Mentors can help establish this plan for career-long personal development and modify it as the resident's career progresses. The choice of an appropriate mentor is an essential early step in the development of any RLRSAP and could be instrumental in the development of an academic career for those residents who have an interest in pursuing research and scholarly activity after graduation.

➲ *KEY CONCEPTS*

- The identification of an appropriate mentor can help the resident researcher define a suitable research project, secure essential resources, identify appropriate grant funding, and guide the RLRSAP to completion and appropriate reporting of results.

- A mentor-guided approach can facilitate a successful career in EM research for resident learners by offering valuable insight into those study topics and designs that have been successfully executed by the mentor and previous mentees.
- Residents should seek out a qualified RLRSAP mentor who has already achieved the career goals that the resident is seeking to achieve themselves.
- The ideal mentor can guide a resident through the process of designing and executing an RLRSAP but will also be able to offer advice to the resident on their career trajectory and how to achieve their desired level of success in academic medicine.
- The ideal RLRSAP topic will be aligned with the resident's career goals, thus maximizing the value of the project's completion for the resident.

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