

Resident Research: The Basics & Beyond

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Scientific investigation is the basis for and foundation of medical practice, including emergency medicine. Although not everything we do is derived from careful scientific inquiry, research has advanced our knowledge and allowed us to help patients in every aspect of care. Consider a typical patient who presents to the ED with a severe headache. Emergency physicians have studied and given us objective information on everything from the effectiveness of triage by ED nurses for this class of patient,¹ the sensitivity and specificity of head CT and lumbar puncture (LP) for diagnosing subarachnoid hemorrhage², and the incidence of spinal headache if a LP is performed³. If the patient turns out to have viral meningitis, emergency medicine investigators have conducted clinical trials on the usefulness of a new antiviral agent, pleconaril, for treatment⁴, and basic science EM investigators have just published a study in rats suggesting that Anti-Interleukin-6 antibodies can attenuate inflammation in a model of meningitis.⁵

The Basics

The logical extension of the fact that emergency medicine clinical practice is based on research, is that EM residents should have formal training in the fundamentals of research and how to review and evaluate the scientific literature. The breadth and depth of EM research training is variable and opinions vary widely amongst EM educators on how research should be taught to resident physicians. In most residency programs research training is accomplished through a combination of didactic presentations on the basics of scientific investigation, participation in journal clubs that evaluate the scientific literature, and involvement in ED clinical projects while working ED shifts. Some residency programs require residents to complete a research project to fulfill the RRC graduation requirement for a scholarly project. The value of mandated resident research has been previously debated, with some questioning the value of forcing a resident who has little enthusiasm for conducting research to do a formal research project.^{6,7}

The importance of research training for EM residents can be eclipsed by other elements of the curriculum and clinical service commitments. But just as a resident who feels deficient in interpreting ECG's will correct this deficiency through extracurricular study, or review of ECG's with a mentor or tutor, so should a resident who is deficient in the basics of research pursue extra training.

A moral and ethical imperative exists for the study of research methodology by emergency medicine residents. Our patients obviously count on us to be able to improve care and introduce new treatments or preventive measures. We cannot do this if we are not able to intelligently immerse ourselves in the world of scientific investigation. While this does not mean that we all need to do research, the best EM clinicians understand basic research concepts and how these translate into care at the bedside. Another good reason to study research methodology is to develop the tools to separate marketing propaganda from sound science. The medical marketplace, like other areas of commerce, is teeming with vendors who present information to physicians that is undoubtedly and appropriately biased toward their products. The only defense for the bombardment of medical advertising is an objective, scientific mind that results from adequate training in research.

In the past the physician has served as an all-knowing

repository of medical facts and techniques. Now, the average computer-literate patient can learn almost as much about his or her disease from the Internet (and sometimes more) than the physician knows. The role of the physician is being transformed from holder of information to interpreter and advisor for information. A strong foundation in research is essential for the physician to fill this role. By understanding fundamental research concepts such as hypothesis testing, study design, data collection and interpretation, and the limitations of research, the emergency physician can help patients make decisions about their care.

A number of resources can be used by EM resident physicians to further their knowledge of basic research concepts. A full accounting is beyond the scope of this article, but here are some suggestions: SAEM has produced a *Fundamentals of Research* and *Advanced Research Series* video sets, which are compilations of lectures and handouts on research that were presented by senior investigators at SAEM Annual Meetings. They should be considered essential viewing for all emergency medicine residents. (See the SAEM website at www.saem.org) for information. *Academic Emergency Medicine* offers in almost every issue articles on research concepts, methodology, and ethics.^{8,9} *Annals of Emergency Medicine* has produced a valuable series of articles on biostatistics and a basic emergency medicine research guide, and frequently publishes articles on theory, design, interpretation of clinical research.^{10,11} A popular and quite readable book on clinical research that is often recommended by EM faculty is Hulley and Cummins, "*Designing Clinical Research*" (Williams and Wilkins).

While methodology and analysis receive a lot of attention from those who are training in research, a major area that must not be neglected is research responsibility and the ethical conduct of research. Recent examples of breaches of patient confidentiality, conflict of interest, and failure to properly obtain informed consent have focused national attention on clinical research. An excellent collection of papers, position statements, and recent developments on matters relating to responsible conduct of research can be found at the American Association of Medical Colleges (AAMC) web site at www.aamc.org/research.

Advanced Research Training for Residents

Some residents will go beyond the curricular requirements for research and beyond additional reading or study, and desire a hands-on, mentored research training experience during residency. This can be a rewarding way to gain a deeper understanding of research and to assess whether a career that involves original research is appealing. Note that the term "research training" is used and not "perform research" – the two are not the same. Although a well-designed research project can be a good vehicle for a resident to learn about research, a meaningful research training experience will be more broad-based. The motivation for and expectations of the research training experience on the part of the resident must be clearly defined prior to starting. There are good and not so good reasons to do research as a resident.

Good Reasons

1. A compelling interest in an area of medicine, and a passion to learn more about this area.

2. A strong desire to develop research skills and knowledge in a mentored environment.
3. Identification of a specific research question that can be answered by a defined, limited study.
4. To assess whether an academic career that involves research is desirable.

Not So Good Reasons

1. To completely answer a major clinical dilemma through research (see reality and logistics below).
2. To publish papers in order to build a strong C.V. and get a good job.
3. To meet an expectation or requirement that "all residents should do research."

Realities and Logistics of Resident Research

The excitement and passion that initially drives an EM resident to pursue additional research training almost immediately runs into predictable roadblocks. How the resident fares in negotiating early obstacles is crucial to whether the research training experience will be a positive or negative journey.

Resident research should not be a solitary pursuit. Having a research mentor to educate, guide, and sometimes console the resident researcher is absolutely essential. As has been noted before, the mentor need not be an academic emergency physician, but may be an expert in the field of interest.^{6,7} The resident should look for someone who has a track record of mentoring junior researchers. Often more than one mentor may be necessary. The resident researcher must develop an understanding with the mentor at the onset of the research as to the amount of time, contact, meetings, and skills that will be taught as part of the mentor relationship. The resident must clearly define his or her expectations for the mentor. For example, a senior resident who wants to perform a pilot project on ED asthma prior to writing a fellowship grant, and who plans to pursue an academic research career, is much different than a resident who plans a career as a community emergency physician, and wants to spend a month learning from the mentor how clinical studies are designed and carried out in the ED so that he will better be able to understand the clinical literature. The mentor will take a different approach with these two

residents, but must clearly understand their expectations and needs up front.

Once the resident acquires a mentor, the next step is to plan the research training experience. The novice researcher almost always over-estimates what can be accomplished in a defined research training period, and the mentor usually provides needed reality testing and revision. In order to avoid the disappointment that inevitably occurs when a research project is only 10% complete at the end of the research training period, the resident must work closely with the mentor to develop a defined, feasible research project. The steps involved include a careful review of the literature in the area, revision of the general research question down to a specific narrow question, the development of a hypothesis that can be answered by a simple study, and careful planning of the research protocol. If the resident only has a month to perform the research, all of these preliminary steps should be carried out in advance so that the dedicated time can be spent on research, not paperwork. Common snag points as the research is being planned include Institutional Review Board approval for clinical projects and Animal Care approval for laboratory projects. For clinical protocols, working out the logistics of how patients will be identified, recruited and enrolled in the study requires a great deal of time and planning. For laboratory projects, pilot studies or trial experiments are often needed to perfect the model. Often, the mentor has already done the ground work for projects. But even if a research project is teed up for the resident researcher by the mentor, the resident should still study these aspects of planning the investigation, as they are a key part of learning how to do research.

One challenge for a resident who is doing research, is to avoid measuring success by whether or not the project "worked". In many cases the research project proves too difficult to accomplish in the given time frame. Enrollment may be slow, animals may die unexpectedly during a protocol, a database may not be accessible or may not contain the desired information. These setbacks are part of research, and are more common when an investigator is just getting started. Setbacks are also essential to learning how to do research. Just as in the clinical setting we remember and learn more from our mistakes, in research we learn from the things that went wrong and develop ways to avoid

these as we move forward. A good mentor can anticipate some of these setbacks and help the junior investigator avoid them. An even better mentor will let the junior investigator encounter some adversity, and then teach how to reassess, retool, and move forward. Thus, the resident researcher must evaluate a research training experience based on "what I learned," not "what I accomplished."

The Important Role of Emergency Medicine Physician Scientists

A resident research experience is valuable simply as a way of increasing a young physician's knowledge of the world of scientific investigation. It may be even more valuable in helping that physician determine where he or she fits in that world. Career satisfaction can be distilled down to some essential points – it's nice to be wanted, better to be needed, and those who feel that they are making a difference are the ones who come to work with smiles on their faces. A career as a physician scientist can wonderfully fulfill these key elements for some emergency medicine residents. Clearly, the demand and need to increase the number of physician investigators is a national emphasis, as is the need to improve research training. Funded opportunities for research training for graduating residents are at an all time high. Sources include the SAEM Research Fund grants, the Emergency Medicine Foundation, and a variety of physician research training programs from the National Institutes of Health, many of which focus on patient-oriented research training.

Can well-trained emergency physician-scientists make a difference in the health of our emergency patients? The answer is emphatically yes – from injury prevention and treatment to emergency cardiac care, to asthma, to domestic violence, to public health (to name just a few) emergency medicine investigators have taken a leading role in driving the research that has improved understanding and helped patients. Without their effort, our ability to provide important advances in medical care for ED patients is doomed to stagnate. If the emergency medicine-clinician cannot objectively incorporate information from EM research into practice, this role will be inappropriately delegated to non-EM specialists, such as corporate entities or the legal system to determine our "standard of care".

Thirty years ago there was a great need for trained emergency physicians, and many people helped fulfill this need

while developing satisfying career in the field. Now we have a need for more, and better trained emergency physician-scientists. While this path is not for everyone, it can lead to a stimulating, extremely satisfying career. And if enough people take this path, it will become a highway to better health for our emergency patients.

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