

Medical Students and Research

Michelle Biros, MS, MD Editor in Chief, *Academic Emergency Medicine*
Research Director, Department of Emergency Medicine
Hennepin County Medical Center, Minneapolis

James Adams, MD
Senior Associate Editor, *Academic Emergency Medicine*
Vice Chair, Department of Emergency Medicine
Brigham and Women's Hospital
Harvard Medical School, Boston

Introduction

At any level of emergency medicine academic training, participating in a research project can be an exciting and rewarding experience. Emergency medicine researchers have the opportunity to be on the forefront of medical science and the subsequent improvement of emergency patient care. The energy, curiosity, intellectual interchange and active thinking that drive a successful research effort are in themselves often enough to sustain long-term involvement in research. However, all potential researchers must have a realistic idea of the research process. Real scientific advances come infrequently and slowly; career researchers spend most of their lives adding small but important pieces of new information to a focused area of investigation.

For medical students, participation in emergency medicine research offers special challenges, given the heavy time and academic demands of the medical school curriculum. The rewards are many, however, if you are able to honestly assess your motivation and realistically appraise your expectations regarding your involvement in a research effort.

This article will discuss the reality of emergency medicine research, especially as you, the medical student, will encounter it. We hope to offer some practical advice about what you should expect and what you can reasonably achieve. Obviously, our perspective is that of research mentors and advisors to medical students. The perceptions of medical student researchers may be different than ours, and we encourage you to obtain as much information as you can from all sources before you commit to research in emergency medicine.

Motivation

The motivations for medical student emergency medicine research involvement are many. Some students have an intense desire to know and learn about a particular clinical or basic question, and believe this can only be fulfilled by performing relevant research. Some find the concept of research intriguing, and want to give it a try. Others want to look harder at the specialty, or at a particular emergency department, and feel that research involvement will give a different perspective than a clinical rotation. Some students want to develop a relationship with a notable emergency medicine researcher, perhaps to foster future mentorship, or to ask for a letter of recommendation. Others may want to develop more comfort in the ED clinical setting and believe involvement in a research effort will be a non-threatening way to develop better communication skills with patients.

Because of the intense competition for residency spots, many medical students interested in emergency medicine feel obligated to pursue some research exposure to strengthen their residency application. Although this motivation may be valid for you, it is easily recognized by residency program directors for what it actually is. It is true that every residency is eager to have a qualified candidate who has

demonstrated an interest in research. However, if you are interested in gaining a research experience only because it will improve your candidacy for residency, it is time to stop and reflect. In these circumstances, we believe it is better to do something that is of genuine interest to you, concordant with your strengths and that illustrates who you really are; program directors will find out anyway. You will rise higher, shine brighter, and be more favorably assessed if you develop and express your genuine talents in a meaningful way. Your credibility will be greater and the cost to your personal life much less if you are honest with yourself and don't sell yourself as something you are not.

Unless you can carefully control your time, remember that research time during medical school may compete with other academic responsibilities or your personal time. Weigh this consideration carefully relative to your true motives to be sure the commitment you make and the benefits you receive will be worth any potential personal costs.

Benefits

Given the caveats above, we believe that any exposure to research is a journey of self-discovery, an exercise in self-discipline and is worthwhile. Intellectual satisfaction, personal recognition, a sense of accomplishment, and career enhancement are obvious benefits of a completed research project.

Residency candidates who will ultimately become leading emergency researchers often show their research interest early, and accumulate a focused research background over the course of years, sometimes beginning during their undergraduate education. However, even a brief encounter with the research process is beneficial for future emergency clinicians. If you pursue an active involvement in an emergency research effort, you will learn how to read well, think better, and remember more. Even if research is not a long-term career goal, understanding research methodology and investigative science will allow you to critically analyze scientific advances. Clinicians who do not understand medical research or cannot objectively scrutinize a clinical research report are not in a position to reliably interpret scientific advances. Instead, they depend upon marketing.

Practical Questions

If you have decided you are interested in an emergency medicine research experience during medical school, there are some practical issues you must consider.

What to do

Students often approach potential research advisors, eager to investigate a specific topic of interest, with plans to initiate, execute, and complete an independent project during medical school. In most circumstances, this is an unrealistic expectation. A new project requires a significant amount of up front preparation before it can be taken to the clinical or basic research setting. This includes the development of a good research question, justification of the project through a complete literature review of the topic, a feasible written protocol, obtaining appropriate approvals (i.e. IRB), development of a budget, and a departmental commitment of space and other supporting resources. This prestudy preparation is obviously very time consuming if it is well done, and requires some previous research experience. If the project requires developing a new model system, you can expect to add at least three months to the front-end prep time. Most students do not have this much time to devote to research. However, if you do, and you decide you want to do an independent research project, be sure to do your homework before you approach a potential advisor. Most established researchers have little interest in supervising projects that are only peripherally related to their research focus, and even less interest in developing the protocol for you. Therefore, at the very least, come with a well-developed research

question, a good literature review, a first draft of a protocol, and specific questions about how to do this project in the local research environment.

A more realistic way to participate in emergency medicine research during medical school is to become involved in an ongoing project, or, with your advisor, to develop a small spin off project based on research already being done within the department. This will provide you with a taste of the research process, exposure to academic emergency medicine and academicians, and, by drastically reducing the prestudy time requirements, enhance the likelihood of actually completing, presenting and publishing your work before you graduate.

Who to work with

Your choice of a research advisor should be thoughtfully made. Notable emergency medicine researchers are in short supply and high demand as research advisors and academic mentors. Most over commit to supervising the research of others, while trying to maintain their expected or required levels of personal performance. Do not hesitate to ask specifically how much time the advisor can devote to helping you with the project, how much hands on time they spend doing research themselves, and what they believe is adequate supervision of a novice researcher. If one of your expectations from the research experience is a letter of recommendation, you will need direct and frequent contact with your advisor during your research time. If you want to learn research methodology by one-on-one interaction with a notable researcher, make sure your potential advisor is still actively involved in the day-to-day business of research. If your potential advisor appears to be too busy to fulfill your needs, select someone else with time to and interest in fostering your experience. Although your second choice for an advisor may not be as famous as your first, your experience will be more meaningful and satisfying.

It would be naïve to believe that personality has no role in the selection of a research advisor. If you are intimidated by a potential advisor when you meet him or her, work together in the clinical setting, interact at lectures or conferences, or in casual conversation, you will also be intimidated in the research setting. You can respect people that you really don't like, but it is not likely that you will be able to work well with them. The discomfort isn't worth it; choose someone else.

What to expect

Your actual involvement in a research effort will depend on the project itself, and should be agreed upon with your advisor before you start. If you join an ongoing project, it is not likely that you will become a lead investigator. If you want to be given visible credit for your participation (i.e., included as an author of the paper which results from the project), ask your supervisor what effort will be required, and how your effort will be evaluated. Seasoned advisors often write up contracts between themselves and student researchers that specifically state what contributions are required for specific levels of credit towards the final product. This ensures that the discussion has taken place and that the "terms " have been understood and agreed upon by all parties.

You may believe that self initiated projects or small spin offs that you perform are yours completely, and indeed, you will probably be responsible for the entire effort. Occasionally, advisors have different ideas regarding who is the principal investigator and who is secondary. Again, this issue needs to be openly and honestly discussed and agreed upon before you start. If you sense that your expectations and those of your supervisor are not the same, it might be worth reconsidering your advisor choice. On the other hand, you must also realistically evaluate what your actual contribution is likely to be. A good idea with limited follow through is not worthy of first authorship. If you have completed the effort but never analyze or interpret the data, never present it at a scientific forum, or never write a paper on it, don't be

surprised if your supervisor completes these steps for you and takes first credit. In these circumstances, you have probably forfeited the position of first contributor. While you may feel you have done all of the work, your advisor has also contributed time, counsel, financial and other support, and may not be able to afford dropping the effort simply because you do. In today's competitive academic environment, unpublished research (which therefore never undergoes peer review or reader scrutiny) doesn't really count.

Some medical students take part time jobs as paid research assistants. Although it is realistic to expect a letter of recommendation attesting to your work habits, these circumstances do not necessarily guarantee anything more. If you want to be listed as a contributor to the research effort, you will probably be required to go above and beyond your job description. Again, this should be discussed before you begin your commitment.

When to do it

A commitment for solid research involvement usually takes far more time than initially expected. The nature of the project will determine how much time is required. In general, the most effective student involvement occurs during a research elective for credit. This block of dedicated time will give you the opportunity to study the research protocol, learn the necessary techniques, and develop data acquisition skills. Since research is then part of your curriculum, you will not be dividing your time between research and other academic commitments, and will not be adding research to an already busy schedule. Many leading researchers require at least a several week (i.e. 4- 6 weeks) commitment before they will accept a student researcher onto their research team.

Some students try to become involved in a research project during free blocks of time, such as a summer or holiday break. Often these time periods are too short to allow meaningful participation in the project. If you intend to do this, your role may be only to collect data, perhaps from a chart review. The likelihood of getting significant credit for this contribution is not high. However, if you do volunteer to participate, realize that the research advisor will have the same expectations of you as they have for those students who are taking research for credit (and thus are highly motivated to perform well). You will be expected to be present and performing, as you have agreed to.

Getting started in emergency medicine research

Given these generalities, how can you become involved in a meaningful emergency medicine research experience? Our specific advice is:

Engaging in the process

1. Honestly assess your motivation and know your goals.
All motivations for research involvement are probably valid; the real reason you want to do research will direct what your advisor can provide for you. When you meet with a potential research advisor, expect to be asked what your specific goals are, so have them well formulated in advance.
2. Assess your current skills level and research knowledge base.
If you have never been involved with research, one of your goals should include learning basic research concepts. To ignore this would be a missed opportunity, which may never present again in your medical career. Your advisor should provide you with appropriate readings and instruction.

3. Determine your timetable.
Your availability will determine what type of project you can get involved with. Remember to consider prestudy prep time; including the time it takes for you to learn the necessary skills for a particular project.
4. Decide where and with whom you could perform research.
Discuss the research habits, reputation, projects and energy of your proposed advisor and the entire department with as many current or previous student researchers as you can. Compare your needs with what it appears the advisor has previously been able to provide.
5. Determine the advisor's availability and interest.
This requires a formal meeting with the potential advisor. Since their time is as valuable as yours, be sure to come prepared to ask specific questions and provide information. Express your interest as concisely as you can; it is difficult for the advisor to direct you to a specific project if your expressed interest is too broad. If you have not narrowed down an area of interest, ask for suggestions at your first meeting or for options within the department. Intelligent questions and obvious knowledge of the potential advisor's current research activities are impressive, and may make a busy clinician researcher an interested and available advisor.

Assess your time availability and timeline before you meet the advisor and know the exact time you can start and will need to finish your involvement. Obviously, your time availability should match the advisor's. Be sure you mention any possible interruptions in your planned research time blocks, such as vacation plans or leaving to interview at residencies. Your commitment to research will be less believable if you aren't around very much, and it may not be possible to alter the research schedule to accommodate frequent requests for time away.

6. Select a project.
In consultation with the advisor, determine what ongoing, spin-off or new project is appropriate for you considering your interest, time, background, and objectives.
7. Discuss expectations.
Your expectations should be honestly stated as soon as you have decided to pursue research involvement. Although such topics as authorship, credit, letters, etc. may be uncomfortable to discuss with an established researcher that you may have just met, it is better to agree on these issues up front than have an unpleasant confrontation after you have already committed time and energy to the project. Most researchers appreciate such honesty, as long as the discussion maintains an open, undemanding and respectful tone.

Performing the project

1. Read.
Get a solid literature background on the project itself and research in general. Your advisor should provide you with material related to the study question. This may be the only time in your medical career that you will have the opportunity to learn fundamental research concepts, so be sure to include these in your reading. A list of suggested readings is included at the end of this article.
2. Ask questions.
Be sure you understand the reasoning behind the project and the need for and importance of each of the steps involved with its completion. Sometimes this is not obvious by reading alone.

You will get more out of direct questioning than you will from helping in a study that you do not understand. Important questions to ask include:

- a. Why was this research topic chosen? What is the relevant background that makes this question important?
 - b. What is the specific study hypothesis? What is the study design? Why was it designed this way?
 - c. What are the methods that will be used to answer the question? Why was this method developed for this research question?
 - d. How is the data to be collected and managed? If the data is collected and managed properly, will the study hypothesis really be answered? What are the unanswered questions?
3. Write the protocol.
If you are beginning a new project, develop a formal written protocol. This will be required for approvals (i.e. IRB or Animal Research committees) for budget justification, and for identifying specific training needs. If you are joining an ongoing project, develop an outline of the project that describes each step needed to derive the data you intend to collect. Include in this outline the answers to the above questions. Such an exercise helps you understand the flow of the project and may help identify unanticipated problems.
4. Execute the project. Be sure you understand exactly your responsibility. If you encounter problems during data collection or project execution, let your advisor know immediately. It is irresponsible and unethical to expose patients or animal research subjects to procedures, data collection, or other study interventions, and then have to exclude their data because it was not properly collected.

Completing the project

1. Dealing with boredom.
Research projects are most exciting when they are in the planning stages, during research skills acquisition, or when the final data interpretation is taking place. The day-to-day grind of developing and piloting new techniques, data collection and data management can become very tedious. This is especially true if your project requires chart review. Remember that medical records are stories of illness and injury, and as such, can be interesting and educational reading. All researchers have experienced boredom at sometime during a project; good researchers keep the end in sight, continue to read and question, and leave themselves open to new learning opportunities.
2. Dealing with frustration.
It is extremely frustrating to run into stumbling blocks just as your project gets off the ground. Clinical projects depend on working clinicians to identify and recruit patients into ongoing studies, and often a heavy clinical load takes precedence over a research effort. In addition, clinicians may not be in the habit of doing research, and will simply forget about your study. Respectful, frequent reminders and your presence in the ED will enhance the likelihood of good patient enrollment into your study.

It is also very frustrating when data is incomplete, or improperly recorded. If your project depends on the medical record, you must realize that it is not a perfect document, and there will be missing data. Study designs anticipate this. However, be sure that the missing information isn't due to your lack of

attention to detail when reviewing the medical record. Remember, if research were easy, everyone would do it.

3. Interpret the data and write the report.

Most research advisors suggest that at least the first draft of an abstract or research manuscript be developed by the medical student researcher. This is a golden opportunity for a medical student that is often missed. Your advisor is unlikely to wait very long before moving on to the next project; if you don't start the writing process soon after data collection and analysis is complete, your advisor may do it for you in order to bring your project to completion. It is therefore in your interest to get the manuscript written and completed as soon as possible.

There are many excellent textbooks on scientific writing, but the best way to learn how to write is to study what has already been written. Reviewing the literature on your research topic has given you a start on this, and can often frame the paper you develop. Previous papers by your advisor can also serve as a model. Interview your advisor on how to best develop a paper, and don't hesitate to get advice frequently.

Many novice writers have difficulty getting started. They believe they know what they want to say but can't find the correct words, and once they begin, will not move on until what they have already written seems perfect. Remember, as a student you have been writing your entire academic life, often under a deadline. Consider this paper similar to any other assignment that needs to be completed within a specific timeframe.

Remember that your research manuscript is not the first time you have presented your ideas; you developed your ideas and refined them when you first approached or met your research advisor. To overcome writer's block, most writing instructors suggest recording your "stream of consciousness". These impressions usually contain the key pieces of information that you want to communicate, and can eventually be focused and abbreviated into a concise, accurate and comprehensible report.

The Instructions for Authors of Manuscripts to various journals can give you a general outline of what is required in a scientific report. ([Click here](#) for the Instructions for *Academic Emergency Medicine*). If you have questions about whether or not your paper is within the scope of what is published in a journal, call the editorial office and ask. When you finally submit your paper, make sure you have exactly followed the Instructions for Authors.

Final Thoughts

Although finding the time to study research during medical school may be difficult, or choosing a research elective above another clinical rotation can be hard, our experience suggests that most student researchers enjoy their experience and believe they benefit from it. Research involvement as a medical student has been a career-defining event for many current senior emergency researchers. It offers a unique opportunity to meet interesting and interested people, and to develop research, academic and personal friendships that can last a lifetime. A student research experience provides a different perspective of the specialty, of clinician researchers, and of problems encountered in the practice setting. Even if you do not pursue a career in academic emergency medicine, an understanding of the research process and how research results should be interpreted and applied will benefit your future emergency patients.

We have mentored or advised many student researchers with vastly different interests, funds of knowledge, goals and energy. For us, it has been an absolutely rewarding experience. The opportunity to foster creativity and direct the process of scientific and self-discovery that occurs with any research exploration is an academic privilege we never anticipated when we were medical student researchers. We have enjoyed emergency medicine student research; we think that you will, too.

Suggested Readings

Annas GJ, Grodin MA: The Nazi Doctors and the Nuremberg Code. Oxford Press, NY, 1992. - *Should be required reading for all clinician researchers; puts complex patient research protections in proper perspective and reminds us of why they exist.*

Garb JL : Understanding Medical Research; A Practitioner's Guide Little Brown and Co, Boston, 1996 - *Quick read, discusses hypothesis testing and then gives great examples of applying research principles to evaluating the literature and to conducting a study*

Greenhalgh T: How to Read a Paper; the Basis of Evidence Based Medicine BMJ Publishing Group, London, 1997 - *Quick read, good discussions of systematic reviews*

Hulley SB, Cummings SR; Designing Clinical Research Williams and Wilkins, Baltimore, 1988 - *A research classic- this is an excellent, easy read which discusses the research process from developing the question to publishing the data*

Lang TA, Secic M How to Report Statistics in Medicine BMJ Publishing Group: ACP, Philadelphia 1997 - *The title is misleading- this excellent book describes not only the meaning of the statistical tests you read about, but also how to write research, how to interpret it and how to clinically apply it*

Streiner N PDQ Statistics BC Decker, inc. Toronto, 1986 - *This excellent basic introduction to statistical concepts uses clinical examples, and mocks long winded statisticians- a quick easy read, and really quite funny.*