

Osler Survival Guide to Research During Residency

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What is research?

Research is traditionally divided into two types: basic science and clinical. However, the more recent view places research activity on a spectrum with “translational research” in the middle. What defines translational research is still somewhat nebulous. In a nutshell, it encompasses activities that translate basic science discoveries into clinical application and, in turn, activities that use clinical observations to refine or generate new research questions for basic science. An example of this would be a gene therapy proven to work *in vitro* and in animal models that then gets tested in a small clinical trial involving human volunteers. Another example would be reanalyzing the biochemical compound of a drug that is found in clinical trials to cause an unexpected benefit very different from its originally purpose. Translational research also includes activities that investigate in a larger population any therapies that have been proven effective in a smaller population.

The aim of research is to contribute unique knowledge to the field of medicine. This unique knowledge can be presented in the form of a published article or a presentation at professional conference. Research can be reported in different ways: a case report, a topic review, or an original article describing the results of a new study.

The prototypical research project is a unique study that answers a previously unanswered question in medicine. The classic research study is an experiment (in the bench science sense) or a randomized clinical trial (in the clinical research sense). However, there are also many other ways to study an important question in medicine and thereby offer a unique contribution to medicine (e.g. observational studies, meta-analyses, etc.).

A research study generally includes the following basic steps:

I. Conception/design	This can take days to weeks. This is when the research question is formed. Forming a good research question requires an in-depth literature review and requires a detailed knowledge of the type of data available (or potentially available) to answer the question. A well thought out and well organized research question and study concept should take the form of a research proposal (1-3 pages, including: title, background, aims, methods, references). Click here to see a sample research proposal. Pearl: a good research question is one where any resultant answer (positive or negative, yes or no, etc.) would be interesting.
II. Implementation	This can take days to months. This is the process of turning the research proposal into action. Some types of studies require an IRB application and review. Many studies require initial meetings with research personnel who will assist in carrying out various parts of the study.
III. Data collection/ cleaning	This step can take weeks to months (for the average resident project). This is the process of collecting findings/observations

	from the study and, usually, entering them into a database format. This process can be simple or complex depending on the type of study, the sample size, and the number of variables collected from each sample. In the process of transferring data into a database format, errors and omissions can be made. Data cleaning is the process of correcting or otherwise appropriately accounting for these occurrences. For some studies, the data has already been collected and cleaned but is part of a larger dataset that you do not have easy access to. In such cases, you may need to go through an application and review process to acquire the data you need.
IV. Analysis	This step can take days to months. This involves performing analysis of the collected data to determine if the study findings are statistically significant. Although the statistical programming may need to be performed by an experienced analyst, the research team should determine the methods of analysis.
V. Write-Up	This step can take weeks to months. The primary author-to-be should ideally write the first draft. A draft manuscript benefits from being reviewed by senior researchers and typically goes through multiple edits before being ready for submission to a journal for publication.
VI. Presentation/ publication	This step can take months to years. The initial results of a study can be reported in abstract form and submitted as such for presentation at a professional conference. Preparing an abstract for publication is a good exercise and typically takes days to weeks. However, getting a full manuscript published can take much longer (e.g. submission to a single journal can involve requests for major revisions that could include section rewrites and re-analyses). A single manuscript may need to go through several iterations of submissions to different journals before finding a home, and each cycle can take months.

How much research can I realistically expect to accomplish during residency?

This depends on a number of factors: your previous research experience, the type of research activity you are interested in, the kind of opportunities provided by your mentor, and how much time you can commit to the project.

The type and amount of research previously accomplished by housestaff is varied. In the past, some residents have chosen to focus their time primarily on reviewing the literature in a new area of interest and formulating research questions that they plan to later explore during fellowship. A few of these residents have written up and published their findings in a review article. Some residents have attended the meetings of a research group to learn how research activity is conducted and organized for a large study. A few of these residents have taken the opportunity to contribute in a small, well-defined way to the larger project and subsequently become a co-author on a publication. Some residents spend time working on their own small, well-defined project – from concept through analysis and write-up. A few of these residents have completed their projects during residency, or shortly after graduation, with their results presented at national conferences and published in major journals.

What defines a good research mentor?

The type of mentor most suitable to work with a house officer depends on the house officer's individual interests, research background, and specific goals for the type of research experience they want to have during residency.

Overall, a good mentor is somebody who is professionally established, has experience successfully conducting the type of research you are interested in, is able to give their trainees good research opportunities, and has a track record of seeing trainees through to the completion of their own research projects.

How do I find a good mentor?

There are a few ways to do this.

The traditional way of finding a mentor is word of mouth. Once you have a general idea of the area of medicine you are interested in researching, start talking to multiple people in this area. Talking to multiple people about your interests is a way to make contacts, generate ideas, and find out who is doing what kind of research. After talking to multiple people, you may notice that a few of the same names are mentioned over and over again as good possible mentors – these are the people who are well-regarded in their area.

Performing a Pubmed search on a potential mentor is another way to get a sense of how established he or she is and what their track record of mentorship looks like. An established researcher not only has an impressive publishing record but is often also listed as the last author (also known as “senior author”) on multiple publications.

Another good resource is the NIH CRISP database, which you can use to identify researchers with active funding in your area of interest. Researchers with ample funding will have more resources at their disposal to provide their trainees with appropriate opportunities and support.

You can also make an effort to talk to junior people (including other housestaff) who have worked with your potential mentor to find out what their experience was like (e.g. was it rewarding? frustrating? etc.).

Why have more than one mentor?

You should know that while a well-known and established senior research mentor may be the gateway to a world of opportunities, he or she may be difficult to schedule meetings with and will probably not be easily available to answer a lot of small questions about your research project on a frequent basis. Therefore, it is often helpful to also be working with a junior mentor, somebody who may not be as established but who also does work in your area of interest and who can provide research guidance at the micro level.

Having more than one mentor is also helpful when it comes to timing and opportunity. Not everybody will be able to offer you exactly the type of research opportunity you are looking for at exactly the time when you are ready to put in the work. As well, interacting with more than one mentor will lend you more than one perspective on important issues in research and medicine.

Making initial contact with a mentor

Getting in touch with a potential mentor for the first time can be intimidating, but it doesn't have to be.

Before your first communication, you should take the time to find out what their areas of interest and expertise are. Do a Pubmed search to see the kinds of articles they have published and with whom they have collaborated on these projects. Go to their departmental web site(s) to see what titles and positions they hold at Hopkins and read any available biographical sketches. A general internet search (e.g. google) or Hopkins web search may also reveal something about projects they are currently involved in. Think carefully about which part of their work overlaps best with your own research interests.

The first communication is often email. Keep this brief and to the point. Mention upfront who you are (intern, JAR, etc.) and who may have referred you to contact them (e.g. Charlie, Mike Weisfeldt, another faculty member). Briefly outline your interest area(s) and mention any relevant personal background (e.g. Masters or PhD training, previous research experience). Finally, express that you are interested in setting up a first meeting, at their convenience. Some mentors may ask you to email a copy of your resume or bring a copy of your resume to your first meeting. This is simply a way for them to learn more about you, your background, and any

previous research-related experience (e.g. knowing that somebody was a psychology major in college might prompt a mentor to ask about helping to run a quality-of-life study).

Before your first meeting, prepare to talk a little bit about your background and what led you to your research interests. Also prepare to talk about the kinds of research projects you are interested in participating in, at what level(s) you hope to participate, and what your end-goals are for the experience.

At your first meeting, you will hopefully be able to learn and ask questions about the different types projects that you could be involved in by working with a particular mentor. You may also learn about other potential mentors who are doing work in this same area. Before making any firm commitments, consider and discuss what the timeline for accomplishing tasks would be and how this could coincide into your rotation schedule. Ideally, the times when a project requires the most work from your end is when you are on an elective or case block. Before your meeting ends, confirm when and how the next form of communication will take place.

Tips for interacting with mentors

Frequent and timely email is how a lot of researchers collaborate on projects. However, there are still many senior researchers who like to collaborate frequently in person. Try to set up from the beginning a tentative schedule of meetings to help keep the project on track. At the very least, meetings should take place at certain critical points during the research process (e.g. going over a project proposal, discussing an analysis plan, reviewing results, etc.). Be as organized and as prepared as possible before each meeting. Plan an agenda of issues to discuss and have a prepared list of questions. The more you have done to prepare before each meeting, the more momentum you bring to the process and the more able your mentor will be to help you keep your project on track.

Sample timeline for getting research done during residency

Intern year month 4-6	Start thinking of what areas of clinical medicine interest you and what kind of research interests you (the two do not necessarily have to overlap). Mention these interests to Charlie at your intern meeting with him.
Intern year month 6-8	Start meeting with potential research mentors.
Intern year month 8-12	Finalize which mentor(s) you will work with and which project(s) you will work on. Think of a timeline for accomplishing the tasks that need to be completed. Submit requests for elective and case time accordingly (keep in mind the fellowship application and interview schedule).
JAR year	Start working on your project(s) early, according to a timeline that will probably need revisions as you go along. Keep in mind the deadlines for conference abstract submissions that you may be able to make, depending on when data collection and analyses can be completed.
SAR year	Continue work on projects started earlier in residency. Smaller projects may be started at the beginning of SAR year. For projects that will not be completed by the end of SAR year, assess how much more work is needed. Start planning how the project's remaining tasks can be completed after you graduate. Consider involving 1 or 2 interns and/or JARs with shared research interests to carry on the required work.

A final word

The process of achieving success in medical research is very different from the process of achieving success in the practice of clinical medicine. In research, there is no defined curriculum, no set path, and no predictable outcome. A lot of what makes people successful at research is simply hard work, diligence, and luck. Therefore, if your first project (or two or more) do not work out for some reason, don't be discouraged. You should know that many successful researchers in academic medicine have faced the same hurdles and challenges – and the majority have had to endure through multiple failures before achieving their successes.

Recommended resources

Advice to a Young Investigator. Book by Santiago Ramon Y Cajal, 1898.

Reprinted by the MIT Press, this book is a classic that is available at your local online or brick and mortar bookstore. "[The] wisdom contained in this slim, elegant volume is almost a century old, it is as fresh and useful today as it no doubt was then."

American College of Physicians: Effective Clinical Practice Primers

<http://www.acponline.org/journals/ecp/primers.htm>

This web site provides links to quick, accessible overviews of commonly used terms and concepts in evidence-based medicine.

Clinical Research During Internal Medicine Residency: A Practical Guide. Article by Kendal Hamann et al., 2006. Am J Med. 2006;119(3):277-283. A must-read for any medicine house officer even considering performing clinical research during their residency.

Designing Clinical Research: An Epidemiologic Approach, 2nd Ed. Book by Steven Cummings et al., 2001. This book provides a highly recommended overview of how to design a clinical research project.

Epidemiology in Medicine. Book by Charles Hennekens et al., 1987.

This book is a standard, manageable introduction to basic epidemiology.

How to Be a Good Graduate Student. Paper by Marie des Jardins, 1994.

<http://www.cs.indiana.edu/how.2b/how.2b.html> Although written for the traditional graduate student, this paper contains pearls of wisdom (e.g. "The Daily Grind" section) that would be useful to anybody embarking upon their own research project.

