Fostering New Investigators

Research Tips for Pharmacy Residents

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Dear Residency Program Director:

Again this year, the ASHP Foundation is providing a series of tips for conducting quality research during a pharmacy residency program. As part of its mission, the ASHP Foundation provides leadership and conducts education and research activities that sponsor high-impact practice research leading to advances in patient outcomes. In keeping with this mission statement, the ASHP Foundation continues to prioritize new investigator development.

Residency Research Tips is composed of practical suggestions for successful completion of pharmacy resident research. When available, links to web resources, including *AJHP* articles, are included as a resource for more in-depth information. Topics that are addressed include timeline development, writing specific aims and hypothesis statements, power calculations and statistical analysis, data presentation, developing surveys, working with the Institutional Review Board (IRB), grant development *and* presentation and publication of research findings. This year, the tips have been updated to include a revised timeline.

Consider encouraging residents in your program to seek grant funding for their research projects through the ASHP Foundation's Pharmacy Resident Practice-Based Research Program. This grant program supports practice-based research that focuses on advancing pharmacy practice initiative conducted by residents in ASHP-accredited pharmacy residency programs and residents in pharmacy residency programs that have submitted an application for ASHP accreditation. Visit the Funding Opportunities section of the ASHP Foundation's Research Resource Center for more information, including applications and application instructions. For the next submission deadline and application cycle information, please visit the Pharmacy Resident Grant webpage for details.

A webinar to review application submission requirements is scheduled annually in August. For more information and to register, visit the Pharmacy Resident Grant webpage.

There are several important steps that residents should take to successfully complete a research project. These include:

- ✓ Establishing a timeline.
- ✓ Maintaining a narrow focus for the resident's project. Ask only one study question as the project needs to be feasible.
- ✓ Asking a relevant question. This year, submissions to the Pharmacy Resident Practice-Based Research Grant program must focus on studies that evaluate pharmacy practice initiative in hospitals and health systems such as the utilization of technology, role delineation changes for the pharmacists and non-pharmacists, or improving the patient care opportunities for pharmacists.
- ✓ Identifying senior investigators in your institution who may have feasible project ideas that could be undertaken by the pharmacy resident.
- ✓ Establishing a research team composed of the investigators who will be responsible for study completion.
- ✓ Establishing relationships and getting support from those departments and individuals who are key to completion of the study.
- ✓ Holding frequent team meetings to monitor the progress of the research and to plan next steps.
- ✓ For prospective studies, considering completion of the project over 2 residency years.
- ✓ Encouraging the resident to stay focused on the study and complete a small amount of the

work each week. The research preceptor and resident should discuss allocating time specifically for completion of the research project.

- ✓ Maintaining documentation of all decisions regarding the study.

The *AJHP* research series contains an article by Dr. Robert Weber, of Ohio State University, that discusses applying the principles of project management to successful completion of research. This article is a good primer for the resident to read in advance of undertaking his or her study.

If you have any questions or would like to suggest topics for future versions of **Residency Research Tips**, please contact me at foundation@ashp.org.

Sincerely,

Barbara B. Nussbaum, B.S.Pharm., Ph.D.
Vice President
ASHP Foundation

Establishing Timelines

One of the most important aspects of conducting quality research – especially during a pharmacy residency is establishment of a reasonable timeline. The research advisor should work with the resident to develop a realistic timeline that will enable completion of a quality project while undertaking the primary training responsibilities associated with the residency program. A graphic or tabular timeline should be used to track milestone components of the research project. View a timeline example.

Evaluating the Existing Evidence

Once the resident has identified a research idea, a comprehensive review of the existing evidence should be completed to develop a thorough understanding of the topic. A review of the literature can ensure that the investigators do not duplicate questions that have been answered already and it can provide insights into important unanswered questions related to the topic area.

For further discussion of the importance of the evidence review, see Dr. Kelly Smith's article Building Upon Existing Evidence to Shape Future Research Endeavors.

Dr. Almut Winterstein discusses the literature review at length in her Research Boot Camp lecture on this topic. See:

Literature Review, Part 1

Literature Review, Part 2

Literature Review, Part 3

Literature Review, Part 4

Watch Dr. Kathleen Bungay's Research Boot Camp lecture, Writing a Research Plan Introduction, to learn how to incorporate your evidence review into a concise rationale and significance section for your ASHP Foundation grant application.

Developing the Research Question

The research question should be identified as early as possible in the residency year. Selection of an appropriate research question is one of the greatest challenges confronting pharmacy residents and their research advisors. The residency year provides a relatively short period of time to conduct quality "research" and the execution of the project must be balanced with the training priorities of the pharmacy residency. It is imperative that the resident and the advisor select an appropriately narrow research question that addresses an important practice issue. For resident projects, the use of retrospective data is usually easier, given the limited time available for study completion.

Succinctly defining the research question is key to a successful resident research project. The research question should be defined as early as possible in the residency year. In their book, *Designing Clinical Research*, Hulley and Cummings describe the use of the mnemonic FINER (Cummings, Browner et al. 1988) in developing the research question.

Feasible
- Adequate number of subjects
- Adequate technical expertise
- Affordable in time and money
- Manageable in scope

Interesting to the investigator

Novel
- Confirms or refutes previous findings
- Extends previous findings
- Provides new findings

Ethical

Relevant
- To scientific knowledge
- To clinical and health policy
- To future research directions

Grant requests to ASHP Foundation should focus on research that relates to the ASHP/ASHP Foundation Practice Advancement Initiative.

Once the research question is drafted, it should be circulated to experienced researchers associated with the residency program for review. One forum for review of the research question, and other components of the proposed study, is a regular research seminar that is attended by the residents and the residency faculty, including those with research experience. For an extensive discussion of his topic, see Dr. Earlene Lipowski's article on developing great research questions and Dr. Christian Hampp's Research Boot Camp lecture on development of a research plan.

1. Hulley SB CS. Conceiving the research question. In: Hulley SB CS, Browner WS, Grady D, Hearst N, Newman TB, ed. Designing Clinical Research. 2 ed. Baltimore: Williams & Wilkins; 2001:17-24.

Writing Specific Aims

Along with the research question, well-defined specific aims or objectives are key to the successful completion of a research project. The specific aims should answer the question "What are you going to do?" For a residency project, the research team should not be overly ambitious with the aims as this will affect project viability. The resident's project should probably be limited to 1-2 specific aims. However, these specific aims can be designed to increase the value of the study. For example, a study that addresses outcomes data, rather than process data, could have an important impact on practice. The National Institute of Allergy and Infectious Diseases provide very helpful guidance on writing specific aims. Similar to the review of the research question, the specific aims should be reviewed by experienced researchers associated with the residency program.

Learn more about writing specific aims by viewing Dr. Kathleen Bungay's Research Boot Camp presentation.

Hypothesis Statements

Hypothesis statements are developed primarily to provide a basis for statistical analysis. The null hypothesis states that there is no difference. In a study comparing a medication and placebo for treatment of a disease, the null hypothesis would predict no difference in measurable effect between the two interventions. Hypothesis statements are not required in descriptive studies.

A helpful learning resource is the National Institute of Allergy and Infectious Diseases primer on generation of a hypothesis statement.

Efficacy vs. Effectiveness

Residents sometimes submit research grants to the ASHP Foundation in which they propose comparing the efficacy of two medications when they are actually proposing a comparison of effectiveness. Efficacy and effectiveness are not interchangeable terms. Given the emphasis on comparative effectiveness studies in the

U.S. healthcare system —from policy decisions to direct patient care—it is imperative that pharmacists have a clear understanding of the differences between efficacy and effectiveness.

Schumock and Pickard clearly defined efficacy as a measure of the capacity of a treatment to produce the desired effect in a controlled environment, such as in a randomized controlled trial. They defined effectiveness as the actual effect of the treatment in practice.

Hébert and colleagues identified 13 domains under which efficacy and effectiveness studies differ. These include the research question, setting, patient selection, study design, baseline assessment, study intervention, co-interventions, compliance, endpoints, analysis, sample size, data management, and study management.

Avoiding Bias

Understanding and controlling for bias, the presence of systematic error, is critically important in the conduct of sound research studies. In his *AJHP* article entitled "Bias: Considerations for Research Practice", Dr. Tobias Gerhard discusses three major areas through which bias is introduced into research studies of health care interventions: (1) factors that relate to the exposure of patients to treatments in the population, (2) factors that influence inclusion of patients in the study, and (3) factors related to assessment and measurement. He also addresses methods to address bias in both design and analysis stages of a study.

In a Research Boot Camp lecture, Dr. Almut Winterstein discusses internal validity with a focus on causality and bias.

Internal Validity, Part 1

Internal Validity, Part 2

Study Design

Study design is the most important part of conducting quality research. A well-designed study enables the researcher to respond to a research question with accurate, objective and valid methods. As part of the Research Boot Camp lecture series, Dr. Almut Winterstein addresses:

Study Designs Used for Clinical Research

Cohort and Case-Control Studies

Randomized Clinical Trials

Introduction to Study Interventions

The Scientific Method: Generalizability and Sampling, Part 1

Measurement, Part 1

Measurement, Part 2

In addition, *AJHP* research series contains several articles that address various aspects of research design. These include:

An Overview of Clinical Research Design by Drs. Daniel Hartung and Daniel Touchette

Intervention Design, Implementation and Evaluation by Dr. Lourdes Planas

Bias: Considerations for Research Practice by Dr. Tobias Gerhard

Validity and Reliability of Measurement Instruments Used in Research by Drs. Carole Kimberlin and Almut Winterstein.

Gaining Institutional Support

Securing departmental and institutional support for a potential research project is critical to the project's success. Most studies require some level of logistical support from within the researcher's department and the institution. Practice research almost always benefits from multidisciplinary involvement. As the methods for the proposed study are being developed, the research team should assess each component of the methods to determine the impact on different departments within the institution. After this assessment has been completed, an organized plan for gaining support from each of the involved departments should be developed. This plan should also address logistical issues that are critical to execution of the study. For example, will the pharmacists need education regarding the protocol? Do other departments require review by their departmental research committee prior to Institutional Review Board (IRB) submission? If medical records review is involved, have all HIPAA implications been addressed with the medical records department prior to the IRB submission? The study methods should be revised as required to reflect the logistics discussions that occur. Along with positively impacting execution of the study, these efforts to engage other departments will be beneficial as the study is being reviewed by the IRB and by the institution's office of grants administration if a grant submission occurs.

For an extensive discussion of his topic, see Developing and Executing an Effective Research Plan by Drs. Robert Weber and Daniel Cobaugh.

Biostatistics

Consultation with a biostatistician can dramatically impact the quality of the resident's research project. Key steps in statistical analysis include:

Establishing the research question.

Formulating a hypothesis.

Identifying primary and secondary outcomes.

Selecting an appropriate test.

Sampling correctly.

Collecting data.

Describing the data.

Performing a test.

For an extensive review of this topic, see Dr. James DeMuth's articles entitled Preparing for the First Meeting with a Statistician and Overview of Biostatistics Used in Clinical Research.

Dr. Madeline McCarren provided an introduction to biostatistics in her Research Boot Camp presentation:

The Role of Statistics and Statisticians

Another useful resource on descriptive and inferential statistics is Statistics at Square One.

Human Subjects Protections

Institutional Review Board (IRB) review and approval is imperative to the ethical conduct of research, to the protection of human subjects and to assure compliance with federal regulations governing research. In the early stages of project planning, the investigators should incorporate IRB processes into the research timeline. This provides a good opportunity for residents and other new investigators to become acquainted with the IRB's procedures and review requirements. The ASHP Foundation requires evidence of IRB approval before it funds research projects and a large number of scientific journals require similar evidence prior to publication.

Dr. Byerly also provides an in-depth primer on this topic in his article, Working with the Institutional Review Board.

Access to information on federal regulations regarding IRBs can be helpful while the resident is organizing his/her research. The resident should give serious consideration to attending an institutional program on conducting human subjects research.

Human Subjects Protections

In a previous edition of *Tips for Conducting Quality Pharmacy Resident Research*, the role of the Institutional Review Board (IRB) was addressed. Protection of human subjects is addressed under Title 45, Part 46, of the Code of Federal Regulations. One of the questions that investigators raise frequently is what type of review – expedited or full – will occur or if a study will be exempted from review. The Code of Federal Regulations §46.101(b) contains information on those types of studies that are exempted from review. The Code of Federal Regulations also contains detailed information on expedited review. A list of research categories that the Secretary of the Department of Health and Human Services has determined may be reviewed through an expedited review is also available.

Again, Dr. Wesley Byerly provides a thorough primer on this topic in his article, Working with the Institutional Review Board.

It is critical that the resident and his or her research advisor discuss the IRB review process with representatives of the institution's IRB.

Data Collection, Display, and Manipulation

As residents collect data from their studies, it is important that they enter and organize the data in a manner that will ease analysis. The data collection form and methods should be developed and tested before initiation of the study. Residents and preceptors should also discuss the processes that will be used for data entry and display prior to study initiation. This should include a determination of quality checks that will be included. If a biostatistician is available, he/she can help verify that all required data are being collected. The biostatistician can also provide invaluable guidance on data display.

Listen to Dr. Almut Winterstein's discussion of data display and manipulation:

Data Collection, Display and Manipulation, Part 1

Data Collection, Display and Manipulation, Part 2

Statistics at Square One provides a primer on several issues related to data display and summary. Included are brief discussions of nominal, ordinal and interval scales as well as information on data display, including dot plots and histograms.

Grant Submissions

For most new investigators, the entire grant submission process can be overwhelming. However, the quality of the grant application will have a major impact on funding decisions. Organization is critical to the process. If a residents decides to pursue funding, such as the ASHP Foundation Pharmacy Resident Practice-Based Research Grant Program, they should immediately read the entire application and make a list of each step required for completion of the application. This should be followed by a discussion between the resident and preceptor that focuses on a timeline for development of the application. The resident needs to understand that quality specific aims and study methods take time to develop and refine. As mentioned in earlier e-mails, garnering institutional support and the grants administration process also take significant amounts of time and should be factored into the grant submission timeline. Although the National Institute for Allergy and Infectious Diseases tutorial on grant writing is geared to development of a National Institutes of Health grant submission, it still provides valuable information for any grant writer. The quality of the application can be enhanced greatly by seeking review by experienced researchers who are not involved with the study.

Also see Dr. Emily Beth Devine's discussion of this topic in her article The Art of Obtaining Grants.

Grant Submissions

Although it is impossible to adequately discuss all aspects of grant writing through these tips, there are several areas that new investigators should pay attention to as they write an application. In this tip, a few key aspects of grantsmanship – adherence to instructions, budget justifications, and timeline development – will be addressed.

One important aspect of grant submission is adherence to the application instructions. When the resident reviews the application and instructions to develop the grant preparation timeline, guide them to also pay close attention to issues such as page limits and font size. In many cases, funding agencies will return, without review, applications that do not adhere to application instructions.

If a grant application has a budget justification section, the applicant should carefully justify requested funds in relation to the project. Rather than simply listing a research assistant, the budget justification should explain to the reviewer the assistant's role on the project.

If the grant program requires a timeline for the project, provide a tabular or graphic timeline that describes key activities on a monthly basis. Reviewers do not find statements such as "the study will be completed over a 12-month period" to be adequate timeline descriptions.

Again, see Dr. Emily Beth Devine's discussion of this topic in her article The Art of Obtaining Grants.

Grant Submissions

One of the most common mistakes made by grant applicants is underestimation of the time required to complete each of the institutional steps required for a successful application. Investigators often underestimate the time required for review by the investigator team, submission of the protocol and consent to the IRB, requesting letters of support, and submission of the entire grant application to the institution's grants management office. Many new investigators are often unaware that a grants administration process exists in their institution. However, this is a critically important piece that cannot be overlooked. All grant applications should be submitted to the grants administration office in advance of submission to the funding agency. The research team should allow adequate time for completion of the grants administration process. If this process is overlooked, it can delay or prevent submission of the grant. If the research team determines that a grant will be pursued, the resident and the research advisor should meet with a grants officer early in the process to learn about the institution's policies and procedures related to grants administration. The grant officers can also offer expertise about numerous aspects of sponsored projects accounting that must be addressed when a grant application is submitted, such as budget preparation and indirect cost rates.

Again, see Dr. Emily Beth Devine's discussion of this topic in her article The Art of Obtaining Grants.

Research Presentations

Presentation of research findings in a public forum is often intimidating for new investigators. Along with anxiety about speaking to a large audience, new investigators also need to develop an ability to concisely present their study findings in as little as 10-15 minutes. A relatively short platform presentation does not allow for a lengthy discussion of the background for the research. In preparing the background slides, there may be time for only one or two bullet points along with the study objectives. The primary and secondary study objectives should be stated clearly and succinctly.

Another challenge is incorporating complex study methods into a few slides. Flow diagrams are very effective for describing methods. In a platform presentation, graphic presentation of results is best. In presenting results, avoid busy tables that the audience will not be able to read or fully grasp in a short period of time. The brief platform presentation will not allow significant time for discussion of the findings.

The presenter will be challenged to identify the most salient points that should be discussed. Take time to discuss the limitations of the study. Otherwise, the audience will point them out to you in the question-and- answer session. If time limitations preclude the inclusion of some data in your presentation, prepare slides with those data and have them available in case an applicable question is raised by the audience.

Also, there are several articles in the literature that provide useful insights into preparing an effective research presentation. See:

Estrada CA, Patel SR, Talente G, Kraemer S. The 10-minute oral presentation: what should I focus on? *Am J Med Sci* 2005;329:306-9.

Mayer K. Fundamentals of surgical research course: research presentations. *J Surg Res* 2005;128:174-7.

Cina SJ, DiMaio V, Smialek JE. Suggested guidelines for platform presentations. *Am J Forensic Med Pathol* 1998;19:54-6.

Submitting a Manuscript

Many new investigators, and even seasoned researchers, become overwhelmed by the process of submitting a manuscript to a biomedical journal. Successful manuscript development requires an organized approach and an understanding of the roles of each section of the paper – introduction/background, methods, results, discussion and conclusions. A key first step is review of the desired journal's author instructions to understand the submission requirements. Also, starting early will allow for a more manageable process. The background and methods sections can be written even before the study results are available. Consider reading Welch's "Preparing Manuscripts for Submission to Medical Journals: The Paper Trail." This article provides a practical, step-by-step discussion of the manuscript preparation process.

Often, a resident's first journal submission will involve a case report. The October 1, 2006 issue of the *American Journal of Health-System Pharmacy* includes an excellent primer by Henry Cohen, Pharm.D., entitled "How to Write a Patient Case Report." This article also includes a list of criteria for publishable case reports.