INSTRUCTIONAL DESIGN AND ASSESSMENT

Incorporating Research into a Postgraduate Year 1 Pharmacy Residency

Michael T. Swanoski, PharmD,^{a,c} Michael F. Akers, PharmD,^{a,c} Maria L. Amaro, PharmD,^{a,c}
Krista L. Huot, PharmD,^c and M. Nawal Lutfiyya, PhD^{a,b}

^aUniversity of Minnesota, College of Pharmacy, Minneapolis, MN

^bEssentia Institute of Rural Health, Duluth, MN,

^cEssentia Health, Duluth, MN

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Objective. To implement a longitudinal research experience in the form of an embedded mini-fellowship in a first-postgraduate year (PGY1) residency program.

Design. In September 2011, a research module was initiated and research meetings were established on a recurrent basis throughout the residency so that residents would have protected time for academic work. The research module was structured around lecture seminars, statistical analysis workshops, and works-in-progress sessions.

Assessment. Two residents completed the initial module and worked on multiple research projects. The projects were assessed by the lead faculty member on the research module based on established learning objectives for the module. The 3 completed research projects were presented at national meeting poster sessions. Five papers were submitted to scholarly journals for peer review. Residents were able to submit their final required project manuscripts just 4 months after beginning the research module.

Conclusion. Formalizing the research efforts of PGY1 residents by establishing a research module with protected time ensured residents worked steadily toward established deadlines and met the objectives of the module.

Keywords: pharmacy residency, research training, academic pharmacy

INTRODUCTION

One of the required outcomes of a first-year postgraduate pharmacy residency program, as defined by the American Society of Health-System Pharmacists (ASHP) accreditation standards, is development and evidence of practice management skills, which are often demonstrated in the context of a research project.¹ Completing a successful and scientifically sound research project during a 1-year residency can be a daunting task and may pose challenges for pharmacy residents with little research training.²

Pharmacy residency research projects vary in complexity. Many sites provide incoming residents with the choice of designing a novel project for their research or choosing a project from a list of quality- or process-improvement projects.⁴ In many instances, the bar for research has been set low for pharmacy residents. Typical residency projects are intended to work to benefit the organization where the resident is located and the data collection or research effort often involves a small number of subjects and result in findings that are not generalizable

or scientifically sound enough to provide evidence-based clinical recommendations.^{5,6} Most residency programs have limited research-related resources within the confines of their own departmental organization.⁷ Many residents may end up feeling discouraged and uninspired after completing a research project that required a vast amount of time and effort but yielded a marginal return at the end of the year.⁶

Many graduates of pharmacy residencies choose to pursue faculty positions in colleges and schools of pharmacy, underscoring the need for research training.⁸ Residency programs focus on patient care activities that, while valuable,^{9,10} do not prepare pharmacy residents for many of the primary expectations of a career in academia: teaching, scholarship, and service. Even if faculty positions are clinical ones, scholarship is required for promotion. Without a successful publication record, promotion is difficult to attain.¹¹⁻¹³ Exposure to other facets of academic culture pertaining to research such as grant writing and peer reviewing for journals is also critical to be fully successful in academic pharmacy.¹¹⁻¹³

The Ambulatory Care Residency Program at the University of Minnesota, College of Pharmacy is the largest

Corresponding Author: M. Nawal Lutfiyya, PhD, Essentia Institute of Rural Health, Division of Research, Duluth, MN 55805. Tel: 218-786-8118. E-mail: mlutfiyya@eirh.org

multi-site program in the United States.³ The college provides educational structure, expertise in practice development, and administrative support, but each site is unique in setting and experience. This article describes an interdisciplinary, longitudinal, mini research fellowship embedded in a PGY1 pharmacy residency program at the college. The objective of this research module was to determine if collaborating with a seasoned research scientist would result in a positive, substantive, and productive research experience for pharmacy residents.

DESIGN

Beginning in September 2011, the University of Minnesota Ambulatory Care Pharmacy Residency Program initiated a research module at the PGY 1 residency site at Essentia Health, an integrated health-system based in Duluth, MN. Participants in the module included 2 PGY1 residents, the site coordinator, and a newly hired Essentia Health pharmacist who had recently completed a PGY1 residency at a different practice location as part of a different residency program. The research module, which took the form of an embedded mini-fellowship, was developed and led by a chronic disease epidemiologist who was also senior research scientist at the Essentia Institute of Rural Health, the research arm of Essentia Health.

Under the aegis of the senior research scientist, the 2 residents, the site coordinator, and the additional pharmacist met weekly for approximately 3 hours. Over the course of the PGY1 year, approximately 3 additional 3-hour sessions were scheduled to complete the research work undertaken. Research meetings were conducted at a regularly scheduled time set aside for academic work. The research module had 11 learning objectives, which are listed in Table 1 according to objective domain, Bloom's learning taxonomy,^{14,15} and objective achievement. To achieve the project objectives, the research module was structured around lecture seminars, statistical analysis workshops, and works-in-progress sessions (Appendix 1). The statistical analysis workshops and works-in-progress sessions facilitated completing as much of the data management, analysis, interpretation, and manuscript writing as possible during the residents' protected academic time.

Creating the research module formalized the research efforts of the PGY1 residents and enabled them to work toward deadlines, such as submission of conference abstract and completion of research papers. Manuscript submissions to journals for peer review for possible publication were also facilitated. Without the structure provided by the research module, these deadlines would have been much more difficult to meet. Before beginning any of the research projects, all participants were required to complete National Institute of Health human subjects

training. Additionally, the required Institutional Review Board forms had to be submitted for each project and receive approval.

Teamwork was essential for this research experience. By working in a team, the task of completing an original research project was less intimidating and seemed more doable. Collaboration allowed for capitalizing on the diverse experiences of the participants in the research module and for sharing the workload. Ultimately each resident/participant was able to be the lead on at least 1 project. First authorship on manuscripts resulting from completed research projects was assigned based on who served as the project lead.

To overcome some of the usual issues with PGY1 research projects, eg, not enough time to collect data and not enough data for generalizable findings, large public health databases were used to answer the research questions developed by the residents and other participants. Once a research question was developed, a decision was made about the best possible database available for answering it. This decision was made based on examining the questionnaire that was administered and the subsequent available database.

To facilitate statistical analyses, Statistical Package for Social Scientists software, version 19.0 (SPSS, IBM, Chicago, Illinois), was used. During the statistical analysis workshops, the participants learned appropriate descriptive and/or test statistics for use by data types and study design, as well as how to use the software by completing all of the data management and analysis work together. During these statistical analysis and works-in-progress sessions, the instructor projected the work from her laptop computer onto a screen visible to everyone while explaining the why, what, and how aspects of the data management or analysis task. The participants undertook the same work on their laptop computers and were able to ask questions in real time as the work was completed. Table 2 displays the research questions explored by the PGY1 residents.

EVALUATION AND ASSESSMENT

Table 1 displays the PGY1 research module learning objectives by objective domain (study design, data analysis, research question, software competency, and research project completion), the cognitive domain from Bloom's^{14,15} learning taxonomy (knowledge, comprehension, application, analysis, synthesis and evaluation), and evidence for achievement of learning objectives. Eleven learning objectives were articulated by the project director at the onset of the research module (Table 1). The research module learning objectives spanned the range of Bloom's learning taxonomy, with the completion of a research project

Table 1. PGY1 Research Module Learning Objectives by Objective Domain, Bloom's Taxonomy and Achievement of Objectives

Objective Domain	Cognitive Domain from Bloom's Taxonomy	Research Module Learning Objective	Achievement of Objectives
Designing a Research Study	Knowledge and Comprehension	Discuss benefits, drawbacks and process of randomization in an experimental study. Discuss benefits, processes and drawbacks of observational studies including cohort studies, case-control studies, and cross-sectional surveys.	Assigned readings and lecture seminars were completed and applied.
Data Analysis	Comprehension and Application Comprehension and Application Comprehension, Application and Evaluation Comprehension, Application and Evaluation Synthesis and Evaluation	Describe a dataset by creating and interpreting summary statistics and descriptive plots. Compute and interpret confidence intervals for both continuous and dichotomous data. Perform and interpret hypothesis tests for both continuous and dichotomous data. Perform and interpret a simple linear regression and ANOVA analysis for continuous data and Chi-square analysis for dichotomous data of more than two groups. Perform and interpret logistic regression analysis.	Four quantitative research studies employing multiple levels of analysis including descriptive, bivariate, and multivariate logistic regression were completed
Research Question	Analysis, Synthesis and Evaluation	Define a problem or research question and identify an appropriate study design to address the problem or question.	Four research questions were posed and studies conducted over the course of the module.
Data Availability	Evaluation	Identify publically available databases that can be used by researchers to answer population-based health-related research questions.	Databases, with data appropriate to the research questions posed, were selected for each research study. For each research study, using the selected database, a data dictionary was created with the interview questions, variables, and original and recoded factors.
Competency With Statistical Software	Knowledge, Comprehension, Application, and Evaluation	Use SPSS to store and retrieve data, to apply methods of analysis discussed to a dataset, and be able to interpret results using descriptive, bivariate and multivariate techniques.	All data management and quantitative analyses were completed using SPSS.
Completion of a Research Project	Evaluation	Be a co-author on at least two completed research projects that have been written up as manuscripts and submitted for peer review for publication in scholarly journals.	Four research papers were produced over the course of the module, with shared authorship among the module participants. Each participant was the lead on at least 1 research project/study.

Table 2. Research Questions Explored By The PGY1 Residents

Title	Research Question	Methods
The prevalence of U.S. adults 19 to 64 years who smoke receiving a pneumococcal vaccine: examination of the uptake of the new CDC recommendations	What is the 2010 prevalence of U.S. adults who smoke receiving a pneumococcal polysaccharide vaccine and is the 2010 prevalence significantly higher than the prevalence in 2005; do these prevalence rates vary significantly between rural and non-rural populations?	Cross-sectional design, multivariate techniques, comparing 2005 and 2010 Behavioral Risk Factor Surveillance Survey (BRFSS) data Dependent variable: receipt of pneumococcal polysaccharide vaccine Population: U.S. adults 19 to 64 years of age who currently smoke Excluded: U.S. adults 19 to 64 with asthma and/or diabetes
Prevalence differences in daily or near daily aspirin use by U.S. adults with diabetes: a cross-sectional comparison of rural and non-rural populations	What is the prevalence of daily or near daily aspirin use for U.S. age-appropriate adults with and without diabetes and/or additional risk factors for cardiovascular events and do these prevalence measures vary significantly between rural and non-rural populations?	Cross-sectional design, multivariate analysis of an amalgamated database using 2005, 2007, and 2009 BRFSS data Dependent variable: daily or near daily aspirin use. Population: U.S. adults greater than 40 years of age
Knowledge of heart attack and stroke symptomology: a cross-sectional comparison of rural and non-rural US populations.	This study sought to examine the knowledge of heart attack and stroke symptoms among rural adults in comparison to non-rural adults living in the United States.	Cross-sectional design, multivariate analysis of 2005, 2007, and 2009 BRFSS data combined into a multi-year database Dependent variable: low heart attack and stroke knowledge score. Population: U.S. adults
A population-based cross-sectional study of health services deficits for U.S. adults with depression: are there differences between rural and non-rural adults with depression?	The aim of this study was to examine health service deficits in rural verses non-rural adults with depression. By analyzing national population-based data, this study sought to fill in some of the gaps in the current understanding of the epidemiology of depression in U.S. adult populations and to specifically explore who is at risk for health service deficits.	Cross-sectional design, multivariate techniques, using 2006 BRFSS data Dependent variable: health service deficits Population: U.S. adults with depression as measured by PHQ-8

and manuscript that represented both the highest domain of Bloom's taxonomy (evaluation) and the defined end product for the research module. Accomplishing all of the learning objectives that mapped to the lower-level cognitive domain of Bloom's learning taxonomy was defined as successfully completing the learning module. As indicated in Table 1, there were empirical referents for the achievement of each of the module's learning objectives.

This research experience resulted in several completed research projects, many of which went beyond the achievement of the learning objectives for the research module. First, as noted earlier, to comply with ASHP's required outcomes for a PGY1 residency, each resident had to complete a manuscript based on a project undertaken in the PGY1 year.¹ Often residents struggle with completing these projects and manuscripts in a 1-year

time period. By starting early and working together with publicly available, scientifically sound data, the residents were able to complete multiple research projects and manuscripts. Two of the completed research projects were presented at the ASHP 2011 Midyear Clinical Meeting poster session. A third project was presented at the 2012 HMO Research Network Annual Meeting. Also, rather than scrambling at the end of the residency to produce a manuscript, the residents were able to submit their final project manuscripts 6 months into their PGY1 year.

Four months into the research module, the manuscript resulting from the first completed research project was submitted to a peer-reviewed journal and subsequently accepted for publication. By the fifth month of the residency, 2 additional manuscripts had been submitted to journals for review and both were subsequently accepted for publication.

DISCUSSION

Despite the successes of the PGY1 pharmacy research experience described here, there remain several areas where refinement to the research module is needed to provide even greater benefit for future participating residents. First, we hope to use a wider variety of databases (including an Essentia health system data warehouse) to examine research questions posed in the next iteration of this research module. Even though the residents in this first research training effort became familiar with a number of databases, only 1 was ultimately used for all 3 of the research projects completed. The choices made regarding which database to use were guided in all instances by the research question. In future years, a concerted effort will be made to actively use at least 2 different databases to expand the residents' knowledge and use of large databases. While large-database analysis is not the only form of research, it has worked well in this mini research fellowship. By providing them with the option of using the Essentia data warehouse data, residents will have the opportunity to answer research questions that are health-system specific.

Additionally, to more fully expose PGY1 pharmacy residents to academic research culture, we hope to enhance residents' research experiences by providing an introduction to grant writing as well as to the process of reviewing manuscripts for academic/scholarly journals. These 2 skills are essential if residents choose careers in academic pharmacy and/or research. Given the importance of securing funding for research, understanding the process for developing a successful grant will be imperative for those interested in pursuing a research pathway in pharmacy. Similarly, because publication in peer-reviewed journals allows for the dissemination of pertinent findings to the health care community, understanding the peer-review process from the inside is also crucial.

Moving forward, the selection of residency candidates will play an important role in the success of the program and a strong interest in research will likely become a prerequisite given the rigorous research experience that we have developed at this residency site. Finally, stemming from this research experience, we hope to expand our efforts by developing a pharmacy postgraduate research fellowship program that will train high-functioning pharmacist researchers who also maintain their clinical skills.

Because there were only 2 residents completing this mini research fellowship in their PGY 1 pharmacy residency, no formal evaluation of the research endeavor was undertaken. We relied on the veracity of work produced (eg, papers for conference presentation and peer-reviewed publication) to demonstrate the program success.

No solid outcomes were measured assessing the value of the program outside of completion of the residency projects and mapping the steps leading up to completion to learning domains. Moreover, we recognize that by using large public databases for this research training module, residents were not exposed to multiple data collection approaches, eg, developing and administering a survey instrument, conducting focus groups, or completing chart audits. Nevertheless, they were exposed to how to formulate and answer meaningful research questions using scientifically sound methods. Finally, the research module was quantitative in nature and did not expose the residents to qualitative research methods and analysis techniques.

There is a clear need for enhanced, formal research training in PGY1 pharmacy residency programs. This training is essential not only because of the difficulties many residents experience when trying to complete their required PGY1 projects, but because many residency-trained pharmacists seek and are eventually employed in academic pharmacy or academic medicine. Structured, rigorous research training during the PGY1 year will build many of the skills needed to successfully pursue a research pathway in academic pharmacy, either in a clinical practice, non-tenure or tenure faculty track.

SUMMARY

While not without limitations, the mini research fellowship developed for PharmD PGY 1 residents was successful in training residents to accomplish research involving large publicly available databases. During this longitudinal research experience, some of the skills acquired included how to develop a research question, design a scientifically sound project, apply biostatistics, and use statistical analysis software. The participating residents completed 5 research projects, all of which were accepted for publication in peer-reviewed journals.

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Appendix 1. Pharmacy PGY1 Research Module Meetings by Type and Assigned Readings

Meeting Type	Meeting Focus	Assigned Readings
Seminar	Overview of the module/review of curriculum and research ethics.	Gostin L. Ethical Principles for the Conduct of Human Subject Research: Population-Based Research and Ethics. <i>Law, Medicine & Health Care</i> . 1991;19:191-201.
	Discussion of NIH human subjects training—where, when and how to do it	Wendler D. How to Enroll Participants in Research Ethically. <i>JAMA</i> . 2011;305:1587-1588. Wickins-Drazilova D, Williams G. The ethics of evaluating obesity intervention studies on children. <i>International Journal of Obesity</i> . 2011;35:S24-S29. Hoey J. Who wrote this paper anyway? The new Vancouver Group statement refines the definition of authorship. <i>CMAJ</i> . 2000;163:716-717. Bennett DM, Taylor DM. Unethical practices in authorship of scientific papers. <i>Emergency Medicine</i> . 2003;15:263-270. Plemmons D. A Broader Discussion of Authorship. <i>Sci Eng Ethics</i> . 2011;17:389-398. Newman A, Jones R. Authorship of research papers: ethical and professional issues for short-term researchers. <i>J Med Ethics</i> 2006;32:420-423. Bebeau MJ, Monson V. Authorship and Publication Practices in the Social Sciences: Historical Reflections on Current Practices. <i>Sci Eng Ethics</i> . 2011;17:365-388.
	Survey Research—primary and secondary—datasets for analysis—examining the survey questionnaires for each of these surveys in order to begin to develop our first research focus: BRFSS, NAMCS, NSCH, and YRBS.	Lutfiyya MN, Patel Y, Steele J, Tetteh B, Chang L, Aguero C, Prakash O, and Lipsky MS. Are there disparities in diabetes care? A comparison of care received by U.S. rural and urban adults with diabetes. <i>Journal of Primary Care Research and Development</i> . 2009;9:320-331.
	Everyone must have completed the NIH human subjects and research module and turn in a copy of their certificate at seminar time. This will permit us to formally begin a research project.	Lutfiyya MN, Bardales R, Bales RW, Aguero C, Brady M, Tobar A, McGrath C, Zaiser J, Lipsky MS. Awareness of MI and Stroke Symptoms Among Hispanic Males. <i>Journal of Immigrant and Minority Health</i> . 2009;12:761-768. Lutfiyya MN, Sikka A, Mehta S, Lipsky MS. Quality Care indicators comparison of U.S. accredited and non-accredited rural critical access hospitals. - <i>International Journal for Quality in Health Care</i> . 2009;21:112-118. Lutfiyya MN, Nika B, Ng L, Tragos C, Won R, and Lipsky MS. Primary Prevention of Overweight and Obesity: An Analysis of National Survey Data. <i>Journal of General Internal Medicine</i> . 2008;23:821-823. Lutfiyya MN, Garcia R., Dankwa C, Young T, Lipsky MS. Overweight and Obese Prevalence Rates in African American and Hispanic Children: An Analysis of 2003 National Survey for Children's Health Data. <i>Journal of the American Board of Family Medicine</i> . 2008;21:191-199. Lutfiyya MN, Shah KK, Johnson M, Bales RW, Cha I, McGrath C, Spera L and Lipsky MS. Adolescent tobacco use: Is rural residency a risk factor? <i>Rural and Remote Health</i> . 8: 875. (Online), 2008 Available from: http://www.rrh.org.au Shah S, Lutfiyya MN, McCullough JE, Henley E, Zeitz HJ and Lipsky M. Who is Providing and Who is Getting Asthma Patient Education: An Analysis of 2001 National Ambulatory Medical Care Survey Data. <i>Health Education Research</i> . 2008;23:803-813.

(Continued)

Appendix 1. (Continued)

Meeting Type	Meeting Focus	Assigned Readings
Works-In-Progress	Study Types and Designs (Analytic (Explanatory) Study, Descriptive Study, Contemporary (Concurrent) Comparison, Historical (Non-concurrent) Comparison, Prospective Study, Retrospective Study)	Stephenson JM, Babiker A. Overview of study design in clinical epidemiology. <i>Sex Transm Inf</i> 2000;76:244–247. Kuper H, Gilbert C. Epidemiology for ophthalmologists: an introduction to concepts, study designs, and interpreting findings. <i>Br J Ophthalmol</i> 2005;89:378–384. Overview of Epidemiologic Study Designs—Chapter 6 in MacMahon B, Trichopoulos D. <i>Epidemiology Principles and Methods</i> . 2nd ed. Boston, MA: Little, Brown and Company; 1996.
	Problem Statement of Research Project Identification of a Research Problem—getting started on the literature review	Colling J. Demystifying nursing research: defining the problem to be studied. <i>Urol Nurs</i> . 2003;23:225-226. Zou KH, Fielding JR, Silverman SG, Tempany CMC. Hypothesis Testing I: Proportions. <i>Radiology</i> 2003; 226:609–613. Tello R, Crewson PE. Hypothesis Testing II: Means. <i>Radiology</i> 2003;227:1–4. Gliner JA, Leech NL, Morgan GA. Problems with null hypothesis significance testing: What do the textbooks say? <i>The Journal of Experimental Education</i> . 2002;71:83–92.
	Writing the methods section of a manuscript. Writing the results section of the research paper Writing the discussion section	Whitley E, Ball J. Statistics review 1: Presenting and summarizing data. <i>Critical Care</i> . 2002;6:66-71.
Statistical Analysis Workshop	Introduction to SPSS, Descriptive statistics, Using the computer for data management and analysis	
	Measures of Association; more on Statistical Significance	Understanding statistical terms: 2. DTB, <i>BMJ</i> . 2009;47:35-36. Sprent P. Statistics in medical research. <i>Swiss Med Weekly</i> . 2003;133:522-529.
	Correlation/ANOVA	Pgs. 153-164 Motulsky H. <i>Intuitive Biostatistics</i> . Oxford University Press. 1995. Pgs. 250-271 Motulsky H. <i>Intuitive Biostatistics</i> . Oxford University Press. 1995.
	Multiple Regression	Pgs. 165-179 Motulsky H. <i>Intuitive Biostatistics</i> . Oxford University Press. 1995.
	Logistic Regression	Chan YH. <i>Biostatistics 202: Logistic regression analysis</i> . Singapore Med J. 2004;45:149. Peng CJ, Lee KL, Ingersoll GM. <i>An Introduction to Logistic Regression Analysis and Reporting</i> . The Journal of Educational Research. 2002;96:3-14. Menard S. <i>Applied Logistic Regression Analysis</i> . Thousand Oaks, CA: Sage Publications, 2002.