

RESEARCH ARTICLES

A Summer Research Training Program to Foster PharmD Students' Interest in Research

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Objectives. To establish and assess the effectiveness of a 10-week summer research program on increasing doctor of pharmacy (PharmD) students' interest in research, particularly as it related to future career choices.

Design. Survey instruments were sent to 25 participants who had completed the research program in the summer of 2004, 2005, or 2006 to assess their satisfaction with the program and its influence on their career choices after graduation.

Assessment. Respondents reported a high degree of satisfaction with the program, indicating that the program allowed them to determine their suitability for a career in research, and 55% reported their intention to pursue additional research training.

Conclusion. A brief introduction to the clinical research environment helped pharmacy students understand the clinical sciences and careers in research. The introduction increased the likelihood of students pursuing a research career path after obtaining their PharmD degree.

Keywords: research, career, students

INTRODUCTION

Motivating pharmacy students to consider alternative career paths, particularly research, has proven challenging, due in part to the high salaries offered to clinical pharmacists immediately upon entering the workforce. The number of years the typical pharmacy student spends in college, and the increasing student loan burden associated with a professional education.¹⁻³ While many students may have an idea of the career path they wish to follow or the setting in which they plan to practice, early and advanced practice experiences and internships help refine career path decisions.

There is a general sense in pharmacy academia that, with the advent of the first-professional degree PharmD curriculum, fewer pharmacy students pursue a research career path.⁴ There are many possible explanations for this perception, including less direct interaction with faculty members, which has led to a poorer understanding of

faculty research activities, and fewer PharmD programs with research requirements. However, pharmacists who are well trained in clinical and translational research are essential to the profession and to the overall biomedical research enterprise. The National Institutes of Health (NIH) recently noted the critical value of PharmDs as clinical scientists who can utilize both their clinical training and extensive knowledge of drugs to address important clinical and translational research questions. As a result, the NIH has established a web site to provide guidance to PharmDs on how to develop a research career.⁵ Further, with the impending retirement in the next decade of the first generation of PharmDs, there is an urgent need in the academy for clinically trained scientists. The challenge for pharmacy faculty members is to identify and stimulate those students with the greatest potential for careers in research.

To graduate pharmacists who are equipped for careers in a diverse range of work environments, the University of Florida (UF) College of Pharmacy (COP) works in collaboration with other UF colleges to offer pharmacy students several options. Joint degrees that combine the PharmD with a doctor of philosophy (PhD), masters of business administration (MBA), masters of public health

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(MPH), or juris doctorate (JD) degree are available to students. The combined PharmD/PhD degree prepares interested individuals for research careers in the pharmaceutical sciences, creating highly qualified clinical scientists. When the current PharmD/PhD program was officially approved in 1991, the UF College of Pharmacy was one of only 3 pharmacy schools offering the joint degree. As of 2007, UF is one of 16 US colleges and schools of pharmacy that have a PharmD/PhD program.⁶ However, while the joint PharmD/PhD program has long been on the books, it has been minimally utilized.

In recognition of the critical value of exposing pharmacy students to a hands-on research experience early in their academic careers, the Department of Pharmacy Practice and Center for Pharmacogenomics initiated a formalized, competitive, 10-week summer research training program in 2004. Herein, we describe this summer research program, survey responses from summer students over 3 summers, and the success of the program in exposing selected students to a research career path.

METHODS

All research-focused faculty members in the Department of Pharmacy Practice participated in the 2004, 2005, and 2006 summer research program. Faculty members defined how many students they were willing to mentor (which determined the size of the admitted class), and they were responsible for developing the project with their students. The faculty members were not offered incentives for participation, other than the opportunity to stimulate an interest in research in an academically-strong student who might choose to undertake formal research training with them following graduation. The summer stipend was tied to the NIH Summer Student stipend, and in terms of hourly wage was comparable to a community pharmacy internship. During the summers of 2004-2006, approximately 50% of the students were supported by institutional National Institutes of Health (NIH) or American Heart Association (AHA) Summer Student research programs, approximately 25% were supported by the Center for Pharmacogenomics, and approximately 25% were supported by the faculty member in whose laboratory they worked. During the summer of 2007, the NIH and AHA summer programs were limited to medical students, so funding was provided by the Center for Pharmacogenomics, the Dean, and individual faculty members.

Application for the summer research training program started early in the spring semester, with acceptance into the program occurring in early March. The application made clear to students that they were expected to prepare a brief research proposal (with preceptor guid-

ance) to compete for funding through the local summer research programs supported by the NIH and the American Heart Association (AHA). It also made clear that students would be expected to work fulltime, complete a research project, and present their project to faculty members, post-doctoral fellows, graduate students, and other summer research students.

The application requested information on the current year in pharmacy school, undergraduate and pharmacy school grade point averages, prior degree(s), research preference, and an essay stating their interest in the program. Specifically, the essay requested information on their motivation for undertaking the summer research program, a description of prior research experience, and plans to pursue advanced training and future professional career goals. Students were provided a list of faculty members and the areas in which each faculty member worked, and were asked to rank in order of preference the faculty members with whom they would like to work. Each of these items aided in the initial evaluation of the students' preparation, potential, and aptitude for research, following which interviews were conducted. Students were typically paired with 1 of their first 2 choices for a faculty mentor.

The 10-week program required committing to full-time participation in a research project, attending laboratory events (eg, departmental seminars, journal clubs, and research meetings), leading a journal club discussion, and giving a final oral presentation on their research. Students were also strongly encouraged to present their data at the College's research day the following academic year, and when appropriate, to prepare an abstract for submission to a national meeting.

Following acceptance into the program, each student was assigned to a faculty mentor, and if he/she would be working in a laboratory with graduate students or post-doctoral fellows, the student was also assigned to work directly with one of those individuals. Students were expected to develop a research question with the help of their mentor, learn laboratory techniques, and subsequently apply the techniques learned to their project. The projects in which students were engaged were typically ones that involved analysis of existing data. As there is a strong research focus on pharmacogenetics in the department, many of the research projects centered around genetics and pharmacogenetics research questions, which were tested using existing genetic and clinical databases. Examples of the types of projects that were undertaken by the 25 students from 2004 to 2006 are shown in Table 1. While most students did not have major direct patient contact during this time, most students were provided the opportunity to shadow others in active patient-oriented

Table 1. Projects Completed by PharmD Students Enrolled in a Summer Research Program (N = 25)^a

Project Types	No. of Students/ Projects
Analytical projects (eg, LC/MS/MS assay development)	5
Biomarker-drug response associations	4
Analytical + metabolism or drug response relationship	3
Transporter-drug response	2
Pharmacogenetics associations	9
Disease genetics associations	9
Other ^b	3

^aTotal is greater than 25 as some student's projects encompass 2 categories

^bOther. These projects involved: (1) review of the package inserts of top 200 drugs for pharmacogenetic information; (2) evaluation of the relationship between ambulatory blood pressure profiles and prognosis in heart failure; (3) development of an anticoagulation clinic quality assurance database

research activities, and many got involved in recruiting and other related activities as a side-effort to their major project.

The primary goal of the summer research program was to excite motivated students about research, and to provide them the opportunity to assess whether a research career path was something they might wish to consider. During the program, informal discussion sessions were held with faculty members, followed by discussions with departmental graduate students and post-PharmD fellows. The purpose of these sessions was to address questions the summer students had about the research career path, discuss the pros and cons of a postdoctoral fellowship versus graduate training, and describe the steps students should take if they believed they might have an interest in pursuing the PhD following graduation.

To aid in evaluation of the program, assess needs for changes, and determine the program's influence on students' career choices, past participants in the program were asked to complete a 1-page survey instrument in early 2007. Previous laboratory experience and motivation for applying to the program were evaluated. Eleven questions were quantitative and the remaining questions required open-ended responses. Students were asked to specify whether a publication or presentation resulting from their research appeared in a peer-reviewed journal, at a national meeting, or at a UF-COP sponsored forum. These data were used to determine the frequency of publications and presentations. Students were also queried about their plans after completing their PharmD degree, including accepting a position as a pharmacist (retail or hospital), pursuing residency/clinical training, or further didactic training (PhD, graduate program, or post-PharmD fellowships), or accepting a position in industry or government. Finally, students were asked about the impact of the summer research program on career decisions. The significance of student responses related to

career path was evaluated using logistic regression or Wilcoxon rank sum test, as appropriate.

RESULTS

Between the spring of 2004 and spring of 2006, 34 PharmD students applied to the summer research program and 25 were accepted and completed the program. Forty-eight percent (12/25) had completed their first year of pharmacy school upon entry into the program, and the remaining 52% (13/25) had completed 2 years of pharmacy school. Students were not able to participate in the summer research program following the third year of pharmacy school because of clinical rotations that take place during that summer.

Twenty-two of the 25 pharmacy students completed the survey instrument in early 2007. Eighty-six percent of respondents were still completing their PharmD curriculum at the time of the survey. One second-professional year student, 3 third-professional year students, and 2 fourth-professional year students (6 of the 22 respondents) had committed to enter the UF Clinical Pharmaceutical Sciences PhD program. All 3 of the respondents who had graduated at the time of the survey were pursuing further research training, with 2 enrolled in a UF-COP PhD program.

Of responders, 12 were second-year students when participating in the program (55%). About half of respondents reported having prior laboratory experience (12 of 22; 55%). Respondents' motivations for applying to the program were classified into 1 of 3 categories: prior interest in research (45%), desire to investigate alternative career options (32%), and inclination for more experience in research (23%). Mean responses to the survey items ranged from 4.0 to 4.8 (Table 2). Mean response to the final question regarding the impact of the summer research program on career path was positive (4.6 out of 5).

Table 2. Responses to a Survey of Participants in a Research Program for First- and Second-Professional Year PharmD Students

Item	Response, ^a Mean (SD)
The summer research experience is something I would recommend to other classmates.	4.6 (0.7)
The pace and tone was acceptable to facilitate learning.	4.4 (0.7)
Scheduled activities (journal club, seminars, research meetings, etc) were enriching and relevant.	4.5 (0.7)
Hands-on learning added to the overall experience.	4.8 (0.5)
I had sufficient guidance and support.	4.2 (1.1)
The research I did was important to the lab.	4.0 (1.0)
The research experience met my expectations.	4.3 (0.9)
Compared to other summer opportunities for pharmacy students, I felt my time was well spent.	4.6 (0.7)
The experience helped me to grow as a future pharmacist.	4.4 (1.0)
The experience influenced my choice of clerkships.	4.3 (1.0)
The experience led me to think about alternate career paths in pharmacy.	4.6 (0.7)

^aResponses rated on a Likert scale of 1 to 5 on which 5 = strongly agree; 1 = strongly disagree

As a means of assessing the impact of the summer research program on the students' decisions to pursue further research training, 2 analyses were conducted using the median scores on items 1, 7 and 8, which quantified the students' overall experience in the program. When comparing the combined median scores, respondents who chose/were planning a research career path after receipt of the PharmD degree had a significantly higher combined median score than those who did not (15 vs. 12, respectively; $p = 0.032$). This is consistent with the result of another analysis (logistic regression), which showed that students with the sum of scores ≥ 14 were 7.5 times more likely to choose/consider a research career path than those with a sum ≤ 13.5 (odds ratio = 7.5; 95% confidence interval 1.17-69.2; $p = 0.046$). The cutoff value of ≥ 14 was chosen as this would represent respondents who picked agree (4) on no more than 1 question and 5 (strongly agree) on 2 or 3 questions.

Students' productivity and future plans were evaluated in a multiple-choice, multiple-answer format. Among the 22 responders, 16 (73%) had published or presented their work (Figure 1). Respondents who had published or presented their data tended toward higher median scores on the 3 questions than those who did not (15 vs. 12, respectively; $p = 0.057$). Nineteen (86%) students had entered or were planning to obtain further formal professional training after graduation, and 12 of the 19 students indicated plans for extensive additional training, (ie, residency followed by fellowship or graduate education). Among this latter group, 8 firmly committed to, or entered a clinical pharmaceutical sciences PhD program. The paths or future plans of summer research program participants are shown in Figure 2.

Responses to open-ended questions included many positive comments about development of laboratory, analytical, and presentation skills. Many also found the ex-

perience helped them correlate clinical pharmaceutical research to patient and pharmacotherapy decisions. Students reported the experience to be valuable, instilling confidence and self-knowledge. Some students indicated that upon entering pharmacy school, they had considered pursuing a PhD, but did not feel they had enough information to make this decision. Many indicated the summer research experience solidified their desire to pursue this path. A few also indicated that while they found the experience valuable, it confirmed that research was not the appropriate career path for them to pursue.

Interestingly, there were somewhat different responses from students who completed the program following their first versus second year of pharmacy school. First-year students seemed to be more likely to express feeling less prepared for an analytical research environment. These students noted some apprehension and anxiety at the start of the program. In contrast the second-year students often indicated that they wished they had pursued the program during the summer following their first year. Finally, the open-ended questions revealed that many students desired even more structure to the

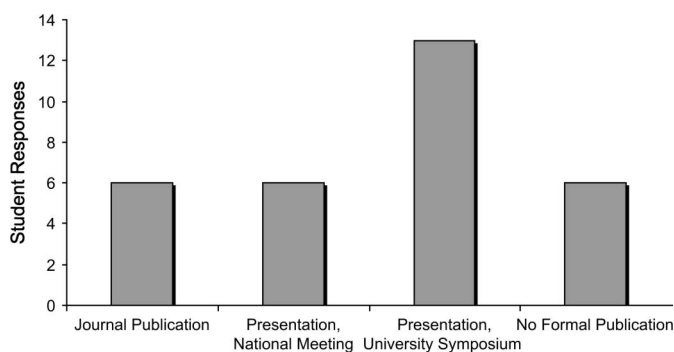


Figure 1. Student presentations and publications resulting from Summer Research Training Program. Students could answer affirmatively to any or all choices.

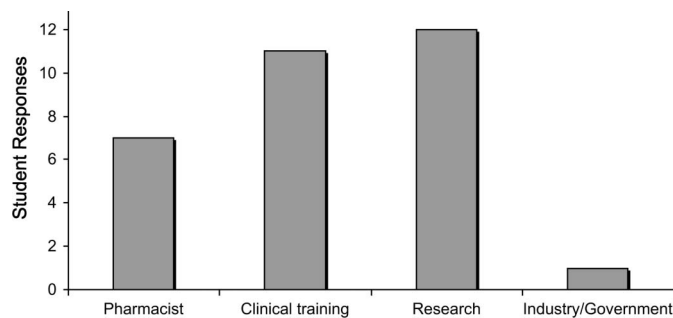


Figure 2. Post-PharmD plans of previous Summer Research Training Program students. Students were allowed to indicate multiple answers (eg, clinical training followed by research training).

program, including formal lectures on a number of topics, such as basic laboratory issues, pharmacogenetics, study design, and statistical analysis.

DISCUSSION

The primary goal of the summer research training program is to provide PharmD students with the opportunity to gain experience in clinical and translational research through an in-depth, hands-on training program. Through this program, it is hoped that students will identify an affinity for research and will consider research as a career path. Survey data from participants of the first 3 years of the program indicate that students found the program expanded their understanding of clinical research and gave them important insights into alternative career paths. Students found the summer program to be academically enriching and generally exceeded their expectations. Students with the highest levels of satisfaction were twice as likely to consider a career in research. Productivity, publication, and presentation of data trended toward higher scores for the questions about the overall experience in the program and a greater likelihood for pursuing advanced research training.

The students who applied to and were selected for this program already had an interest in research and were seeking first-hand research experience. While some had previous research experience, it was uncommon for the students to have previous experience in clinical and translational research. This summer research experience resulted in 55% of participants determining that they would pursue additional research training. Compared to historical norms, this is a substantial increase in the number of students pursuing this path. Conversely, some students learned that they were not suited for careers in research, allowing them to focus their attention elsewhere. Second-year students saw more relevance and application to research than first-year students, which was to

be expected in students with greater knowledge in the areas of pharmacology, pathophysiology, and pharmacokinetics. For the summer of 2007, a total of 20 applications were received from which 9 students were selected for the program. Based on the feedback that the experience was more valuable to students when completed in the summer following their second year of pharmacy school, we began preferentially admitting second-year students. Eight of the 9 students for the summer of 2007 were second year pharmacy students. Additionally, based on students' comments suggesting the potential value of greater structure and more didactic lecture, these elements were incorporated into the summer 2007 program.

Offering clinical research training to undergraduate students may be highly valuable in terms of producing research publications and enhancing the critical thinking and problem-solving skills in medical students.⁷ Numerous successful models demonstrate that undergraduate research opportunities stimulate curiosity in class material and science, as reported in schools of medicine.^{8,9} The UF-COP summer research program adopted this concept and recruited interested pharmacy students, providing both exposure to research and experiences on which to base future career path decisions. On average, the program has stimulated 4 students per class to pursue research training post-PharmD. This is a substantial increase over the classes graduating in the first few years after full implementation of the entry-level only PharmD program (2001-2005), which had no more than 1 student per class pursuing research training.

CONCLUSION

A formalized, 10-week summer research program for first- and second-professional year PharmD students was enthusiastically embraced by University of Florida students and led to a substantial increase in the number of graduates annually pursuing additional research training, primarily through a Clinical Pharmaceutical Sciences PhD program. It is essential for pharmacy academia that those with a professional background in pharmacy become engaged in the research enterprise. These data suggest that for students with an interest in research, a formal, intensive research program in which students have a specific project and work closely with faculty and other research trainees substantially increases the likelihood that they will pursue further research training following completion of their PharmD degree.

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