

ACCP COMMENTARY

Recommended Education for Pharmacists as Competitive Clinical Scientists

American College of Clinical Pharmacy

Key Words: clinical pharmacy, research funding, research training, pharmacist-researchers, clinical pharmaceutical scientist.

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RRH: EDUCATION FOR PHARMACISTS AS CLINICAL SCIENTISTS *ACCP*

This commentary was prepared by the 2007 ACCP Research Affairs Committee: Thomas C. Dowling, Pharm.D., Ph.D., Chair; Paul Beringer, Pharm.D.; Jill S. Chappell, Pharm.D.; Kristine R. Crews, Pharm.D., BCPS; Ronald P. Evens, Pharm.D., FCCP; Jodi L. Grabinski, Pharm.D., M.S., BCOP; James S. Kalus, Pharm.D., BCPS; Richard D. Leff, Pharm.D., FCCP; Joanna Louie, Pharm.D.; John E. Murphy, Pharm.D., FCCP, FCP; Nancy T. Nkansah, Pharm.D., BCPS; Chris R. Rathbun, Pharm.D.; and Nathan P. Wiederhold, Pharm.D. Approved by the ACCP Board of Regents on February 11, 2008.

Address reprint requests to the American College of Clinical Pharmacy, 13000 West 87th Street Parkway, Lenexa, KS 66215; e-mail: accp@accp.com; or download from <http://www.accp.com>.

The American College of Clinical Pharmacy (ACCP) Research Affairs Committee was specifically charged with providing recommendations to the Board of Regents regarding the optimal pathway or pathways for preparing doctor of pharmacy (Pharm.D.) graduates to be innovative clinical and translational scientists who are able to successfully compete for funding at the national level, and with suggesting ways in which ACCP could promote and facilitate the education and career development of these individuals. This commentary addresses ACCP's strategic initiative that aims to develop competitively funded clinical scientists and make available the resources and programs necessary to enhance the research and scholarly capabilities of these scientists.¹

The demand for clinical scientists is becoming increasingly apparent, in part because of the changing dynamics in federal funding for clinical and translational research. The National Institutes of Health (NIH) roadmap outlines a series of priorities that must be addressed to optimize its research

mission, which is to efficiently transform basic research discoveries into drugs, treatments, or methods for the prevention of disease.² Some key initiatives of the roadmap that will likely involve clinical pharmaceutical scientists include “development of research teams for the future” and “re-engineering [of] the clinical research enterprise.” For example, new research partnerships are to be developed with organized patient communities, community-based health care providers, and academic researchers.

Clinical research involves studies of human subjects, including surveys, cross-sectional studies, case series, case-control studies, cohort studies, first-in-human studies, proof-of-principle projects, and all phases of clinical trials. *Translational research* has recently been described as two distinct processes: first, the application of discoveries generated from laboratory and preclinical studies to the development of clinical trials, and second, the adoption of best health care practices by the entire medical community. In more specific terms, the first process in translational research (bench to bedside or laboratory to human) includes laboratory-based research aimed at clarifying mechanisms of disease; developing measures or markers of disease presence, severity, or improvement; and developing drugs or devices to treat disease or improve health. The second process in translational research (bedside to the community or evidence to practice) includes conducting studies that identify community, patient, physician, and organizational factors that serve as barriers and facilitators to translations; developing novel interventions and implementation strategies to increase translation, such as quality improvement programs or policies; and evaluating the impact of strategies to increase the translation of relevant health behaviors and processes of care.³

For the pharmacy profession to take best advantage of these new opportunities and ensure its place at the research funding table, optimal approaches must be identified and implemented quickly to prepare the next generation of clinical pharmaceutical scientists to be highly successful in competing for research funding in the future. The shortage of clinical pharmaceutical scientists has been discussed for some time in the profession,⁴ and optimal education and training approaches for developing these scientists are currently being considered by the American Association of Colleges of Pharmacy (AACP) and the ACCP, respectively. Issues related to training and opportunities for pharmacy researchers were also addressed at the December 2006 NIH Conference on Pharm.D. Pathways for Research.⁵

It is obvious that many of today’s successful clinical pharmaceutical scientists gained success after several years of on-the-job training. This often occurred because of fortunate juxtapositions with clinical scientist mentors in pharmacy and other health professions. Although this type of development will continue, it is not the optimal method for developing a significant number of

successful clinical scientists for the future. In this report, recommendations are provided for the optimal education and training of Pharm.D. graduates to become competitive clinical pharmaceutical scientists, and suggestions are made with regard to ways that ACCP can promote, facilitate, and contribute to the expansion of the clinical sciences workforce.

Current Supply and Demand for Clinical Scientists

The demand and opportunities for clinical pharmaceutical scientists to meet the growing societal need for discoveries in clinical and translational research, and to play leading roles in NIH roadmap initiatives such as the Clinical and Translational Science Awards (CTSAs), have never been greater. Despite the apparent need, many challenges face the current clinical scientist workforce in academia and industry, including the limited availability of training and graduate programs, lack of mentorship, and lack of funding for trainees.

In 2006, Elias A. Zerhouni, M.D., Director of the NIH, addressed the need for reengineering the clinical research enterprise and stated that there was a “fundamental roadblock ... identified as the loss of attention, the loss of energy, and the potential loss of a full generation of clinical scientists in clinical research.” He proposed that “instead of having all these fragmented resources ..., why don’t we stimulate change toward more of an academic focus for clinical scientists, something that will define a career path that is just as defined as a joint appointment in molecular biology and medicine....” Reinforcing the need for substantive training programs, he stated, “Translational and clinical science is not something that you can learn on the job the way we did 30–35 years ago.”⁶ To further emphasize this need, Dr. Zerhouni stated in 2007 that “speeding translation requires a steady pipeline of clinical and translational researchers.”⁷

Recently, the National Academy of Sciences (NAS) emphasized the need to address the increasing demand for a competent clinical research workforce. In the detailed plan proposed by one of the NAS committees, the following conclusion was made:

The increasing diversity and age of the U.S. population present new challenges for the U.S. clinical research community, whose role is to develop healthcare therapies and paradigms from the knowledge gained in basic research. A particularly acute challenge is the need to replenish and diversify the workforce, especially physician-scientists and nurses, whose small numbers are insufficient to meet the increasing need for clinical research.⁸

Supply and Demand in the Pharmacy Academy and Pharmaceutical Industry

The demand for clinical pharmaceutical scientists in academia is evident.⁹ The dramatic increase in the number of colleges and schools of pharmacy and the rapid increase in the sizes of

student bodies within previously existing colleges and schools have contributed to a shortage of qualified faculty, especially faculty with clinical research experience.¹⁰ This is a critical issue for the academy. A recent review of job advertisements reported in the *AACP News* covering April 2006 to April 2007 identified at least 17 position listings for clinical scientists from 15 different colleges or schools of pharmacy.

According to an informal survey conducted within the ACCP Pharmaceutical Industry Practice and Research Network (PRN), the need for clinical pharmaceutical scientists is widespread within the industry. With increased federal regulation, pressures to optimize time and costs for producing and evaluating clinical research data, and the evolution of many biotechnology companies from research to development phases, there is a strong demand for clinical scientists who can successfully work in the clinical and translational phases of the drug development process. Indeed, the Department of Labor predicts that 26.1% more workers in pharmaceutical and medicine manufacturing will be needed by the end of the 10-year period from 2004–2014. The projected change for medical scientists within industry (41.8% more workers) is even more dramatic.¹¹ Thus, pharmacy-trained clinical scientists have the potential to fill an important need within the industry.

Opportunities and Challenges for Clinical Scientists

Although all faculty members in colleges and schools of pharmacy are expected to “show evidence of scholarship and publication,”¹² the amount of time devoted to scholarship and the emphasis on scholarship varies widely among colleges and schools as well as within and between the departments of a given school (e.g., clinical nontenure-track compared with tenure-track clinical scientists). The degree of research education and training needed to be successful in academia also varies depending on the type of faculty position and the culture of scholarship within the institution.¹³ This section focuses on the education and training necessary to develop a competitively funded clinical pharmaceutical scientist faculty.

Academic programs focusing on the clinical and translational sciences face many challenges related to the development and implementation of research. Most tenure-track clinical and translational research faculty appointments associated with research-intensive academic institutions require the rapid development (3–5 yrs) of an independent research program. However, junior investigators require mentoring, time, and financial support to develop programs that are then able to support their research endeavors. This process can last for several years before the investigators are adequately prepared to themselves become mentors. Without an adequate research focus and prior research experience, junior faculty members are often not able to meet the challenges associated with obtaining independent extramural peer-reviewed funding during this relatively short-tenure

probationary period. Although the provision of start-up funds provides an initial sense of support and security, a significant amount of preliminary data are needed to apply for federal grants to support research staff, graduate students, postdoctoral fellows, and technicians, as well as to pay patients or volunteers for participation in clinical trials. Thus, a firm commitment from the academic institution and an understanding of these challenges are needed for the growth of clinical scientists and their training programs in academic settings. Mentoring of junior faculty and graduate students by senior clinical scientists with a track record of significant external funding (preferably federal and foundation), including grantsmanship and effective development of collaborations, is critical to support clinical scientists and develop clinical sciences training programs.

Academic clinical scientists who are expected to develop independent, externally funded research programs with a focused research portfolio will be increasingly required to develop research collaborations with basic and clinical colleagues integrated into CTSA structures.¹⁴ All of this must be accomplished during the relatively short timeline of the tenure probationary period.

A unique set of challenges exists for clinical scientists within the pharmaceutical industry. They are increasingly required to understand drug development processes, good clinical practices, federal regulations and guidelines, and clinical research protocol development, implementation, and monitoring. In this case, research is usually conducted with use of internal funding sources, with fewer requirements for preparation of competitive grant applications. However, extensive training and experience in writing protocols, including background, rationale, and methods sections, are required as part of any investigational new drug application that will be reviewed by the United States Food and Drug Administration. This process can be likened to the grant writing and peer-review processes that take place in the academic setting. Pharmacists have a strong technical background in areas such as dosage form technology, medicinal chemistry, pharmacology, and therapeutics that are critical to the drug development and commercialization process and are thus good candidates for clinical scientist positions in the pharmaceutical industry.

In the areas of discovery and translational research, clinical pharmaceutical scientists can provide input into preclinical studies that assess new technologies and methods applicable to pharmacogenomics and design approaches to develop clinically useful biomarkers. They may also oversee and plan clinical development strategies; design studies; write research protocols; oversee study implementation; analyze data, author reports, and publications; and review the scientific content of informational materials distributed outside the company. Individuals with specialized training in pharmacokinetics and drug metabolism are typically required to design and analyze data obtained from phase I clinical pharmacology studies. Other types of clinical scientists focus on the safety and efficacy components of phases II and III studies that support regulatory approval, or they oversee

phase IV postmarketing research that addresses critical questions regarding novel combinations and optimal treatment strategies.

Research Education Opportunities for Competitive Clinical Scientists

Post-Pharm.D. Fellowships

Completion of a fellowship has been a widely accepted method for training Pharm.D. clinical scientists for several decades.¹⁵ The first clinical research fellowships were developed in the early 1970s, and in 1978, funding for pharmacy fellowship programs became available from the American Society of Health-System Pharmacists Research and Education Foundation.^{15, 16} The ACCP has provided funding for various fellowships for many years, and it conducts peer reviews of fellowship programs to help ensure quality across programs for those who might be considering a fellowship as a way to develop their research skills.

The state of fellowship training in pharmacy has not been adequately explored since 1995 (report published in 1998).¹⁵ To glean useful information about fellowships, the Research Affairs Committee conducted an informal review in January 2007 of each of the 85 fellowship programs listed in the ACCP Directory of Residencies and Fellowships.¹⁷ Important characteristics of the programs, divided by primary focus, are presented in Table 1. Outcomes and pharmacoconomics (17%), infectious diseases (14%), and cardiology (12%) were the most common types of fellowships. The length of the fellowship programs ranged from 1–3 years, with 2 years being the most common. Most fellowship programs were based in academic settings, and 14% reported the involvement of a pharmaceutical industry partner. Less than half of the programs offered the opportunity for fellows to take formal graduate coursework, though this varied by primary focus of the fellowship. For example, coursework was offered in 70% of cardiology and 85% of infectious diseases programs. Courses commonly offered included biostatistics, research design, pharmacokinetics, and microbiology. Six programs (7.1%) offered a master's degree in conjunction with the fellowship, and three (3.5%) offered fellows the opportunity to participate in an NIH K30 curriculum (usually a certificate program designed to create clinical researchers through coursework and mentoring). Most programs (68%) **(AU: Is this percentage intended to be an average of the percentages in Table 1? If so, should this be “72%”?)** appeared to be focused on clinical research; the rest indicated emphasis on translational research. Most programs emphasized study design, ethical conduct of research, data analysis, data collection, and dissemination of research results as part of the fellowship. Nearly half (44%) **(AU: If based on Table 1 data, should this be “41%”?)** offered opportunities to gain teaching experience. Only 9% exposed the fellow to animal research. Some programs required the fellow to

complete at least one project from beginning to end, whereas others involved the fellow in multiple continuing projects.

These findings confirm earlier assertions that fellowship training varies dramatically from program to program¹⁵: the major sources of variability were the availability of coursework or advanced degrees, the fellowship setting, and the number of studies to which a fellow would be exposed. Lack of uniformity among fellowship programs was recognized early on in the evolution of fellowships. This led to the creation of a consortium of national pharmacy organizations that ultimately defined the major differences between residency and fellowship training in 1986. This group defined a fellowship as “a directed, highly individualized, postgraduate program designed to prepare the participant to become an independent researcher.”¹⁸ Despite the establishment of this definition more than 20 years ago and the availability of a formal peer-review process for fellowships within the past decade, considerable variability in the structure of fellowship programs is still evident.

Because the stated purpose of fellowship programs is to develop “independent researchers,” which, by implication, means those with the highest likelihood of success for funding, and because the state of fellowship training varies considerably, ACCP believes that pharmacy fellowship programs should move toward becoming degree-granting programs.

Federal- and Foundation-Funded Research Training Programs

The NIH funds a variety of research training programs. These consist of awards to individuals for research and study (e.g., K12, K23), as well as administrative funding for the development of curricula for training clinical scientists (i.e., K30 Clinical Research Curriculum Awards). In addition, some training grants (T32) can be administered by an institution to provide funding for pre- and postdoctoral research training. The newly developed NIH Web site titled “Pharm.D. Gateway to NIH” (http://www.nigms.nih.gov/training/pharmd_gateway.htm) is an excellent resource for finding the opportunities available.

The NIH is transforming its funding approaches focused on CTSA (NIH U54) and its roadmap. The CTSA specifically strongly encourage developing new, or expanding existing, clinical and translational science education programs (master of science [M.S.] and doctor of philosophy [Ph.D.]). Programs submitting a grant application without an educational program in place will not be considered for funding. Many of the current K30 programs developed master’s degree options in clinical research as part of their offerings to student scholars. Unfortunately, there is still far more need for the development of clinical pharmaceutical scientists than can be met by the available programs, and pharmacists have not participated in existing programs in large numbers. The U54 CTSA programs will likely be an avenue for pharmacists to participate in clinical and translational

research and to develop new pharmacist–clinical scientists. Although training programs generated from these grants are not the only way to develop research skills, pharmacists who desire a career as a clinical scientist should be prepared to participate in these programs wherever possible. To help its members take advantage, ACCP could track the funding of CTSA grants and make its members aware of the opportunities associated with these programs for both research and research training and education. One approach might be the creation of a specific section on its Web site related to federal and foundation research funding and research training fund opportunities with links to important research Web sites.

Many foundations also support clinical research training. Several of the professional pharmacy organizations have these types of foundations and institutes, such as the American Association of Pharmaceutical Scientists and the American Foundation for Pharmaceutical Education, as well as the pharmaceutical industry's Pharmaceutical Research and Manufacturers of America Foundation, which includes a predoctoral fellowship program for graduate students enrolled in Ph.D. programs. Pharmacy clinical scientists need to be aware of these opportunities.

Graduate Degree Programs

Graduate programs in clinical pharmaceutical sciences were introduced more than 20 years ago to provide opportunities for pharmacy clinicians to work with basic and clinical scientists in an active and collaborative environment. Many schools and colleges of pharmacy and medicine are well equipped to conduct clinical and translational research, with access to academic health centers and CTSA core resources such as Clinical Research Centers (formerly known as General Clinical Research Centers), genomics laboratories, and biostatistical support. These schools and colleges are ideally suited to develop research and graduate degree programs focusing on clinical and translational sciences. Such training programs aim to integrate science and the direct application of science to address important problems related to pharmacotherapy. This is best accomplished in a collaborative research environment, with the necessary research facilities to foster the development of highly competent, independent clinical scientists.¹⁹

Traditional graduate programs in the pharmaceutical sciences have focused on basic science research or health service administration. Some of these programs provide an opportunity for professional students to enroll in combined Pharm.D.–Ph.D. or Pharm.D.–M.S. programs that may or may not include clinical research requirements.²⁰ However, during the past 20 years, an increasing number of clinical sciences Ph.D. programs have been designed as post-Pharm.D. experiences that focus on clinical research and require dissertation study in an area of clinical research as defined by the NIH (Table 2). These programs have typically been smaller than, or incorporated into, traditional

graduate programs. Most programs consist of two to six clinical sciences faculty mentors and enroll one to three new students per year. It is estimated that 80 students are currently enrolled in these programs; 50 students have graduated during the past 5 years, with about 50% pursuing faculty or postdoctoral positions. Students enrolled in these Ph.D. programs have often had years of clinical or pharmaceutical care experience, including residencies or fellowships, enabling them to make significant contributions and to derive new knowledge in clinically relevant research areas.

Incorporation of advanced clinical training, either as a prerequisite (e.g., residency) or an in-program requirement, is a distinguishing feature of many clinical sciences graduate programs. Incorporation of required clinical pharmacy experience (up to 20 hrs/wk) at an academic health center was recently proposed.²¹ Such approaches may also serve as a mechanism of support to supplement or replace stipends for clinical pharmaceutical sciences graduate students. Didactic coursework requirements vary from program to program but typically involve 2 years of study in areas such as biostatistics, drug development, clinical trials design, research ethics, pharmacokinetics or drug metabolism, analytic methods development, and pharmacogenomics. Some programs also offer coursework in grant writing, which should become a requirement for all programs that aim to create graduates capable of developing well-funded research programs. Hypothesis-driven dissertation research projects are integrated with coursework and are designed with increasing intensity, focus, and commitment during subsequent years of the graduate program.

Advantages of these graduate training programs include the requirement of a dissertation that demonstrates a research focus, hypothesis testing, development of a research portfolio, experience with statistical analyses, manuscript preparation, study design, and familiarity with institutional review boards and other regulatory processes. Without this depth of training, the likelihood of becoming a competitively funded clinical scientist in the future will be increasingly remote. Unfortunately, there is an increasingly evident shortage of clinical scientists, and fewer colleges and schools are committed to increasing the number of clinical scientist graduates, despite their own vested interest in graduating these individuals.

Master's degree programs in clinical sciences may be an alternative to Ph.D. degree programs for some individuals. Graduates of master's degree programs that focus on grantsmanship would, however, likely have a greater potential for competitive funding success.

The ACCP believes that an advanced degree program, preferably a Ph.D., with residency training or equivalent clinical experience, is the optimal avenue for developing pharmacists as competitive clinical and translational scientists. The ACCP further believes that the clinical skills gained during a residency (or its equivalent) are important to the full development of clinical scientists. The residency could be accomplished before the program, or it could be a component of graduate

education. The ACCP should work with its academic members, AACP, and other interested partners to encourage the development of Ph.D. programs in clinical sciences at the colleges and schools of pharmacy with the clinical and translational research infrastructure and faculty capable of providing high-quality programs. These programs should have strong educational grounding in the development of grants targeted at federal and foundation funding; whenever possible, these programs should incorporate faculty from schools of medicine and the institutional CTSA infrastructure associated with the academic health care setting.

Role of ACCP in Supporting Clinical Scientist Training

The ACCP and other health professional organizations have recognized the importance of generating evidence-based information that is of value to society. As such, vital support to promote the development of clinical research activities has been provided in several important ways. For example, funding has been provided for specific research projects that may yield important preliminary data or address important areas of clinical and translational research that may not be funded by traditional mechanisms (e.g., some types of outcomes research). Research funding has also been provided for seed projects, which then allows researchers to be more competitive for governmental and foundation grants. During the past 20 years, the ACCP Research Institute has provided 199 competitive research awards to 166 investigators. To date, 44 (27%) have subsequently received K or R awards from the NIH. Given that the average age of a principal investigator at the time of his or her first R01 award is about 45 years, it is reasonable to predict a 10–15-year lag time between receipt of an ACCP Research Award and subsequent R01 funding.

Funding from professional organizations can also help researchers qualify for the NIH loan repayment program, which requires a candidate to commit 2 years to 50% research that has been funded by a nonprofit agency. This program repays up to \$35,000/year of qualified educational debt, pays an additional 39% of the repayments to cover federal taxes, and may reimburse state taxes that result from these payments. This can be an important incentive for pharmacy students facing a large debt on graduation. Organizations can also support the development of clinical scientists through funding for thesis and dissertation research.

The ACCP and its PRNs currently provide travel stipends to professional students attending the ACCP annual meeting. This type of support would also benefit graduate students who are required to present the results of their research projects at national meetings. Here, students and fellows have the opportunity to learn about the research of others and to meet and network with their peers as well as leaders in their areas of research. This represents an opportunity for ACCP to build its membership in an area critical to the organization. With the development of new, and the

expansion of current, graduate programs in clinical sciences, additional funding opportunities could be helpful to ACCP pharmacist members wanting to enroll in Ph.D. programs and for research funding directed specifically toward dissertation research in clinical sciences.

The ACCP currently provides a Web site called StuNet (<http://www.accp.com/stunet/index.aspx>) for students earning their first professional degree. It might be beneficial to create a similar site and provide incentives for membership to students in graduate degree programs in clinical sciences.

Most clinical pharmacists have embraced the concept of evidence-based medicine. However, as was suggested in a 1986 report, most do not actively participate in the generation of clinical research that guides drug therapy.²² The author of that report thought that this was not necessarily an issue of disinterest, but that it more commonly tended to be a result of the dearth of resources dedicated to fostering a culture that promotes clinical research activities. It certainly could also have been because of a lack of research training for most clinicians. Although there has been improvement since 1986, the climate for promoting clinical research is not that dramatically different in colleges and schools of pharmacy today. This may be due, in part, to the need to develop productive collaborations with physician investigators, especially for prospective clinical trials that are typically greater than minimal risk and that require nursing staff and clinical research space. The ACCP has taken a vital stance on this issue by including in its Research Agenda several clauses directly addressing the necessity of pharmacy-trained clinical scientists.¹ The agenda calls for pharmacists to serve as principal investigators for pharmacotherapy research, generate a substantial portion of the research that guides drug therapy, and become competitive for research funding. Providing research training and information resources could bolster the careers of ACCP members interested in clinical sciences, help strengthen ACCP as an organization, and promote the profession of pharmacy as a whole.

Summary

The development of competitively funded pharmacist–clinical scientists is crucial to meet the growing needs of the profession and society. The ACCP has an opportunity to play a leadership role in demonstrating the importance of clinical research and in supporting the development of pharmacists who are clinical scientists. The recommendations previously noted are summarized as follows:

- The recommended education pathway for research that funds competitive clinical and translational scientists is an advanced degree program, preferably a Ph.D., with residency training or equivalent clinical experience accomplished before or during the program. This

recommendation is consistent with that proposed by the AACP Task Force on Clinical Scientist Training.²³

- The ACCP should promote the transition of pharmacy fellowships to degree-granting programs.
- The ACCP should develop initiatives to support existing clinical scientist training programs, including graduate student research and travel awards.
- The ACCP should specifically promote advanced education and training in clinical and translational sciences and provide members with information on available programs and funding opportunities in a section on the Web site devoted to clinical and translational science education and training.

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Table 1. Summary of the 85 Fellowship Programs Listed in the ACCP Directory of Residencies and Fellowships

Characteristic	Type of Program						
	Cardiology	Critical Care	Drug Development	Infectious Diseases	Outcomes and Pharmacoeconomics	Pharmacokinetics	Other ^a
Duration (yrs)	2.0 ± 0.0	2.0 ± 0.0	2.0 ± 0.6	2.2 ± 0.4	2.1 ± 0.3	2.0 ± 0	1.96 ± 0.6
Proportion of programs	10 (12)	5 (6)	7 (8)	12 (14)	14 (17)	5 (6)	32 (37)
	Percentage of Type of Program						
Offer coursework	70	40	14.3	84.6	30.8	27.3	35.5
Clinical focus	50	80	100	61.5	100	60	54.8
Translational focus	50	20	0	38.5	0	40	41.9
Teaching offered	60	80	28.6	53.9	15.4	0	51.6
Postgraduate training of director							
Fellowship/residency/neither	90/10/0	66/33/0	0/50/50	58/17/25	60/20/20	33/33/33	48/29/25
Director with Ph.D.	10	0	0	7.7	8.3	20	9.7

^aAmbulatory care, geriatrics, oncology, pharmacogenomics, nephrology, neurology, drug information, clinical informatics, pain management, pediatrics, pharmacotherapy, pharmacy practice, women's health, transplantation, psychiatry, and translational research.

(AU: Please verify cut-in headings and no. of programs added for the % given. Is your meaning retained?)

Table 2. List of Pharmacy Schools Offering Postgraduate Ph.D. Degrees in Clinical Sciences

Institution	Program Listing
University of Florida	Clinical Pharmaceutical Sciences Track
University of Georgia	Clinical and Experimental Therapeutics Program
University of Iowa	Clinical Pharmaceutical Sciences Program
University of Kentucky	Clinical Pharmaceutical Sciences Track
University of Maryland	Clinical Pharmaceutical Sciences Track
University of Minnesota	Experimental and Clinical Pharmacology Track
University of North Carolina	Experimental Therapeutics Program
University of Pittsburgh	Clinical Pharmaceutical Sciences Track
University of Texas at Austin	Clinical Sciences Research Program
Virginia Commonwealth University	Pharmacotherapy Research Track