

## Pharmacy Fellowships: Challenges and Opportunities for Pharm D. Graduates

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### Abstract

**Introduction:** Pharmacy fellowships are post-doctoral training programs intended to prepare pharmacy graduates for careers in research or the pharmaceutical industry. There are currently 131 pharmacy fellowship programs in the United States, but standardization, interest among students, and overall research regarding these fellowships are ambiguous at best. This literature review was conducted to describe common facilitators, challenges, contents and outcomes of fellowships, and to evaluate the group of programs as a whole.

**Methods:** To do this, articles were identified using PubMed and a Google search engine, and were reviewed in context with the study goals. The primary search term used was "pharmacy fellowship(s)."

**Results:** Key findings included articles describing the current state of pharmacy fellowships, the need for standardization, and how to pursue a pharmacy fellowship. A total of twelve articles were selected due to their relevance to the scope of this article.

**Conclusion:** The current state of fellowships, their subgroups, efforts to develop and organize the group of programs, and possible careers following training are discussed. Benefits and limitations of the current fellowship system are summarized based on the current and relevant literature. Furthermore, this literature review is intended to serve as an accumulation of the current data on pharmacy fellowships to guide students interested in applying for a fellowship program

**Keywords:** Pharmacy fellowships; Clinical pharmacy; Global health

### Introduction

Saturation of the job market in the field of pharmacy has led more and more students to seek out post-doctoral training including residencies and pharmacy fellowships in hopes of maintaining a competitive edge [1]. ASHP defines pharmacy fellowship as "a directed, highly individualized, postgraduate program designed to prepare the participant to become an independent researcher" with the ultimate goal of preparing the fellow for both independent and collaborative scientific research [2]. Despite these programs leading to non-traditional opportunities and career paths within the field of pharmacy, a study conducted by Sweet and others found only 4% of respondents applied for a fellowship, and what's more, only half of those were accepted into a fellowship program. Furthermore, a number of respondents pursuing post-doctoral training expressed desire for more information on pharmacy fellowships throughout the course of their Pharm.D education [1]. To address students' interest, this study aims to explore pharmacy fellowships as a path of post-doctoral training available to Pharm.D. graduates, strengths and limitations of the pharmacy fellowship system in the United States, and job outlook for fellowship graduates.

### Methods

A search of PubMed and Google was conducted from March to April 2016 using the key terms "pharmacy fellowship(s)". Results were sorted by most recent and relevance and articles were selected based on the relevance to pharmacy fellowships and post-doctoral training.

### Review of Literature

#### Current state of fellowships

A pharmacy fellowship is defined as "a directed, highly individualized post-graduate program designed to prepare the participant to become an independent researcher" [3]. Currently, pharmacy fellowships can be offered through schools or colleges of pharmacy, healthcare institutions, or pharmaceutical companies. Programs are generally one year but can extend to two years [2]. Pharmacy fellowships are aimed at developing fellows to go into a wide variety of branches including independent research, the pharmaceutical industry, and academia. During a pharmacy fellowship program, up to 80% or more of a fellow's time may be spent engaging in research activities, with the remaining time often being devoted to formal education [3].

In 2009, the American College of Clinical Pharmacy (ACCP) released a commentary stating that in order to appropriately train pharmacists to become clinical or translational scientists, a Ph.D.

degree was recommended, as opposed to fellowship training. As expected, this recommendation caused quite a bit of debate within ACCP and within the profession. A study by McCarthy notes that the job opportunities and career pathways available to graduating pharmacists have changed greatly over the years, and this could potentially be due to a slight surplus of graduating pharmacists in recent years. Therefore, in 2013, ACCP reviewed this recommendation and reconsidered their stance [4].

Most recently, ACCP noted that the National Institute of Health (NIH) has recently put more emphasis on clinical and translational research, specifically relating to drug therapy and disease management. They continue to say that pharmacists are “uniquely positioned” to engage in both bench and clinical research [4]. However, ACCP now asks whether or not “the profession can generate enough appropriately trained pharmacists to take advantage of these opportunities” [4]. Larochelle [3] conducted a search to identify current pharmacy

fellowship programs using a combination of ACPE-accredited colleges and schools of pharmacy, ACCP, and a Google search engine. From their search, 131 programs were identified. Compare this to approximately 1,600 PGY1 residency positions available, and it becomes clear that there is an insufficient number of pharmacy fellowship programs available in the United States [4].

In a large study by Burgunda, in a group of 783 graduating pharmacy students, only thirty graduates (4%) pursued fellowships. Additionally, of these thirty students, only fifteen of them (50%) were successfully placed. Several students in the study noted the need for more information on fellowships. These statistics demonstrate not only the need for the development of more pharmacy fellowship programs, but also the need for more student education about fellowship programs and the potential job opportunities prior to application. (Table 1 and 2).

Sponsoring College	Sponsoring Organization	Focus	Length of Program
Creighton University	Creighton University Medical Center	Drug Information Research	2 years
Duquense University		Clinical Research Fellowship	1-2 years
		Pediatrics	2 years
East Tennessee State University		Community Pharmacy	2-3 years
Howard University		Oncology	2 years
Massachusetts College of Pharmacy and Health Sciences-	Brigham and Women's Hospital	Outcomes Research	2 years
Massachusetts College of Pharmacy and Health Sciences-Worcester	Charles River Labs	Pharmaceutical Sciences	2 years
	Saint Vincent Hospital	Medication Safety	2 years
Midwestern University	Northwestern Memorial Hospital	Infectious Diseases	2 years
Northeastern University	Tufts-NEMC	Critical Care	2 years
Ohio State University		Pediatrics	2 years
Oregon State University/		Academic Research	2 years
Purdue University		Global Health	1 year
		Academic and Ambulatory Care	1 year
Thomas Jefferson University		Health Policy and population health, health services research, outcomes research	2 years
Touro University (CA)		Other	1-2 years
University of Arkansas for Medical Sciences College of Pharmacy		NA	NA
University of Buffalo	Novartis	Drug Development	2-3 years
The State University of New York	Clinical Pharmacokinetics Lab (CPL)	Protein Therapeutics	2 years
	State University of New York Upstate Medical University		
	Pfizer or Novartis	Drug Development	2 years

University of California- Los Angeles	Terasaki Foundation	Transplantation	1 year	
University of Cincinnati		Transplantation	1 year	
University of Colorado	Kaiser Permanente- Colorado	Outcomes Research	2 years	
University of Connecticut	Hartford Hospital	Outcomes Research	2 years	
University of Florida		Family Medicine	2 years	
University of Houston College of Pharmacy	St. Luke's Episcopal Hospital	Infectious Diseases	2 years	
University of Illinois at Chicago	UIC Center for Pharmaco-economic Research	Infectious Diseases	2 years	
		Outcomes Research	2 years	
		Transplantation	2 years	
University of Iowa		Ambulatory Care	2 years	
		Translational Research	2 years	
University of Kentucky		Infectious Diseases	2 years	
University of Maryland	Maryland Poison Center	Toxicology	2 years	
		Health Outcomes	1-2 years	
University of Michigan		Nephrology	2 years	
		Translational Research	2 years	
University of Minnesota		NA	NA	
University of Missouri Kansas City		Regulatory Pharmaceuticals	2 years	
University of Nebraska	Nebraska Medical Center	Critical Care	2 years	
		Pharmacoeconomics and Outcomes Research	2 years	
University of New Mexico	New Mexico Poison and Drug Information Center		NA	
	University of New Mexico Health Sciences Center	Cardiovascular Pharmacotherapy	2 years	
University of North Carolina Chapel Hill		Academic Research	2 years	
		Drug Development	2 years	
		Infectious Diseases	2 years	
		Pharmacokinetics	2 years	
		Regulatory Affairs	2 years	
		Carolinas Poison Center	Toxicology	2 years
		Nanotechnology	2-3 years	
		Community Pharmacy Academia	2 years	
		Educational Research	1 year	
		Neocritical Care Pharmacotherapy	2 years	
Clinical Pharmacology	2 years			

		Heart Failure Pharmacotherapy	2 years
		HIV Pharmacotherapy	2-3 years
		Oncology	2-3 years
University of Pittsburgh		Geriatric Pharmacotherapy	2 years
		Community Care	Not specified
		Outcomes Research, Pharmacoeconomics	2 years
University of Rhode Island	Providence Veterans Affairs Medical Center	Infectious Diseases	2 years
		Infectious Diseases	2 years
University of the Science in Philadelphia		Clinical Research	1 year
	Janssen Scientific Affairs	Medical Information and Clinical Practice	2 years
	McNeil Consumer Healthcare	Medical Information and Regulatory Affairs	2 years
University of South Carolina	Palmetto Health Richland	Infectious Diseases	1 year
University of South Florida College of Pharmacy	My Matrixx	Managed Care Pharmacy	1 year
Univeristy of Southern California		Pharmaceutical economics and outcomes research	2 years
University of Tennessee, Memphis			NA
University of Texas at Austin	Scott and White Health Plan	Managed Care Pharmacy	2 years
University of Utah		Outcomes Research and Pharmacoeconomics	2 years
		Toxicology	2 years
University of Washington	Allergan	Outcome Research	2 years
	Bayer	Policy	2 years
Virginia Commonwealth University		Other	1 year
Wayne State University		Infectious Diseases	2 years
Western University of Health Sciences		Cardiology	2 years
		Outcomes Research	2 years
		Translational Research	2 years
		Transplantation	2 years
[o] No Academic Partner	Achaogen Inc.	Drug Development	2 years
	Alnylam Pharmaceuticals	Drug Development	2 years
	Cetero Research		
	Charleston Area Medical Center Health Education	Drug Development	2 years
	National Institutes of Health	Pharmacokinetics	2 years
	St. Jude's Research Hospital	Clinical Pharmacy	Not specified
	University Health System Consortium		

	UT M.D. Anderson Center	Oncology	2 years
	VA Medical Center New York		
	Veterans Affairs Cooperative Studies Program	Clinical Trials	Not Specified

**Table 1:** Traditional Pharmacy Fellowships (Non-Industry).

Sponsoring College	Sponsoring Organization	Focus	Length of Program	
University of the Science in Philadelphia	Janssen Scientific Affairs	Medical Information and Clinical Practice	2 years	
	McNeil Consumer Healthcare	Medical Information and Regulatory Affairs	2 years	
	Alexion	Global Medical Information	2 years	
	Becton Dickinson	Global Medical Affairs	2 years	
		Health Economics and Outcomes Research	2 years	
	Biogen	Regulatory Affairs	2 years	
		Safety and Benefit Risk Management	2 years	
	Genzyme	US Payer Access (MS)	2 years	
		Clinical Documentation	2 years	
		Global Commercial Strategy	2 years	
		Global Pharmacovigilance and Epidemiology	2 years	
		Medical Affairs	2 years	
		Regulatory Affairs	2 years	
		Norvatis	Early Clinical Development	2 years
		Pfizer	Clinical Research Pharmacy	2 years
			Clinical Supply Chain Strategy and Management	2 years
		Quality Assurance	2 years	
	Sunovion	Medical Information	2 years	
Massachusetts College of Pharmacy and Health Sciences	Takeda Pharmaceuticals	Global Medical Information	1 year	
	Takeda Pharmaceuticals	Global Pharmacovigilance	2 years	
Northeastern University Bouve College of Health Sciences	Alnylam	Medical Affairs	2 years	
Purdue	Eli Lilly	Regulatory, Drug Information	2 years	
	Johnson and Johnson	Regulatory, Advertising and Promotion	2 years	
	Hook Drug Foundation	Community Practice Research	2 years	
	Eli Lilly	Medication Safety	2 years	
	Takeda Pharmaceuticals	Global Regulatory Affairs	2 years	
Rutgers	Acorda	Clinical Development and Medical Affairs	2 years	
		Regulatory Affairs	2 years	

	Actelion	Global Clinical Science and Epidemiology	2 years
	AstraZeneca	US Medical Affairs- Therapeutic Area Concentration	2 years
		US Medical Affairs- Medical Operations/Patient Safety	2 years
		Global Regulatory Affairs- Oncology	2 years
		Global Patient Safety- Oncology	2 years
	Bayer Healthcare Consumer Care	Global Pharmacovigilance and Product Quality and Safety	2 years
		Global Medical Affairs and Medical Development	2 years
		Global Product Development and Innovation	2 years
		Innovation and Research and Development Category Leadership	2 years
		Rx-to-OTC Swtich	2 years
		US Regulatory Affairs	2 years
	Bayer Healthcare Pharmaceuticals	Business development and liensing	2 years
		Clinical Operations	2 years
		Corporate and Government Customers (US Managed Markets)	2 years
		Early Pipeline Strategic Marketing	2 years
		Global Market Access/Health Economics Outcomes Research	2 years
		Global Regulatory Affairs	2 years
		Medical Communications	2 years
		Global Medical Affairs- Oncology	2 years
	Bristol-Myers Squibb	Regulatory Affairs	1 year
		Advertising and Promotion	1 year
		Immunoscience: Medical Information/Medical Science Liaison	2 years
		Virology Medical: Medical Inofrmation/Medical Strategy	2 years
		Cardiovascular Medical: Medical Strategy/Medical Science Liaison	2 years
		Oncology Medical: Medical Information/Clinical Trial Investigations/ Medical Sciencei Liaison	2 years
		Worldwide and US Medical Strategy: Immuno-Oncology	2 years
		Oncology Medical: Worldwide Medical Content/ US Medical Strategy	2 years
		US Medical Knowledge Management	2 years
		Health Economics and Outcomes Research	2 years
		Cardiovascular Medical: Medical Information/Worldwide Medical Content	2 years
		Policy and Advocacy	2 years
		Strategic Analytics and Business Intelligence	2 years
	Catalent	Applied Drug Delivery	2 years
	Celgene Corporation	Global Scientific Communications	1 year
		Global Medical Information	1 year

		Global Clinical Research and Development	2 years
		Global Regulatory Affairs	2 years
		US Economics and Outcomes Research	2 years
		US Medical Affairs	2 years
		Global Market Insights	2 years
	Daiichi-Sankyo	Medical Affairs	2 years
		Marketing Sciences	2 years
	Genentech Inc.	Clinical Operations	2 years
		Clinical Science- Late Stage Development	2 years
		Medical Affairs/Medical Science Liaison	1 year
		Regulatory Affairs	2 years
		US Medical Affairs	2 years
	Johnson and Johnson	Global Scientific Engagement	2 years
		Promotional Compliance	2 years
	Novartis	Clinical Pharmacology	2 years
		Clinical Research and Development	2 years
		Drug Regulatory Affairs	2 years
		Scientific Communications/Medical Information	2 years
		Commercial Strategy/Brand Marketing	2 years
	Pfizer Consumer Health	Clinical Research and Development	2 years
		Global Medical Affairs	2 years
		Global Regulatory Affairs	2 years
	Pfizer Inc.	Global Medical Information/Global Medical Affairs	2 years
		Medical Affairs: Global Established Pharma	1 year
		Medical Affairs: Oncology	1 year
	Roche	Clinical Science Translational Medicine	2 years
	Sanofi Aventis	Clinical Documentation	2 years
		Global Pharmacovigilance and Epidemiology	2 years
		Global Regulatory Affairs	2 years
		Health Outcomes Research and Communications	2 years
		Pharmacy Account Team/Channel Development	2 years
		Strategic Marketing	2 years
		US/Global Cardiovascular Medical Affairs	2 years
		US/Global Patient Advocacy and Public Affairs	2 years
		US Medical Information Services	1 year
	Sunovion	Regulatory Affairs	2 years

	TEVA Pharmaceuticals	Regulatory Affairs: Global Branded and Generic Products	2 years
St. John's University	Allergan Inc.	Global Regulatory Strategy	2 years
		Clinical Development	2 years
		Regulatory Affairs: Advertising and Labeling	2 years
	American Regent	Medical Affairs and Pharmaceutical Marketing	2 years
		Clinical Research and Development	2 years
	Daiichi Sankyo	Clinical Development Oncology	2 years
		Clinical Safety	2 years
University of Illinois in Chicago	TAP Pharmaceuticals		
University of North Carolina at Chapel Hill	PPD	Clinical Research and Drug Development	2 years
	United Therapeutics	Clinical Research and Drug Development	2 years
	UCB- Neurology	Clinical Research and Drug Development	2 years
	GlaxoSmithKline	Medical Affairs	2 years
	United Therapeutics	Medical Affairs	2 years
	Quintiles	Pharmacokinetics/Pharmacodynamics/Pharmacometrics	2 years
	Nuventra	Pharmacokinetics/Pharmacodynamics/Pharmacometrics	2 years
	GlaxoSmithKline	Global Regulatory Affairs	2 years
	GlaxoSmithKline	Pharmaceutical Outcomes Research	2 years
University of Southern California	Allergan Inc.	Clinical Development	
		Drug Delivery Sciences	
		Global Pharmaceutical Science	
		Infectious Diseases Pharmacology	
		Medical Affairs	
		Pharmaceutical Development	
		Pharmacokinetics and Pharmacodynamics	
University of Texas at Austin	Novartis	Pharmacoeconomics & Outcomes Research / Market Access (Oncology)	2 years
[o] No Academic Partner	Centocor Inc.		
	Eisai Inc.		
	Eli Lilly		
	PPD (Contract research organization)		
	Procter and Ganble		
	Roche Laboratories Inc.		
	Upsher-Smith Laboratories		

**Table 2:** Industry Fellowships.



## Sub groups of fellowships

One challenge for professional pharmacy students is the discord between fellowship programs and their categorization. A disconnect between labels for fellowships, expectations among students of fellowship focus, and a blending of the use of the terms “residency” and “fellowship” have potentially caused difficulty in finding and applying for fellowships [2]. These misunderstandings of program offerings and content are a potential source of difficulty in the application process for students.

In order to remedy this difficulty, various authors have suggested methods for standardizing fellowships. For example, Larochelle [3] suggested separation of fellowship types into two categories, which they termed “traditional fellowships” and “industrial fellowships.” In this categorization scheme, traditional fellowships were those in which the ultimate goal was development of the fellow as an independent researcher and future primary investigator. These programs are traditionally highly individualized and their focus is determined by the fellow and preceptors involved. In contrast, industrial fellowships maintain a component of individually driven research, but are focused on development of a catered set of skills and experience for a focused field of pharmacy such as pharmacovigilance, regulatory affairs, or drug safety. Mueller [5] described an alternative method of fellowship categorization with four major categories: clinical practice combined clinical research and practice, industry, and combined research and graduate education. Additionally, the authors call for a greater degree of standardization among fellowships in order to guarantee similar experiences to ease entry and application by the student to fellowship programs.

While these recommendations for categorizing fellowships are not comprehensive, they do highlight the difficulties that students can face in applying and researching large numbers of varied fellowship programs, and they make recommendations for the potential standardization of fellowships into subtypes in order to ease differentiation of available programs.

## ACCP optional accreditation, what is assessed

Pharmacy fellowship programs have the option to be reviewed and recognized by ACCP as a program that meets their guidelines for research and fellowship training programs. This is an optional peer review process conducted by ACCP’s Research Fellowship Program Review Committee (RFPRC). This committee reviews four areas of a fellowship program including: training program requirements, preceptor qualifications, fellowship applicant criteria, and fellowship experiences. The purpose of reviewing these areas is to ensure programs meet the minimum requirements set forth while still allowing for an individualized training program [5].

The guidelines for the fellowship training program are very broad. The training program requirements stipulate that a program should be at least two years, of which 3,000 hours should be devoted to research. Additional requirements include availability of advanced educational opportunities, appropriate facilities, qualified instructors, institutional support, and access to literature and facilities. Additionally, preceptors are evaluated and should be exemplary and qualified members in their field as evidenced by past, present, and ongoing research. Requirements for applicants include masters or doctoral degrees, clinical experience preferred, and interest in the field of research. Lastly, there are requirements of the fellowship experience including

completion of one research project along with experience with various areas of the research method [5].

As previously mentioned, Larochelle reported 131 fellowship programs in the United States, and as of 2009, only 11 programs were found to have undergone the ACCP review process [3]. This ACCP review process represents an underused resource available to standardize and guide fellowship programs.

## Job outlook/career path

Although there has been a shift in fellowship opportunities as a whole and a lack of standardization of programs, career opportunities following graduation from a fellowship program still highly correlate with the focus of respective fellowships. Traditionally, pharmacy fellowship graduates would most likely transition into faculty positions at schools of pharmacy, as the majority of fellowships were research based [6]. This path continues to be an opportunity for students, especially because positions in academia for clinical researchers are expected to increase [4].

However, the majority of fellowship graduates now fill positions in pharmaceutical companies or regulatory agencies, as there has been a growth of industry based fellowships [7]. Within these organizations, a pharmacist’s role is distinct but generally involves research, communications, or regulatory aspects of workflow. Clinical development research is a mainstay for fellowship trained pharmacists, where an employee typically manages clinical trials, organizes protocols, and creates reports of the trials. Opportunities within economic and outcomes research also exist, and could be growing [7]. Communications itself is a broad area as a career path, as pharmacists now serve as medical science liaisons, who disseminate clinical information to entities outside of the company, and as part of medical affairs and information teams, who develop content and programs for these entities. Many fellowship graduates also work in marketing, developing effective and appropriate advertising strategies. In regulatory affairs, many pharmacists develop strategies to effectively communicate with regulatory agencies and ensure compliance with policies, or are part of the regulatory agencies and communicate with the pharmaceutical company [8].

The major organizations that provide these opportunities commonly collaborate with schools of pharmacy to create fellowships designed specifically to train pharmacists for the respective careers. Predictably, retention within a company and department after graduation from a fellowship is high (56.2% and 74.6% respectively) shown by a survey held by Melillo [7]. Consequently, a pharmacy fellowship provides the greatest opportunity to obtain an industry position post-graduation.

## How to pursue

For students pursuing a pharmacy fellowship in the United States, there are few reliable or comprehensive resources available. However, one of the most helpful resources is the Industry Pharmacists Organization [9], which provides information for students interested in pursuing a pharmacy fellowship. Students can become a member for free, which allows them access to exclusive resources. Some of the highlights of the IPHO website include webinars for students that provide information about opportunities for pharmacists in the pharmaceutical industry. IPHO also has a pharmacy fellowship catalog and a guide to fellowships at the American Society of Health-System Pharmacists (ASHP) Midyear Clinical Meeting, which help candidates

decide on the exact fellowship programs he or she wants to pursue. Additionally, IPhO provides a feature called FellowMatch, allowing candidates to see which positions are open at different institutions [9] The candidate is able to upload any supplemental materials and apply to multiple industry fellowship programs through this service. While other organizations such as ACCP and American Pharmacists Association (APhA) reference pharmacy fellowships as a potential course for study on their websites, IPhO by far has the most abundant resources for students interested in pursuing fellowships. Nevertheless, not all resources are free to students on IPhO's website, and should not be used as a sole resource for fellowship program education.

## Conclusion

Pharmacy fellowships provide Pharm.D. graduates with unique opportunities to engage in clinical and translational research and prepare fellows to become individual researchers. They have been shown to reliably lead to careers focusing on research or industry, including roles in medical communications and regulatory affairs, but there are many barriers preventing students from pursuing programs. Currently, there are not enough programs to take advantage of these unique opportunities, and in many cases there is not enough education provided to student pharmacists throughout the Pharm.D. curriculum to foster interest. Additionally, the lack of clarity in categorization of fellowships presents a difficulty for students and professionals trying to understand their role in pharmacy, prompting recommendations to ease the application process and increase differentiation among the various opportunities that pharmacy fellowships provide. ACCP does offer a peer review service for fellowship programs to help standardize fellowships, although the program is currently highly underutilized. Nevertheless, there are organizations such as IPhO that serve as a resource for students. Continued study and collaboration can help

organize and standardize fellowship programs to increase their visibility as an opportunity for students and develop to ensure the training provided prepares students for careers they were designed for.

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