

SPECIAL ARTICLES

Pharmacy Education in India

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Pharmacy education in India traditionally has been industry and product oriented. In contrast to the situation in developed nations, graduate pharmacists prefer placements in the pharmaceutical industry. To practice as a pharmacist in India, one needs at least a diploma in pharmacy, which is awarded after only 2 years and 3 months of pharmacy studies. These diploma-trained pharmacists are the mainstay of pharmacy practice. The pharmacy practice curriculum has not received much attention. In India, there has been a surge in the number of institutions offering pharmacy degrees at various levels and a practice-based doctor of pharmacy (PharmD) degree program was started in some private institutions in 2008. However, relatively little information has been published describing the current status of complex pharmacy education of India. In this paper we describe pharmacy education in India and highlight major issues in pharmacy practice including deficiencies in curriculum. The changing face of the profession is discussed, including the establishment of the PharmD program. The information presented in this paper may stimulate discussion and critical analysis and planning, and will be of value in further adaptation of the pharmacy education to desired educational outcomes.

Keywords: pharmacy education, pharmacy practice, India

INTRODUCTION

India, a developing nation that occupies the greater part of South Asia, is a sovereign, secular republic consisting of 28 states and 7 union territories.¹ With a population of approximately 1.2 billion,² India is the second most populous country on the planet. In India, formal pharmacy education leading to a degree began with the introduction of a 3-year bachelor of pharmacy (BPharm) at Banaras Hindu University in 1937. At that time, the curriculum was presented as a combination of pharmaceutical chemistry, analytical chemistry, and pharmacy, which prepared graduates to work as specialists in quality control and standardization of drugs for pharmaceutical companies,³ but not for pharmacy practice. Before India gained independence in 1947, there were 3 institutions offering pharmacy degree programs.⁴ In 1944, the Punjab University started a pharmacy department; in 1947 L.M. College was established in Ahmedabad (Table 1).

At independence in 1947, India inherited a system for the pharmacy profession from the British rulers that was unorganized and there was no legal restriction on the practice of pharmacy. The concept of pharmacy practice was not realized until after independence was gained. In 1948, the Pharmacy Act⁵ was enacted as the nation's first minimum standard of educational qualification for pharmacy practice

to regulate the practice, education, and profession of pharmacy. Currently, one needs at least a diploma in pharmacy to practice as a pharmacist. Provisions of the Act are implemented through the Pharmacy Council of India (PCI).⁶ The Act requires individual states to establish state pharmacy councils that are responsible for controlling and registering pharmacists in their respective states. Throughout this paper the word "institution" has been used to describe both colleges/schools and universities. English is the only language of instruction for all pharmacy institutions.

EDUCATIONAL PROGRAMS

A variety of pharmacy degree programs are offered in India: diploma in pharmacy (DPharm), bachelor of pharmacy (BPharm), master of pharmacy (MPharm), master of science in pharmacy [MS(Pharm)] and master of technology in pharmacy [MTech (Pharm)], doctor of pharmacy (PharmD), and doctor of philosophy in pharmacy (PhD). The entry point, for DPharm, BPharm, and PharmD programs is 12 years of formal education in the sciences. The DPharm program requires a minimum of 2 years of didactic coursework followed by 500 hours of required practical training anticipated to be completed within 3 months in either a hospital or community setting. The BPharm involves 4 years of study in colleges affiliated with universities or in a university department. Students holding a BPharm degree can earn an MPharm degree in 2 years, of which the second year is devoted to research leading to a dissertation in

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Table 1. First 10 Pharmacy Colleges/Universities Offering Degree Programs in India

Year of Inception	Colleges/Universities	Category	Current Degrees Offered
1937	Department of Pharmaceutical Engineering, Institute of Technology, Banaras Hindu University, Varanasi	Central University	BPharm, MPharm, PhD
1944	University Institute of Pharmaceutical Sciences, Panjab University, Chandigarh	State University	BPharm, MPharm, PhD
1947	L. M. College of Pharmacy, Ahmedabad	Private College	BPharm, MPharm, PhD
1950	Department of Pharmacy, Madras Medical College, Chennai	Medical College	BPharm, MPharm
1950	Birla Institute of Science and Technology, Pilani	Private University	BPharm, MPharm, PhD
1951	College of Pharmaceutical Sciences, Andhra University, Visakhapatnam	State University	BPharm, MPharm, PhD
1952	Department of Pharmaceutical Sciences, Dr. H.S. Gour University, Sagaur	Central University	BPharm, MPharm, PhD
1956	Department of Pharmaceutical Sciences, Nagpur University, Nagpur	State University	BPharm, MPharm, PhD
1958	Pharmaceutical Department, University Institute of Chemical Technology, Mumbai University, Mumbai	State University	BPharmSci, MPharmSci, PhD (Tech)
1963	Department of Pharmaceutical Technology, Jadavpur University, Kolkata	State University	BPharm, MPharm, PhD

Universities under Government: (1) A Central University is formed by the Government of India, by an Act of Parliament. (2) State University is established by an Act of State Legislature.

A Private University is a privately-funded university under section 3 of University Grants Commission (UGC) Act of 1956.

any pharmaceutical discipline, for instance pharmaceuticals, pharmacology, pharmaceutical chemistry, or pharmacognosy. Recently, MPharm programs on industrial pharmacy, quality assurance, and pharmaceutical biotechnology have been introduced. To train the graduate pharmacist to provide clinical-oriented services, the MPharm program in pharmacy practice was introduced at Jagadguru Sri Shivaratreeswara (JSS) College of pharmacy at Mysore in 1996 and at Ooty in 1997.⁷ There are 6 National Institutes of Pharmaceutical Education and Research (NIPERs) in India offering MS (Pharm), MTech (Pharm), and higher-level degrees. The NIPERs were created with the vision of providing excellence in pharmacy and pharmacy-related education. Students with an MPharm degree in any discipline can work toward a PhD with an additional minimum 3 years of study and research. The PharmD program constitutes 6 years of full-time study. The PharmD (post-baccalaureate) program is a 3-year program. The PharmD program was introduced in 2008 with the aim of producing pharmacists who had undergone extensive training in practice sites and could provide pharmaceutical care to patients.

Growth of Pharmacy Education

Prior to mid 1980s, the growth of publicly funded institutions of higher education (including pharmacy institu-

tions) was very slow.⁸ Until early 1980s, there were 11 universities and 26 colleges offering pharmacy education at the bachelor's and master's levels.³ In addition, there was at least 1 government school in every Indian state offering the DPharm program. Since the late 1980s, due to rapid industrialization in the pharmaceutical sector, privatization, and economic growth, pharmacy education has been developing faster in India than anywhere in the world. In 2007, there were 854 institutions that admitted more than 52,000 students to the BPharm degree program and 583 institutions that trained more than 34,000 students in the DPharm degree program.⁹ Most of the institutions, however, are privately funded colleges or privately funded universities. The private sector, which accounted for about 10% of the students admitted in the 1980s, now accounts for 91% of all pharmacy students admitted.¹⁰

While there are a large number of DPharm and BPharm graduates each year, the number of students that has graduated in any state varies widely. A large number of privately funded institutions are located in states like Tamilnadu, Karnataka, Andhra Pradesh, Maharashtra, and Gujrat.¹¹ In Tamilnadu, around 45 colleges and universities educate approximately 2,960 DPharm and 2590 BPharm graduates per year (within a total state population of about 64 million).

Admission Criteria

Entry qualifications for pharmacy programs vary across and within states, and most significantly, between private and public institutions. Entry requirements also vary depending on the degree program. The majority of privately funded institutions do not have a direct formal application processes. There is no centralized data repository to indicate the number of applicants to private and public institutions in India.

DPharm Program. In India, higher secondary study is concluded by a terminal examination, the higher secondary examination, at the end of 12 years. Admission to the first year DPharm program in any government college is based on performance on the higher secondary examination. However, private colleges have their own admission procedures that comply with the education regulations of the PCI. Students generally may choose to undertake the DPharm program as their second or third choice, having been unable to obtain a place at the college in another degree program that was their first choice. The DPharm curriculum is framed through the education regulations of the Pharmacy Act. The present education regulations framed way back in 1991 (ER91). The curriculum is the same throughout the country. In the 1990s, the efforts of the pharmacy council of India for upgrading the minimum qualification for registration from DPharm to BPharm failed due to lack of consensus.¹²

BPharm Program. Admission to the first-year BPharm program is made directly from higher secondary school on the basis of marks obtained in the higher secondary examination or on the basis of a merit list rank prepared based on scores on an entrance examination administered by a state or individual institution. Administering an entrance examination as an admissions requirement is used mainly by public institutions. For example, admission to the first-year BPharm of Banaras Hindu University (BHU) is made through the joint entrance examination (JEE) conducted by Indian Institutions of Technology (IITs), a group of 13 autonomous engineering and technology-oriented public institutes of higher education established and declared as institutes of national importance by the government of India. The selected students opt for more rewarding bachelor of technology (BTech) programs; therefore, most of the 40 seats open in the BPharm program at BHU remain vacant. The practice regarding preparing a merit list of applicants also differs. Some states and institutions place emphasis on entrance examination scores and use this as the only criterion in the selection process. A few private universities and at least 1 Indian state (Tamilnadu) have abandoned entrance examinations and use grades scored in the higher secondary examination instead. Many government institutions adopt a middle ground and use a combination of grades and entrance examination scores in their selection

process. The merit list rank preparation or the entrance examination conduction for admission to the first-year BPharm and bachelor of engineering programs is undertaken jointly in all states except Tamilnadu and Karnataka, where it is combined with the medical degree programs. In general, applicants who rank lower on the list enter a BPharm program. In 2008, more than 35,000 students completed an entrance examination in West Bengal, a northeastern Indian state. The 25,000 students who ranked highest on the list chose to enter engineering programs, while students below this rank selected BPharm programs in private institutions.¹³ There were reports in 2008 that institutions were having difficulty attracting suitable candidates to fill openings in their pharmacy programs.

MPharm Program. The criterion for entry to an MPharm program is academic performance in the BPharm or an entrance test or both. Currently, there is more demand for the MPharm program than the availability of places in the country. An important criterion, a high Graduate Aptitude Test for Engineering (GATE) score, qualifies a student to receive government scholarship during the period of their MPharm study. This criterion is optional for admission to the first-year MPharm program. However, many public institutions require both past academic performance and GATE score for application to the MPharm program.

PharmD Program. Admission to a PharmD degree program is on the basis of successful completion of the higher secondary examination or the DPharm program. Passing the higher secondary examination with physics, chemistry, and biology or mathematics entitles a student to enter the PharmD program. BPharm degree holders can join the PharmD program in the fourth year.

REGULATIONS AND QUALITY ISSUES

Pharmacy education in India is regulated by 2 organizations: the Pharmacy Council of India (PCI),⁶ under the Pharmacy Act of 1948, and the All India Council for Technical Education (AICTE),¹⁴ which was established under the AICTE Act of 1987. As mentioned previously, the PCI makes regulations regarding the minimum standard of education required for qualification as a pharmacist. It is responsible for registration of persons fulfilling the prescribed eligibility criteria (minimum DPharm) and issuing a license permitting them to practice in an Indian state. Registration activity is decentralized and the state pharmacy councils are responsible for registering pharmacists in their respective states. Thus, the PCI regulates the DPharm program and the recently introduced PharmD program. The BPharm program needs to be recognized by the PCI for the qualifications to be accepted for registration purpose only. The PCI has no jurisdiction over MPharm and other higher-level degree programs.

Pharmacy education at all levels excluding the PharmD is regulated by the AICTE and all these programs must be approved by it. The AICTE is primarily responsible for planning, formulating, and maintaining norms and standards in technical education, which include pharmacy. Besides the Pharmacy Act, pharmacy practice is also governed by the Drugs and Cosmetics Act of 1940,¹⁵ which stipulates the manufacture, distribution, and sale of drugs. Currently, there are no regulatory body and regulatory control for clinical pharmacy practice.

The AICTE is also responsible for quality assurance of pharmacy programs (DPharm, BPharm and MPharm) through accreditation by National Board of Accreditation (NBA) constituted by the AICTE. However, only 8% of pharmacy programs have been accredited.⁹ Accreditation is voluntary and also a stringent process; thus, few institutions have applied for accreditation on their own. The voluntary accreditation seems to serve little purpose for any of its stakeholders. Unlike other countries, the current regulations do not require any continuing education to maintain licensure once they are conferred. In addition, registered pharmacists do not have any established norms on competencies or standards of services. There is no categorization of practicing and non-practicing pharmacists.

CURRICULUM

Table 2 lists the DPharm curriculum that was revised in 1991 and is the same across all colleges.⁶ Curriculum change can be undertaken by central government notification through an amendment of the Pharmacy Act. The basic pharmacy courses of the program consist of mostly old and outdated concepts with many unnecessary topics that are of little practical value. The Pharmaceutics I practical subject is devoted to preparations of aromatic waters, iodine and other simple solutions, tinctures, extracts, and spirits among others. The Pharmaceutics II practical devotes 100 hours to learning at least 100 prescription products and their compounding and dispensing methods, and covers mixture, divided powders, liniments, and various incompatibilities in prescription products. All of these topics are of little relevance in an era where manufactured ready-to-dispense medicines are widely used and accepted.

The orientation of the pharmacist has changed from the product to the patient. The expansion of the role of pharmacists received an important boost in 1990, when Helper and Strand¹⁶ coined the term *pharmaceutical care*. Pharmaceutical care is the responsible provision of drug therapy for the purpose of achieving definite outcomes that improve the patient's quality of life. Approximately 30,000 students receive DPharm degree each year and enter the profession without being taught pharmaceutical care concepts and many other areas of contemporary pharmacy.

Table 2. Outline of DPharm Degree Curriculum in India

Course Title	Hours of Study	
	Theory	Laboratory
Year 1 (Part I)		
Pharmaceutics –I	75	100
Pharmaceutical Chemistry –I	75	75
Pharmacognosy	75	75
Biochemistry and Clinical Pathology	50	75
Human Anatomy and Physiology	75	50
Health Education & Community Pharmacy	50	-
Year 2 (Part II)		
Pharmaceutics –II	75	100
Pharmaceutical Chemistry –II	100	75
Pharmacology and Toxicology	75	50
Pharmaceutical Jurisprudence	50	-
Drug Store and Business Management	75	-
Hospital and Clinical Pharmacy	75	100
Part III (3 months)		
Practical Training	500 in either in a hospital or community pharmacy	

Note: Syllabus framed in 1991

There is no standardized BPharm curriculum and it varies across the universities that offer this degree. It is industry and product oriented. The vast majority of pharmacy colleges offering education are away from practice sites and there is no compulsory training in a practice site. Unlike other countries, the curricular revision and innovation in India have not received adequate attention. The BPharm program of most of the Indian universities includes a mix of basic science (such as mathematics, physical chemistry, inorganic chemistry, and organic chemistry), advanced chemistry and analysis (such as biochemistry, medicinal chemistry, and analytical chemistry) and basic pharmacy (such as pharmaceutics, pharmacology, pharmacognosy, and pharmacy law). A detailed description of one university's (Dr. M.G.R. Medical University) BPharm degree curriculum is presented in Table 3.¹⁷ The curriculum has 18 laboratory components (82% of theory course work). In addition, it devotes around 40% for chemistry and analysis-related subjects. The curriculum does not include coursework in the behavioral and social sciences, and health care policy.

The MPharm degree program requires an additional 2 years of study after a BPharm degree (a total of 6 years of pharmacy study). The MPharm degree is offered in many disciplines such as pharmaceutics, and pharmacology. The curriculum is divided into 2 parts. The first part consists of 1 year of didactic course work (both theory and laboratory) and the second part involves completing a research project

Table 3. Overview of BPharm Degree Curriculum of Dr. M.G.R. Medical University, Chennai

Year	Subjects
1	Pharmaceutical Inorganic Chemistry; Pharmaceutical Organic Chemistry; Anatomy, Physiology and Health Education; Biochemistry
2	Physical Pharmaceutics; Advanced Pharmaceutical Organic Chemistry; Pharmaceutical Analysis and Physical Chemistry; Pharmaceutical Technology; Pharmacy Practice and Pathophysiology; Biostatistic and Computer Applications
3	Pharmacognosy and Phytochemistry; Medicinal Chemistry I; Pharmaceutical DF and Cosmetic Technology; Pharmacology I; Forensic Pharmacy and Business Management
4	Pharmaceutical Biotechnology; Formulative Pharmacy and Biopharmaceutics; Advanced Pharmacognosy; Pharmacology II; Modern Methods of Pharmaceutical Analysis; Medicinal Chemistry II

under the supervision of a pharmacy faculty member in a chosen discipline. Students who pursue an MPharm in industrial pharmacy may undertake research projects in pharmaceutical industries during their second year of the curriculum. An industrial expert is responsible for part of the research, serving as the student's co-supervisor.

An MPharm degree in pharmacy practice/clinical pharmacy was started in 1996 with the aim of training the post-graduate pharmacy students in patient-oriented service. Students of such MPharm programs undertake their second-year research projects in either a hospital or community setting. There are 14 colleges, mostly located in South India, that offer the MPharm degree in pharmacy practice. However, most of the BPharm graduates are not attracted to this clinically oriented MPharm program. The deficiencies of the program are analyzed in a letter published in the *Journal* which explains that postgraduates with an MPharm in clinical pharmacy cannot opt to work as clinical pharmacists in Indian hospitals, as the value of clinical pharmacy services is not recognized, and the current regulatory framework does not yet recognize the need for clinical pharmacists at the national level.¹⁸

PharmD Program

In 2008, the 6-year PharmD and 3-year post-baccalaureate PharmD began to be offered as professional degree programs in India, focused mainly toward clinical and community aspects of the profession and mandatory practical training at practice sites. The PharmD program is comprised of 6 academic years, with 5 years of study and 1 year of internship and residency at a practice site. Six months of the internship and residency are spent in a general medicine department and 2 months each in 3 other specialty departments. The clerkship, coupled with project work covering drug utilization reviews, pharmacoepidemiology, pharmacovigilance or pharmacoconomics, was also in place. An outline of the program is given in Table 4. Like DPharm, no institution has the authority to update the curriculum to adapt to changing needs. A detailed eval-

uation of the PharmD curriculum has shown that the basic science, chemistry, and pharmacy subjects are an extension of the existing DPharm and BPharm programs. Although the curriculum emphasizes the clinical and patient-oriented aspects of the profession, it overemphasizes basic sciences (such as chemistry and analysis), while subjects such as pharmaceutics and health policy have been overlooked. The launching of the PharmD program in India has sparked an enormous amount of debate among educators and policymakers. There are 47 institutions (46 private and 1 public) offering the PharmD program, with a yearly intake capacity of 1410 students. Only 20 of these offer the post-baccalaureate PharmD, which provides only 200 places. All of these institutions except one are privately funded and 45 are located in Karnataka, Tamilnadu, and Andhra Pradesh, with 1 each in Madhya Pradesh and Maharashtra.⁶

The introduction of the PharmD program may not help clinical pharmacy education and practice in India, and apprehensions have been raised regarding inadequacies within the PharmD curriculum,¹⁹ unclear professional advantage over the current DPharm program as a professional degree,²⁰ and promotion of the PharmD degree to gain international status and provide pharmacists for the United States.²¹

EMPLOYMENT

The DPharm program was developed and designed to train students to serve as institutional and community pharmacists. Pharmacists with a DPharm degree have the opportunity to join a hospital (government or private) or community pharmacy (mostly private). The majority of diploma-trained pharmacists choose to work in government hospitals rather than private hospitals or pharmacies. They are also considered for placements in the pharmaceutical industry. The salary of pharmacists in government positions is lower than the salaries of similarly qualified health professionals (nurses, diagnostic technicians, and radiographers) and pharmacists in privately owned community pharmacies are always underpaid. In the recently accepted Indian government's sixth pay commission recommendations,

Table 4. PharmD and PharmD (post baccalaureate) Degree Curriculum Outline^a

Course Title	Hours of Study ^b		
	Theory	Practical ^c	Tutorial ^d
Year 1			
Human Anatomy and Physiology	99	99	33
Pharmaceutics	66	99	33
Medicinal Biochemistry	99	99	33
Pharmaceutical Organic Chemistry	99	99	33
Pharmaceutical Inorganic Chemistry	66	99	33
Remedial Mathematics/ Biology	99	99	33
Total hours = 1320			
Year 2			
Pathophysiology	99	-	33
Pharmaceutical Microbiology	99	99	33
Pharmacognosy and Phytopharmaceuticals	99	99	33
Pharmacology-I	99	-	33
Community Pharmacy	66	-	33
Pharmacotherapeutics-I	99	99	33
Total hours = 1056			
Year 3			
Pharmacology-II	99	99	33
Pharmaceutical Analysis	99	99	33
Pharmacotherapeutics-II	99	99	33
Pharmaceutical Jurisprudence	66	-	-
Medicinal Chemistry	99	99	33
Pharmaceutical Formulations	66	99	33
Total hours = 1188			
Year 4			
Pharmacotherapeutics-III	99	99	33
Hospital Pharmacy	66	99	33
Clinical Pharmacy	99	99	33
Biostatistics and Research Methodology	66	-	33
Biopharmaceutics and Pharmacokinetics	99	99	33
Clinical Toxicology	66	-	33
Total hours = 1089			
Year 5			
Clinical Research	99	-	33
Pharmacoepidemiology and Pharmacoconomics	99	-	33
Clinical Pharmacokinetics and Pharmacotherapeutic Drug Monitoring	66	-	33
Clerkship	-	-	33
Project work (Six Months) ^e	-	660	-
Total hours = 1056			
Year 6			
Internship or Residency program			

PharmD (post baccalaureate) – entry directly to the fourth year of the program

^a Hours of study is based on 33 working weeks.

^b Practical means Laboratory of the respective subjects; 4th year practical includes work in a Laboratory and in a hospital as well.

^c Tutorial includes seminar and discussion,

^d Project work is to be undertaken in a practice site.

practicing pharmacists have been placed in the lowest band and structure, along with other nontechnical persons.²²

The vast majority of pharmacists with a BPharm degree normally seek positions (such as production, quality control, and marketing) with the thriving pharmaceutical industries in which services are well defined and industrial pharmacists are well remunerated. They also have the opportunity to be appointed to drug regulatory agencies or quality control laboratories by the state or central government. MPharm degree holders in any discipline including an MPharm in clinical pharmacy may join industries in any of the above positions. Many MPharm graduates entering the pharmaceutical industry choose positions in areas such as research, formulation development, and clinical trials. Additionally, they have the opportunity to work in the academic area, typically as researchers or faculty members. The demand for pharmacists is further growing with the growth of the pharmaceutical industry in India. Pharmacists with a PhD mainly work in academia and in the research and development section of pharmaceutical industries.

SUMMARY

Pharmacy education in India, both at the BPharm and MPharm levels, is taught as an industry- and product-oriented profession with a focus on the basic sciences.²³ During the past decade, pharmacy education has expanded significantly in terms of number of institutions offering pharmacy program at various levels. However, pharmacy education in India continues to be one of the last options for students aspiring to a university degree. The pharmacists with a BPharm or MPharm generally seek avenues other than pharmacy practice. These pharmacists prefer placements in production, regulatory affairs, management and/or quality assurance, and marketing with the pharmaceutical industry. Only small numbers of these graduates and postgraduates opt to work in community and institutional pharmacies. In India, diploma holders (DPharm holders) are practicing pharmacists in the global sense as they engage in community or institution pharmacy practice.

A specialized MPharm in pharmacy practice program launched in the 1990s failed to create employment opportunities in practice areas for these postgraduates. The main change that is currently affecting pharmacy practice is the introduction of the PharmD program in India. One thousand four hundred ten students have enrolled in 47 colleges (mostly private sector) localized in a small geographical part (South India) of India. Going by the experience of socioeconomic status of our country, this steep increase in the required study period from the 2-year DPharm to the 6-year PharmD for producing practicing pharmacists raises issues of PharmD-trained pharmacists who seems to be “unavailable” to serve for India.

In order to demonstrate the requirements for pharmacists in India, it is necessary to undertake a pharmacy workforce study, to review pharmacy education programs, and to compare them with the roles that have been accepted internationally. Then, to design and develop pharmacy degree programs—perhaps one program exclusively for industry and another for practice.

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