

INTERNATIONAL PHARMACY EDUCATION SUPPLEMENT

Clinical Pharmacy Education in China

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Pharmacy education in China focuses on pharmaceutical sciences, with the bachelor of science (BS) of pharmacy as the entry-level degree. Pharmacy practice curricula in these programs are centered on compounding, dispensing, pharmacy administration, and laboratory experiences, which are the traditional responsibilities for pharmacists. Additional graduate-level training is available at the master of science (MS) and the doctor of philosophy (PhD) levels, most of which concentrate on drug discovery and drug development research. Presently, the emphasis in practice is beginning to shift to clinical pharmacy. With this change, additional degree offerings are being developed to meet the growing demand for clinical pharmacists. There is also interest in developing more clinical skills in practicing pharmacists through additional non-degree training. The Ministry of Education is considering a proposal for an entry-level professional degree of master and/or doctor in clinical pharmacy similar to the doctor of pharmacy (PharmD) degree in the United States.

Keywords: China, international pharmacy education, clinical pharmacy

EDUCATIONAL PROGRAM DESCRIPTION

Modern higher education in pharmacy in China began in the Qing Dynasty in 1906. Before the establishment of the People's Republic of China in 1949, there were 8 schools and universities offering pharmacy programs and degrees.¹ In 1955, the first university to recruit post-graduate pharmacy students in the People's Republic of China was Beijing Medical College (currently known as Peking University Health Science Center).² Today, there are more than 257 pharmacy schools and universities that offer the BS degree and higher degrees throughout China. In 2005, more than 6,000 graduates received BS degrees, 800 received MS degrees, and 290 received PhD degrees in pharmacy.³

Traditionally, students receive a BS degree as an entry-level pharmacy degree. Students holding a BS degree can earn an MS degree in 3 years or a PhD in 5 years. Students with an MS degree can work toward a PhD with an additional 3 years of study. In China, there is a system by which disciplines are catalogued into first or second levels. First levels are similar to majors in the US, while second levels are the equivalent of minors or areas of

concentration within a major. Another route to pharmacy education is through bachelor or master degrees in medical sciences (BM or MM, respectively). These students declare their first level as medical sciences and their second level as clinical pharmacy. They are eligible for licensure as a pharmacist; however, they cannot practice medicine.

Clinical pharmacy education in China has developed only recently. Perhaps, because there is no standardization of curricula, there are a variety of degrees offered from various programs (Table 1). BS degrees in pharmacy or medicine, MS degrees in pharmacy or medicine, and PhD degrees in pharmacy can all have components of clinical pharmacy. From 1989 to 1999, the West China School of Pharmacy at Sichuan University offered the first 5-year clinical pharmacy BS degree. Since 2000, the Ministry of Education has allowed only pharmaceutical sciences as a first-level discipline for BS degrees. Students wishing to study clinical pharmacy at the bachelor's level may select clinical pharmacy as a second-level area of concentration under pharmaceutical sciences. As an exception, in 2008 China Pharmaceutical University was allowed to offer a first-level, 5-year BS degree in clinical pharmacy.

Peking University developed a 6-year continuous or dual degree BS/MS program in clinical pharmacy in 2001 and is the only university in China to offer such a degree.

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Table 1. Clinical Pharmacy Educational Offerings in China

University	Length of Program	Degree(s) Awarded
Anhui Medical University	5	BM ^a
Beijing University Chinese Medicine	3 ^b	MS/PhD
Binzhou Medical University	4	BS ^c
China Medical University	5	BM ^a
China Pharmaceutical University	5	BS
	3 ^b	MS/PhD
Chongqing Medical University	4	BS ^c
Dalian Medical University	5	BM ^a
Fudan University	4	BS ^c
	3 ^b	MS ^c
Fujian Medical University	4	BS ^c
Guangdong Pharmaceutical University	4	BS ^c
Harbin Medical University	5	BM ^a
Hebei Medical University	3 ^b	MS ^c
Huazhong University of Science and Technology	4	BS ^c
Jilin University	3 ^b	MS ^c
Jinzhou Medical University	3 ^b	MS ^c
Nanchang University	4	BM ^a
Peking University	6	MS
	3 ^{b/5} ^d	MS/PhD
Second Military Medical University	4	BS ^c
	3 ^b	MS/PhD
Sichuan University	4	BS ^c
	3 ^b	MS/PhD
Shandong University	7	MM ^e
Shanghai Jiaotong University	3 ^b	MS ^a
Shenyang Pharmaceutical University	4	BS ^c
	3 ^b	MS/PhD
Sun Yat-Sen University	3 ^b	MS ^c
Taishan Medical University	5	BS ^c
Wuhan University	5	BM ^a
Yangzhou University	4	BM ^a

Abbreviations: BS=bachelor of science; MS=master of science; PhD=doctor of philosophy; BM=bachelor of medical sciences; MM=master of medical sciences

^aClinical pharmacy is a subspecialty of medical sciences in these programs

^bCandidates must hold a BS degree for the 3-year MS or a MS degree for the 3-year PhD

^cClinical pharmacy is a subspecialty of pharmaceutical sciences (BS), or pharmaceutics, pharmacology, and pharmacognosy etc. (MS), not an independent specialty in these programs

^dCandidates must hold a BS degree for the 5-year PhD

^eClinical pharmacy is a specialty of medical sciences in this program

In 2007, the first 15 MS students graduated from this program at Peking University, the largest number of clinical pharmacy graduates in 1 year in China. In 2003, Peking University was permitted by the Ministry of Edu-

cation to offer a 3-year post-baccalaureate MS in clinical pharmacy.⁴ Shortly thereafter, programs were approved at 3 other universities (Sichuan University, China Pharmaceutical University, and Shenyang Pharmaceutical University).³ Shandong University has another interesting degree option, the master of medicine in clinical pharmacy degree. In this program students complete a 7-year program in medicine after graduation from high school with a concentration in clinical pharmacy.

From 2005 to 2007, 4 universities (Peking University, Sichuan University, China Pharmaceutical University, and Shenyang Pharmaceutical University) began to recruit candidates for a PhD degree in clinical pharmacy. The first graduates from these programs are expected in late 2008. There are 2 possible routes for attaining/obtaining the PhD in clinical pharmacy: after graduating from a BS program, the student completes a 5-year PhD program; or after graduation from an MS program in clinical pharmacy or a related pharmacy area, the student completes a 3-year PhD program.

Applicants and Admission Criteria

In China, students are admitted directly to pharmacy programs from high school. There is no centralized data repository to indicate the number of pharmacy applicants in China. However, in 2007, 10 million qualified applicants applied for some type of higher education; of these, 5.67 million students were accepted into schools or universities. In 2005, more than 42,000 students entered a BS program in a pharmacy school. About 4,700 students began MS coursework, and of these, about 30 entered MS in clinical pharmacy programs.³

All students interested in higher education take a standardized college entrance examination during their final year of high school. Each college of pharmacy establishes a minimum examination score for admission. Students are admitted solely on the basis of these standardized entrance examination scores.

Curriculum

BS students complete 4-5 years of undergraduate training, but there are no standardized curricula or accreditation requirements for these programs. Courses include a mix of basic science (such as mathematics, physics, inorganic and organic chemistry, and philosophy), advanced chemistry (such as analytical chemistry and medicinal chemistry), and basic pharmacy (such as pharmacognosy, pharmacology, pharmaceutics, pharmacokinetics, and pharmacy administration). Some institutions also offer what are considered biomedical courses, which may include introductory discussions of pathology and special populations of patients (ie, pediatrics, geriatrics). Students are trained

in the use of both Western and traditional Chinese medicines. For those students studying hospital pharmacy, pharmacy practice is usually confined to a 6-month experience in a hospital pharmacy department. Other students may undertake research projects under faculty supervision during the final portion of the curriculum. While the curricula for clinical pharmacy programs are widely variable, 3 curricular examples are offered in Table 2.

A detailed description of the curriculum for the dual degree 6-year BS/MS in clinical pharmacy program at Peking University follows. The curriculum is broken into 2 parts. The first part consists of a core undergraduate education as described above, as well as basic medical sciences courses (such as biochemistry, pathology, physiology, biology, immunology, anatomy and pathophysiology). This portion of the program is completed in 3.5 years.

In order to enter the second part of the dual BS/MS in clinical pharmacy, students must pass all courses and successfully complete a graduate level English examination. The second part of the degree program includes courses in advanced clinical pharmacy, pharmacy informatics, pharmacoeconomics, pharmacogenetics, introduction to pharmacy practice, and applied pharmacy policy, etc. In addition to these didactic experiences, students also have 2 courses combining didactic and experiential training. One is the primary pharmacy practice course that provides students with a general familiarity with the hospital pharmacy department, pharmacy administration, the drug delivery system, therapeutic drug monitoring, and laboratory research. The second course is a clinical medical theory and practice course in the areas of diagnosis, internal medicine, surgery, obstetrics and gynecology, pediatrics, respiratory, cardiovascular, and gastrointestinal medicine. During this second course of training, physicians serve as preceptors for the students. Students usually have half-day medical courses in diagnostics, internal medicine, surgery, gynecology and obstetrics, and pediatrics taught by senior physicians. The other half of the day is spent in a selected clinical area learning the general medical routine and in small group problem-based learning activities. In the final 2 experiential months, students spend 2-3 weeks in various specialty areas of practice. Under the supervision of both a physician and a clinical pharmacist, students participate in patient care rounds, review medication orders, perform therapeutic drug monitoring, and supply drug information to patients and other health care practitioners during this time. Additionally, they have final written examinations and oral practice examinations to evaluate their knowledge base.

In the concluding 1.5 years (during the second part of training), students continue clinical learning in a specialized area of pharmacy practice and complete a research

project under the supervision of pharmacy faculty members who may co-supervise students with a physician. Students identify a clinical problem for laboratory work, culminating in a thesis project. Each thesis has 2 parts: clinical pharmacy practice and research. The thesis is judged on students' creativity and the ability to solve problems from clinical practice. Following completion of this work, a thesis defense, and publication of the project in a major Chinese journal, students receive the MS in clinical pharmacy.

The curricula for the postgraduate MS in clinical pharmacy degree vary widely across the schools that offer this degree. For example, at Peking University, the curriculum is the same as that for the second part of training in the 6-year entry-level pharmacy program, with additional general education courses such as political science, dialectic (logic), statistics, and English.

Students who pursue a clinical pharmacy PhD must spend a large portion of their program in laboratory research. These students are well grounded in basic sciences, but often lack practice research, which is a recognized deficiency. At the present time, PhD training is not conducive to practice in clinical pharmacy, but may be the path to a university faculty appointment or a research position in the pharmaceutical industry.

Clinical Program Strengths

In most pharmacy schools and universities in China, physicians are responsible for part of the clinical training of students pursuing a BS, MS, or PhD degree in clinical pharmacy, serving as their co-advisor. Students become familiar with the working methods and models used by physicians. This helps the students apply analytical processes to the clinical care of patients and fosters skills important to developing a good working relationship with physicians. The senior clinical pharmacist serving as an advisor is responsible for helping students understand how to solve medication problems and apply analytical skills to clinical problems, and develop skills for communicating with other healthcare practitioners, patients, and patients' families. A pharmacy faculty member serves as a supervisor for MS and PhD clinical pharmacy students and is responsible for approving the subject and content of students' theses and arranging for clinical experiences.

Chinese pharmacy students gain a thorough knowledge of laboratory procedures and the scientific method. The requirement of publishing a paper, as well as presenting an oral defense of the thesis or dissertation project, ensures development of writing and public speaking skills. The publication requirement also ensures peer review of the student's research by a wider audience.

Table 2. Example Clinical Curricula for Three Chinese Universities

Course Type	Sichuan University (5 yrs*)	Guangdong Pharmaceutical University (4 yrs)	Shandong University (5 yrs)
Public basic sciences	English; politics; philosophy; athletics; mathematics; computer science; chemistry (inorganic, organic, analytic, laboratory) physics; law; physical chemistry		
Basic medical sciences	medical statistics; biochemistry; microbiology; immunology; human anatomy; physiology histology and embryology; pathophysiology	cytobiology	cytobiology; molecular biology; laboratory animals; medical psychology; histology and embryology; pathophysiology; genetics; functional laboratory; medical ethnics
Basic pharmacy	pharmacology; drug chemistry; drug analysis; pharmacy informatics; pharmacy administration; pharmaceutics latin; research method and design; biopharmaceutics	medicinal botany and pharmacognosy; natural drug chemistry; pharmacokinetics and biopharmaceutics	traditional Chinese medicine; new drug design; biopharmaceutics and pharmacokinetics; toxicology
Clinical medical sciences	basic diagnostics; general surgery; internal medicine; pediatrics; obstetrics and gynecology; dermatology; otolaryngology; epidemiology; ophthalmology; neurology; psychiatry	general clinical medicine	medical imaging; diagnostics; internal medicine; surgery; gynecology; pediatrics; infectious diseases; dermatology and venereal diseases; psychiatry
Clinical pharmacy	clinical pharmacology clinical pharmacokinetics; hospital pharmacy administration; pharmacotherapeutics		clinical drug evaluation; drug-related diseases and prevention; drug economics; drug epidemiology; pharmacotherapeutics
Practice	half-year clinic practice; half-year hospital pharmacy practice	half-year hospital pharmacy practice	one-year clinic and pharmacy practice; half- year specialty practice

^aThis is a past length of program in Sichuan University (West China School of Pharmacy). It was a representative program in Chinese clinical pharmacy before 2000

Assessment

Teaching is assessed by 3 methods at many institutions: student, peer, and Ministry of Education evaluation. Student evaluation is conducted by survey methods. The peer evaluation usually takes the form of other faculty observing and assessing lectures for the faculty member being evaluated. Student and peer evaluations are not

uniformly conducted at all universities. The Ministry of Education also conducts a periodic review of course documents, observation of teaching, and discussions of teaching quality with students.

Competency- and ability-based educational outcome assessments are still in development for most programs in China. The majority of the BS programs in clinical

pharmacy have not been assessed systematically. Curricula for BS candidates in the clinical pharmacy concentration are not competency or abilities based during the majority of the program. In the final year, limited abilities-based practice courses in hospitals are offered at some schools and universities.

Curricula for MS in clinical pharmacy programs are gradually developing competency- and abilities-based outcomes. At Peking University, some problem-based learning is often used in didactic settings and many institutions use oral and/or practice skills examinations during experiential training.

Accreditation

At this time, there is no independent accreditation body for pharmacy education in China. Instead, all national higher education institutions in China are evaluated and approved by the Ministry of Education every 5 years. This evaluation was first implemented in 2003. In an attempt to standardize curricula in various universities and schools, the Ministry of Health is now developing unified teaching materials for health care higher education.

LICENSURE

China first implemented a system of licensure for pharmacists in 1994. The Department of Human Resources in conjunction with various branches of the State Food and Drug Administration (SFDA), Peoples Republic of China, have distributed "Licensed Pharmacist Qualification System Temporary Rules" and subsequently "Licensed Chinese Medicine Pharmacist Qualification System Temporary Rules." The SFDA is the governing body that is charged with oversight of the licensing examination, registration of licensed pharmacists, and continuing education required for licensed pharmacists.⁵

Passing the licensure examination is not required for all areas of pharmacy practice and the passing rate of examination is often low (12.83% in 2004, 18.18% in 2005, and 16.69% in 2006).⁶ Some fields such as pharmaceutical manufacturing, industry, and management, as well as hospital pharmacies, clinic pharmacies, and community pharmacies, require at least 1 licensed pharmacist. However, in these situations, the licensed pharmacist may be in a supervisory role over unlicensed pharmacists.

PRACTICE

To meet social, economic, and development goals for China, the national population should not exceed 1.4 billion before 2010. If China attempts to meet the current US ratio of 1 pharmacist for 1500 people, 939,000 phar-

cists will be required. A more modest goal of 1 pharmacist per 5000 people requires 280,000 pharmacists.⁵ However, the annual number of pharmacy graduates has been approximately 10,000, which cannot meet the country's needs.⁴ In order to address this deficiency, in August 2001, a 5-year plan was promulgated to increase the number of licensed pharmacists.⁴

In the past, the major responsibilities of pharmacists were stocking, distributing, and dispensing medications. At this time, pharmacists do not have prescriptive authority. The public's concept of a pharmacist is generally associated with professionals working in the pharmacy department of hospitals and community pharmacies. Each year, almost all new pharmacists entered this traditional type of pharmacy practice. Of approximately 300,000 pharmacy graduates from 1949 to 1998, 156,000 (52%) worked in hospital pharmacies, 62,000 (21%) worked in the pharmaceutical industry, and 27,000 (9%) worked in "wholesale" or community pharmacies.⁵

As China's economy has developed, the employment of pharmacy graduates has fundamentally changed. Currently, pharmacy graduates work in hospitals, community pharmacies, the insurance industry, long-term care, pharmaceutical manufacturing, and research institutes. Fudan University School of Pharmacy surveyed BS students graduating between 1996 and 2004.⁷ Their findings demonstrate a shift in employment from the previous study.⁵ The majority (45.2%) of more recent graduates worked in research and development; 28.8% became pharmaceutical manufactures' representatives; and 15.4% entered hospital pharmacy. Graduates with traditional MS and PhD degrees plan to work in research and development (76.5%), medication regulation (10.0%), clinical trials (4.3%), or as pharmaceutical manufacturers' representatives (4.3%).

The most severe shortage of pharmacists in China is in pharmacists with a clinical background. Traditional pharmacy education emphasizes pharmaceutical sciences over clinical pharmacy. Although the education of clinical pharmacists began in a limited fashion in the early 1990s, there are few qualified professional clinical pharmacists in China. A large number of the early clinical pharmacy graduates took dispensing positions in hospital pharmacies, marketing or research positions in the pharmaceutical industry, or teaching or research positions in academia. Even now, the number of clinical pharmacy graduates annually is limited. Therefore, there are not sufficient clinical pharmacists or new graduates to meet the increasing demand.⁸

Hospital pharmacy practice is changing from "drug-centered" to "patient-centered," and the primary focus for hospital pharmacy is changing from drug supply to

pharmaceutical care. Thus, the pharmacist's activities are changing from drug dispensing and compounding to rational drug use and patient care. This kind of transformation has attracted outstanding pharmacy graduates, including those with advanced degrees, to seek employment in hospitals.

For graduates with an MS degree in clinical pharmacy, there are many clinical opportunities available including clinical pharmacology, clinical practice, patient management, pharmacy administration, and laboratory research in hospitals, community pharmacies, pharmacy research institutes, pharmaceutical industries, and government offices.

Bachelor of science graduates can also work in hospital pharmacies, but their functions are primarily stocking shelves and managing inventory, dispensing, and compounding. They also may participate in laboratory research. Recently, some of these pharmacists have been asked to perform clinical pharmacy functions because of the lack of clinical pharmacists. Pharmacists practicing in community pharmacies manage pharmacy operations and provide patient counseling.

The field of clinical pharmacy has grown since 2002. At that time, the government required all hospitals to develop clinical pharmacy programs to address drug-related problems and to promote rational drug use in hospitals.⁹ Many large general hospitals started to differentiate a few practitioners as clinical pharmacists or hired graduates with an MS or PhD degree in clinical pharmacy. Currently, about 90% of graduates from MS in clinical pharmacy programs are working in clinical pharmacy. Additionally, some pharmacists working in hospitals and the pharmaceutical industry are electing to return to school to pursue a 3-year master of science in clinical pharmacy program or a 1-2 year postgraduate clinical pharmacy course specifically designed for practicing pharmacists.

The main venue of clinical pharmacists in China is in comprehensive medical centers and is focused on a few specialty areas. However, clinical pharmacy is developing in more clinical areas and as the supply of clinical pharmacists increases, this type of practice is increasing. The clinical pharmacist works as part of a medical treatment team and performs the following types of clinical activities:

- Participates in daily clinical rounds;
- Obtains medication histories;
- Prevents, detects, and resolves medication-related problems;
- Provides drug information;
- Assists with medication selection;
- Devises treatment plans for individual patients;

- Assesses efficacy and safety of treatment plans;
- Conducts/performs therapeutic drug monitoring of medications with a narrow therapeutic index;
- Counsels patients regarding medications;
- Provides special monitoring for newly marketed medications including collection, analysis, and reporting of data for these medications;
- Performs drug usage evaluations and rational drug use evaluations;
- Performs research, particularly in the areas of evidence-based medicine, pharmacogenomics, proteomics, population pharmacokinetics, clinical pharmacology, and bioavailability.

Clinical Pharmacy Professional Development

Some pharmacists working as clinical pharmacists in China have a great deal of on-the-job professional experience, but have not received formal training in clinical pharmacy. Therefore, in addition to degree-granting programs, a great deal of professional development is currently focused on obtaining clinical pharmacy skills for practicing pharmacists. The Ministry of Health established 1-year clinical pharmacy training programs for currently practicing pharmacists in January 2006. The training includes both didactic and experiential components. A systematic, standardized, but individualized, method to provide this continuing education is advocated that requires pharmacists to:

- (1) Begin thinking of themselves as clinicians;
- (2) Improve their knowledge base in clinical medicine, clinical pharmacy, and biology;
- (3) Improve their knowledge of medical ethics, patient psychology, and medicine administration;
- (4) Develop their skills in communication, computer use, and foreign language;
- (5) Learn to participate in patient care rounds and other clinical pharmacy activities;
- (6) Learn to employ the hospital information system to advance the profession through such activities as establishing an adverse drug reaction database or pharmacokinetics and pharmacodynamics databases;
- (7) Participate in clinical professional meetings and advanced training classes.

The goal of this plan is to develop 300-500 additional clinical pharmacists within 3 years from 50 of these training programs. These hospitals have been specifically certified under the Pharmacy Administration Specialty Committee of Chinese Hospital Association beginning in 2005. This group is working collaboratively with clinical pharmacy specials and educators to standardize assessment and accreditation guidelines for pharmacists and hospitals.

CLINICAL EDUCATIONAL CHALLENGES AND THE FUTURE

Generally, pharmacy higher education in China requires further development to meet societal needs. For example, the entry-level MS program in clinical pharmacy at Peking University currently graduates only 12-15 students each year. The MS and PhD in clinical pharmacy programs do not have the capacity to produce large numbers of clinical pharmacists. BS pharmacy education in most of China is basic science-oriented programs. To meet the increasing demand for clinical pharmacists, the Ministry of Education is currently assessing a plan proposed by Peking University to develop professional degrees in China that would be similar to the PharmD degree in the United States. The proposed names for these degrees are the master of clinical pharmacy (CPM) and the doctor of clinical pharmacy (CPD).

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