

Comparison of professional pharmacy degrees and health systems in United States, Canada, Spain and Mexico

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SUMMARY

Introduction: It is known that in countries like United States, Canada or Spain, pharmacists are well recognized as important members of the healthcare team, in both community and hospital settings, due to their vital role in caring for patients' medication safety. In Mexico, just a short time ago, pharmacists were recognized in this manner. The objective to this study is to compare professional pharmacy training programs and healthcare systems in the United States, Canada, Spain and Mexico.

Methods: A convenience sample of four universities were selected due to the authors' extensive knowledge of the content and development of the profession.

Results: Pharmacy curricula in the United States and Canada are very similar. They have many clinical pharmacy subjects, such as pharmacotherapy, therapeutics, pharmaceutical care, drug calculations and skills-based lab courses. In Spain and Mexico, however, while some of the coursework is similar, Spain has an experiential rotation program and Mexico does not. Mexican universities allow students practice in workshops to simulate pharmacy practice.

Conclusion: It will be important to develop pharmacist training programs in Mexico (*químico, farmacéutico biólogo*), with more clinical pharmacy subjects as well as patient-centered communication skills to strengthen the profession and be able to contribute within the health team and provide better patient care.

Key words: Health systems plans, clinical pharmacist, pharmacist, pharmacy, education.

Comparación del grado profesional de farmacia y los sistemas de salud en Estados Unidos, Canadá, España y México

RESUMEN

Introducción: Es sabido que en países como Estados Unidos, Canadá o España, el farmacéutico es reconocido como un elemento importante en el equipo de salud, ya sea en la farmacia comunitaria u hospitalaria, teniendo un papel importante en la seguridad de la medicación del paciente. El objetivo de este estudio fue comparar los planes de estudio de farmacia y los sistemas de salud de Estados Unidos, Canadá, España y México.

Métodos: Se tomó una muestra a conveniencia de cuatro universidades, las cuales fueron seleccionadas por el amplio conocimiento de los autores del contenido de los programas y el desarrollo de la profesión.

Resultados: La currícula de farmacia de Estados Unidos y Canadá son muy similares, sus programas contienen gran cantidad de materias relacionadas a farmacia clínica como farmacoterapia, terapéutica, cuidado farmacéutico, cálculos de medicamentos y habilidades

con el paciente. España y México, varias de sus materias son similares, con la diferencia de que en España, como en los otros dos países ellos tienen programas de rotaciones en farmacias comunitarias u hospitalarias. En México, la mayoría de las universidades aborda por talleres en estos temas.

Conclusión: Sería importante enriquecer los programas de químico, farmacéutico biólogo en México con un mayor número de materias en el área de farmacia clínica, así como habilidades de comunicación con el paciente para fortalecer la profesión y tener la capacidad de participar dentro del equipo de salud, así como informar de una mejor manera al paciente sobre su medicación.

Palabras clave: Planes de sistemas de salud, farmacéuticos clínicos, farmacéutico, farmacia, educación.

INTRODUCTION

While for over 50 years, pharmacists have been recognized as healthcare professionals in countries such as the United States, Canada, and Spain, this has not been the case for Mexican pharmacists. Some information has been published on the best pharmacy schools in the world and the countries with the best preparation in the training of pharmacists, mainly highlighting several universities in the United States, such as University of California in San Francisco, as well as several universities in the United Kingdom, such as the University of Cambridge, Oxford and others. Australia has also been mentioned as a leader in pharmacy education, as well as some universities in Sweden and Spain¹.

Mexican pharmacists are recognized as chemists or scientists, due to their primary forms of employment in hospitals, clinical laboratories and blood banks. Community pharmacies are not required to employ pharmacists, so drug dispensing is entrusted to non-pharmacist personnel. Pharmacists are not accountable for patient's safety and well-being. Finally, last January 24th, 2020, the Mexican law approved the pharmacist as part of the healthcare team². In Mexico, pharmacists graduate from a Chemistry-Pharmacy-Biology (*químico, farmacéutico biólogo*) university program. As graduates, they can work in a variety of areas, including: quality control (food or pharmacy industry), clinical laboratories, blood banks, immunology, research, genetics, tequila industry, meat industry, microbiology, hospital pharmacy or community pharmacy. The advantage of the Chemist-Pharmacy-Biology program is the large variety of job opportunities. On the downside, the degree program has no equivalent in other countries, so graduates are not recognized as pharmacists outside of Mexico. This may pose challenges for students who would like to pursue a Masters or PhD degree in a foreign university, especially in this area. We believe that there are some reasons for the lack of recognition of the Mexican pharmacist as a healthcare professional and one of these could be the Chemistry-Pharmacy-Biology (CPB) curricular program.

OBJECTIVE

Due to the recent recognition of pharmacists as health professionals in Mexico and the documented importance of pharmacists in the healthcare system, we decided to compare the pharmacy degree programs of four international universities, as well as a brief review of their corresponding healthcare systems.

We will highlight these differences by comparing the pharmacy curricula of four academic institutions in Mexico, the United States, Canada and Spain.

METHODS

Despite the fact that the best universities for the training of pharmacists stand out in the United States and the United Kingdom, we compared the plans of the following countries: United States, Canada, Spain and Mexico. These countries were selected since the authors have collaborated in other projects together, in addition to belonging to countries where the figure of the pharmacist is widely recognized, with the exception of Mexico. The comparative degree programs belong to the universities where the authors work, which allows for each author to share their experiences from a teaching, research and clinical pharmacy practice perspective.

RESULTS

The first program reviewed is the Drake University Doctor of Pharmacy (PharmD) program in the United States. The curriculum requires 2 years of pre-pharmacy coursework, which includes courses such as chemistry, biology, calculus, microbiology, statistics, and Career Academic and Professional Success. Following completion of the pre-pharmacy classes, successful students are admitted into a four-year professional program³. The first three years of the PharmD degree program are completed on campus and include the courses shown in table 1. The final year of the curriculum is completed off campus. Students are assigned to Advanced Pharmacy Practice Experiences, where they spend eight, 5-week rotations exploring different types of pharmacy practice. These include four "core" rotations (ambulatory, acute, community and hospital) along with four "elective" rotations. The degree focuses on clinical application of pharmacy topics which prepares graduates to improve health outcomes in the patients they serve.

Following graduation with the Doctor of Pharmacy degree, students are required to pass two exams to be licensed to practice pharmacy in the United States. One of these exams is called the NAPLEX (National Association of Boards of Pharmacy)⁴ Exam and includes questions related to medications. The other exam focuses on pharmacy law, from both a national and state perspective⁵. A majority of pharmacists in the United States work in community pharmacies. Many new graduates also apply for competitive post-graduate training programs, such as research fellowships or 1-2 years clinical residency training programs. Residencies help pharmacists specialize in areas like infectious disease, emergency medicine or oncology in a hospital setting.

In the United States, there are both public and private options for medical insurance. For those over 65 years of age, the government-funded Medicare system provides health insurance. For those under 65 years of age, there are three main categories. A majority of working people in this group have insurance benefits that are provided by their employer. The employees pay some of the cost and the employer pays the remainder of the insurance premium. A second group of this population, often unemployed, qualify for state-government funded insurance, called Medicaid. The Affordable Care Act, which was signed into law by former President Obama in 2010, extended health-insurance coverage to millions of uninsured Americans. Finally, there are also people in the United States who are still uninsured.

In Canada, we compared two Pharmacy Doctorate programs. In the Montreal University Pharmacy Faculty, the pharmacy doctorate is a four-year program. In the first year, the pharmacy students learn mainly general knowledge on human anatomy, physiology and pathology. They also learn about physical chemistry and pharmacology. In the second and third year, the students concentrate their learning in pharmacotherapy and pharmaceutical care⁶. They go through a wide variety of subjects related to clinical pharmacy that are shown in table 1.

During the three first years, the students have mandatory laboratory practice where they learn and apply patient care skills in community and hospital settings. Every summer, students complete an internship in a community or a hospital pharmacy. The fourth year of the pharmacy program is entirely dedicated to internships in community and hospital pharmacy. Another program in Canada, at Alberta University, requires the students to take 10 subjects called

Table 1. Sample curricula from pharmacy programs. Focus on subjects related to clinical Pharmacy

United States of America (Drake University)	Canada (Montreal University)
Biochemistry Health Care Systems and Policies Pharmacy Skills and Applications Principles of Drug Actions I, II, III Drug Calculations Therapeutics I, II, III Therapeutic Drug Monitoring Physiology Pathophysiology Management in Pharmacy Nonprescription Therapies Kinetics Pharmaceutical Sciences Pharmaceutics I, II Literature Evaluation Methods Immunizations Pharmacy Law and Ethics Social and Administrative Pharmacy	The Pharmacist Health Professional Pharmacy and the Law Normal Functioning of the Human Body I, II, III, IV Single Dose Medications Multiple Dose Medications Drugs and Interactions Pharmacy and the Patient Community Pharmaceutical Practice The Pharmacist and Scientific Knowledge Pharmaceutical Care: Cardiology I, II, III, Immunology, Hematology, Nephrology, Infectious Diseases I, II, Gastroenterology and Endocrinology Pharmaceutical Advice
Spain (Universidad Miguel Hernández)	Mexico (Universidad de Guadalajara)
Clinical Pharmacy Pharmacology and Pharmacotherapy I, II, III Pharmaceutical Care Biopharmacy y Pharmacokinetics I, II Legislation and Social Pharmacy Genetics Applied to Pharmacy Pharmacognosy and Phytotherapy Human Physiology Clinical Pathology I, II	Bioethics and Deontology Health Regulations and Legislation Pharmacology I, II Physiology and Fundamentals of Pathophysiology Health Regulations and Legislation Community and Hospital Pharmacy Hospital Pharmaceutical Services Biopharmacy and Pharmacokinetics Pharmacognosy

Pharmacotherapy 1-10. The program includes the study of chronic diseases, different patient care scenarios, immunizations, nephrology and others systems⁷. The students incorporate principles of evidence-based therapeutics to make patient-centered treatment decisions. Other subjects are Patient Care Skills, which develops patient communication skills and interprofessional communication skills, Advanced Pharmacy Practice Experiences and others.

To get the professional pharmacy doctorate degree and the right to practice the profession, students must complete the pharmacy program as established by the Canadian pharmacy program at the university. The provincial governments publicly fund the Canadian health care system. Canadian people do not have to pay for physician consultations or hospitalizations. Some provinces also cover medication expenses. Even though each university in Canada and the United States offers slightly different pharmacy programs, most of their subjects are related to patient care and appropriate medication safety and use.

In Spain, the pharmacy degree program is different than those found in the United States and Canada, because students must take courses such as physics, psychology, chemistry, microbiology, pharmacology, pharmacotherapy, management, plant biotechnology, pharmaceutical care, clinic analysis and laboratory diagnosis. They can also take some elective subjects like hospital pharmacy, Galenic medicine and others⁸. Subjects related to clinical pharmacy are shown in table 1.

To obtain the degree, students must have to present a thesis or have three publications in a high level (Q1) journal. Alternatively, students can choose specialty areas in Microbiology and Parasitology, Clinical Laboratory, Immunology, Hospital

Pharmacy and others. The students interested in those specialties then have to take the FIR National Exam (Pharmaceutic Internal Resident). The duration of the residency is four years and there is also a theoretical-practical. See Reference 9 for more information. In Spain there is a public health system that covers the full scope of healthcare for the population. There are few people covered by private healthcare.

To work as a pharmacist in hospitals, the title of Hospital Pharmacist is required. This title is obtained, as is the case of medical professionals, through the residency system which is available after a selective examination. This system has been in place since the mid-1980s. The residency program lasts for four years. The current training plan was created in 1999 and is pending the approval of a new, updated plan. Hospitals and Hospital Pharmacy services must be accredited to participate in the residency training programs.

Finally, in Mexico, the pharmacy curricula are similar to the programs in Spain. Even though the pharmacy career exists in Mexico, most of the pharmacy professionals who work in hospital or community pharmacy settings have a Chemistry-Pharmacy-Biology degree (*químico, farmacéutico biólogo*, QFB). For this reason, we will discuss this degree program instead of the pharmacy program. The QFB degree has subjects related to chemistry, like organic chemistry, analytical chemistry and biochemistry. Students have a combination of required courses along with four elective courses. Some subjects in the degree program are: general and applied toxicology, bioethics and healthcare ethics (deontology), pathophysiology, biotechnology, microbiology, parasitology, immunology, lab analysis, and others¹⁰. Subjects related to clinical pharmacy are mentioned in table 1.

Table 2. Comparison of clinical pharmacy core subjects

	Pharmacology	Pathophysiology	Therapeutics	Pharmacy Law	Pharmacokinetics	Pharmaceutical care	Pharmacy skills
USA	X	X	X	X	X	X	X
Canada	X	-	X	X	X	X	X
Spain	X	X	X	X	X	X	X
Mexico	X	X	-	X	X	-	-

Table 3. Experiential Education in Clinical Pharmacy

	USA	Canada	Spain	Mexico
Required	Yes	Yes	Yes	No
Timing in curriculum	All 4 years	Since 1 st year	Final year	--
Number of hours	1 st year = 70 h 2 nd year = 100 h 3 rd year = 160 h 4 th year = 1600 h	1 st year = 160 h 2 nd year = 160 h 4 th year = 1120 h	P4 year = 900 h	
Coordinated by	University	University	University	--

Students have multiple options to acquire the QFB: 1) achieve an average score of 90 in their credits (evaluation scale: 0-100), 2) passing a national exam called CENEVAL or 3) by writing a thesis. Also, students must finish 300 practice hours and 480 social service hours in order to obtain the degree.

Most student look for employment upon graduation, while some choose post-graduate training in different fields of study. A small percentage of graduates chose post-graduate pharmacy training. In Mexico, we can divide the medical system in a general way into public or private attention, although there is a minority that can be served by the military. In figure 1 we summarize the health system in Mexico¹¹.

IMMS or ISSSTE are the health plans provided to employees of the majority of companies in Mexico, along with people who work in industry or University workers. The second health plan is called Seguro Popular, which is being evaluated for changes, specifically called INSABI (Wellness Health Institute). The final option for patients is represented by private health-care and is less common in Mexico. IMMS, ISSSTE, and Seguro Popular are not required to be certified or accredited by a governing organization. That means that in Mexico there are not any public hospitals that are certified and only few private hospitals that are. There may be some specialty areas that follow quality control guidance from the International Organization for Standardization (ISO), but not all of them. And finally, the hospital is required to be certified in order to have the employer pay or to have individual patients pay for private health care. The Hospital Certification system was implemented in Mexico in 2009¹², which allows hospitals to accept patients with private insurance. In these kinds of hospitals, pharmacists are required as part of the health team. In the remainder of the hospitals, pharmacists regrettably find it challenging to secure employment.

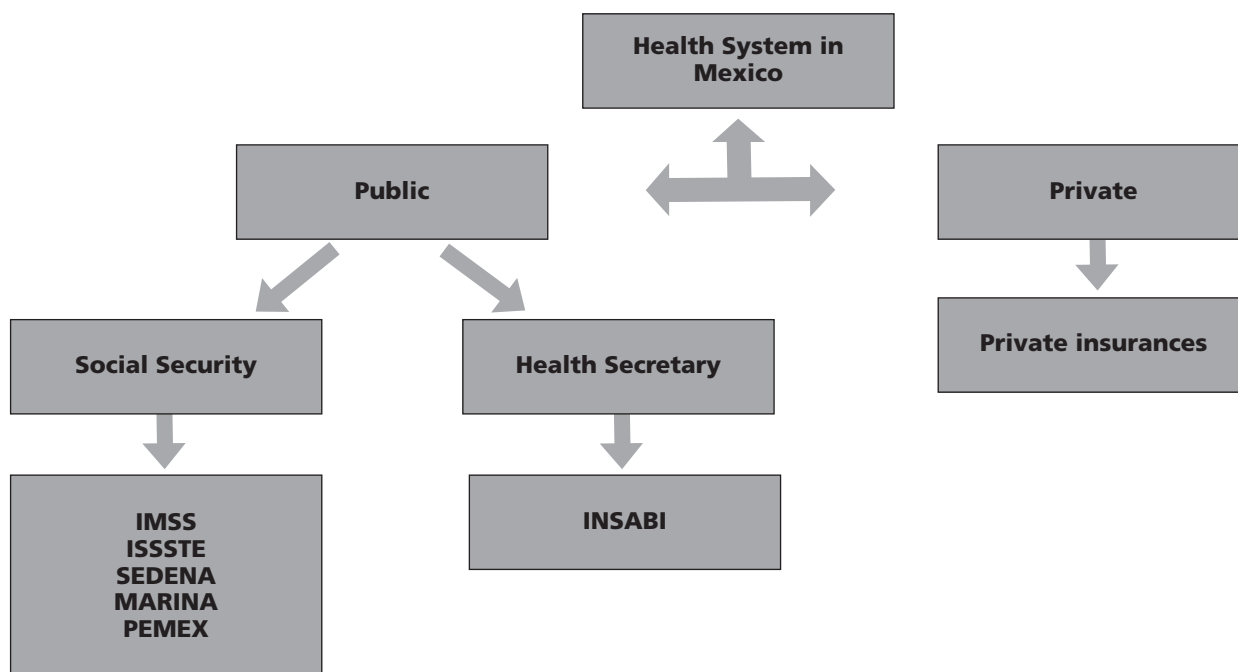
DISCUSSION

Pharmacy programs in the United States and Canada are similar; they have many courses related to pharmacotherapy, specifically focusing on each organ system, table 2. These programs are strong in skills related to managing patients'

medication regimens, communications skills, and practice in a variety of pharmacy settings, including hospital and community practice, table 3. On the other hand, pharmacy programs in Spain and Mexico have several similar courses. Experiential learning is different between programs, though, with the United States, Canada, and Spain offering experiential learning for students, while Mexico focuses primarily on practice-based skills in lab settings. The advantage of comparing the coursework of these universities is that the authors were able to comment on their programs in detail, both in theory and in practice. This allows a discussion of the subject within the team and the ability to capture more accurate information, since sometimes, when making comparisons or compilations of information only through web pages, it is not possible to know the reality in detail.

It is expected that little by little, any type of hospital will be hiring pharmacists as a part of its health team to carry medication-related functions. Along with hospitals, community pharmacies should also expand their scope of practice to emphasize more patient care activities. It will be important for the pharmacy education programs in Mexico to emphasize the importance of hospital practice in each semester of the curriculum, as well as to constantly focus on patient care skills, therapeutics, and clinical decision-making skills which mimic clinical pharmacy practice situations. The pharmacy programs which include experiential learning opportunities and strong theoretical pharmacy fundamentals, along with communications skills, are very important in preparing students to be active clinical pharmacy practitioners and assets to the healthcare team. It may be challenging to change the pharmacy curricula in Mexico, but universities could provide degrees that include rotation periods in different hospitals and intensive clinical training for at least two years when pharmacy students finish their degree and are interested in working as pharmacist. Some of the limitations of this study were not having any comparison with other countries in Latin America or with countries like the United Kingdom or Australia. The authors are not experts in evaluating credits by theoretical or practical subjects that could contribute to discussion.

Figure 1. Health System in Mexico



IMSS: *Instituto Mexicano del Seguro Social* (Mexican Institute of Social Security); ISSSTE: *Instituto de Seguridad Social para los Trabajadores del Estado*; (Institute of Social Security of State Workers); SEDENA: *Secretaría de la Defensa Nacional* (Secretary of National Defense); MARINA: (Marine); PEMEX: *Petróleos Mexicanos* (Mexican oil); INSABI: *Instituto de Salud para el Bienestar* (Wellness Institute of Health).

This is one of the few studies we are aware of in the educational literature that compares the pharmacy degree programs in four different countries. This study analyzed the strengths and weaknesses of each pharmacy degree program in the different countries and tried to incorporate recommendations for improving the training of the pharmacists in Mexico to provide better services at the hospital and community level.

CONCLUSIONS

Although some pharmacy master degrees or specialization courses exist in Mexico and professors do their best to prepare students for success^{13,14}, in order for true change in the profession to occur, we would suggest the creation or certification of masters and PhD programs in Mexico centered on clinical pharmacy (community or hospital pharmacy). These programs would need to be endorsed by the National Council of Science and Technology (CONACyT) and international organizations. The additional training would include rotation programs in public and private hospitals, as well as guaranteeing the training and development by professors involved with active teaching and research in the clinical pharmacy field.

Every day it is becoming more important to incorporate pharmacists into the health team for decision-making, so it will be necessary to have better academic preparation for both students and teachers in the field of clinical pharmacy. Community pharmacy, in Mexico, will be another challenge to address by slowly changing slowly the regulations requiring a pharmacist's presence in the pharmacy at all times.

Conflicts of interest: The authors declare that they have no conflict of interest.

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