Review Article

การปฏิบัติงานทางเภสัชกรรมและการศึกษาเภสัชศาสตร์ในประเทศไทย

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บทคัดย่อ

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การทบทวนนี้กล่าวถึงสถานการณ์ของปฏิบัติงานทางเภสัชกรรมและการศึกษาเภสัชศาสตร์ของประเทศไทย ซึ่งเป็นหนึ่งในประเทศที่ปรับหลักสูตรเภสัชศาสตรบัณฑิต เป็นหลักสูตร 6 ปี (Doctor of Pharmacy หรือ PharmD) ประเทศไทยตั้งอยู่ในภูมิภาคเอเชียตะวันออกเฉียงใต้ ระบบบริการสุขภาพส่วนใหญ่เป็นภาครัฐ สังกัดกระทรวงสาธารณสุขเป็นหลัก กำลังคนเภสัชกรในประเทศไทยยังไม่เพียงพออย่างยิ่ง อัตราส่วนเภสัชกรต่อประชากรต่ำกว่าแผนยุทธศาสตร์ของรัฐบาลไทยและต่ำกว่าเกณฑ์ขององค์การอนามัยโลก ภาคส่วนที่เภสัชกรไทยทำงาน ได้แก่ โรงพยาบาล การตลาดยา เภสัชกรรมชุมชน อุตสาหกรรมยา การคุ้มครองผู้บริโภคและการศึกษา ตั้งแต่ปี พ.ศ. 2553 คณะเภสัชศาสตร์ทุกแห่งจัดการเรียนการสอนหลักสูตรเภสัชศาสตรบัณฑิต หลักสูตร 6 ปี หรือ “all-PharmD” สภาเภสัชกรรมได้กำหนดให้ผู้สำเร็จการศึกษาด้านเภสัชศาสตร์ทุกคนต้องสอบใบอนุญาตเป็นผู้ประกอบวิชาชีพเภสัชกรรม เพื่อสร้างความมั่นใจและสร้างมาตรฐานคุณภาพของเภสัชกรจากคณะต่าง ๆ นอกจากนี้ยังจำเป็นต้องร่วมมือกันมากขึ้นระหว่างภาคการศึกษา ภาคปฏิบัติ และภาคนโยบายเพื่อนำมาซึ่งการปรับปรุงแนวทางปฏิบัติงานทางเภสัชกรรม หน่วยงานกำกับดูแลควรพิจารณาระบบสนับสนุนที่เปิดโอกาสให้เภสัชกรได้รับการฝึกปฏิบัติขั้นสูงโดยใช้ความเชี่ยวชาญของตนอย่างเต็มที่ และจัดทำนโยบายสำหรับการบริหารวิชาชีพเภสัชกรรมในระบบการดูแลสุขภาพ โดยกล่าวถึงเส้นทางในวิชาชีพเพื่อความก้าวหน้าทางวิชาชีพและค่าตอบแทนในกรณีที่มีการปฏิบัติงานด้านเภสัชกรรมรูปแบบใหม่ที่เพิ่มขึ้นมา เป็นเรื่องที่น่าสนใจที่จะติดตามว่าผู้สำเร็จการศึกษาจากหลักสูตรเภสัชศาสตรบัณฑิต หลักสูตร 6 ปี ของไทยซึ่งคาดว่าจะมีความสมรรถนะวิชาชีพในระดับสูงขึ้นกว่าบัณฑิตในหลักสูตรเดิม และมีความพร้อมในการทำงานหลังจบการศึกษาจะทำให้เกิดการเปลี่ยนแปลงด้านปฏิบัติงานด้านเภสัชกรรมอย่างไร การเปลี่ยนแปลงในการศึกษาเภสัชศาสตร์ของไทยมีศักยภาพที่จะทำให้เกิดความก้าวหน้าในการปฏิบัติงานด้านเภสัชกรรม ถึงแม้จะมีความท้าทายและอุปสรรคมากมาย

คำสำคัญ: การปฏิบัติงานทางเภสัชกรรม, การศึกษาเภสัชศาสตร์, ประเทศไทย, หลักสูตรเภสัชศาสตรบัณฑิต (หลักสูตร 6 ปี)

Pharmacy practice and pharmacy education in Thailand

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Abstract

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This review focuses on the situation of pharmacy practice and pharmacy education in Thailand, which is one of the countries that is transforming its pharmacy degree to the level of Doctor of Pharmacy. Thailand is a Southeast Asian country. The government provides the majority of health-care services, mostly through the Ministry of Public Health. The pharmacy workforce remains insufficient. The pharmacist-to-population ratio is lower than both the Thai government's strategic goal and the World Health Organisation's recommendation. Thai pharmacists operate in the following sectors: hospital, community pharmacy, industry and marketing, consumer protection and education. From 2010, all Thai faculties of pharmacy offered only the PharmD program, hence it is called an "all-PharmD" program. Since 2003, the Pharmacy Council of Thailand has decreed that all pharmacy graduates must take a licensure examination to ensure and standardize the quality of pharmacists from different faculties. There also needs to be more collaboration among education, practice and policy to bring about improvements in pharmacy practice. The regulatory agencies should consider the supportive framework that enables pharmacists to provide advanced practice while employing their experience, career structures for progression and growth, and funding for the advanced pharmacy services. It is interesting to see how the 6-year PharmD graduates, who are expected to have greater competence than prior BPharm graduates, will influence pharmacy practice. Despite several hurdles and barriers, the transition in Thai pharmacy education has the potential to support advancements in practice.

Keywords: Pharmacy practice, pharmacy education, Thailand, 6-year PharmD

Introduction

Global pharmacy practice and education are changing as a result of new scientific discoveries, evolving patient requirements, and shifting illness patterns. For present and future needs, there is a rising demand for advanced pharmacy practice models and pharmacy workforce competencies. As a result, several nations are undergoing considerable changes in pharmacy education in order to develop programmes that produce competent pharmacy graduates (Anderson *et al.*, 2012, Rouse *et al.*, 2014). However, making changes in practice has been more complicated than the implementation of the pharmacy education degree programmes. It will succeed not only from pharmacists' efforts but needs recognition from other health care providers, regulatory bodies and governments (Francisco, 2003, Watanabe *et al.*, 2005). This article aimed to review the current challenges in pharmacy education and pharmacy practice in Thailand, which is one of the countries transforming its pharmacy degree to the level of Doctor of Pharmacy.

Thailand Country Profile

Thailand is located in Southeast Asia; it is divided into 77 provinces with a population of 70.1 million (Institute for Health Metrics and Evaluation, 2021). Most Thai people are Buddhists (93%), followed by Muslims (5.4%), Christians (0.9%) and others (Wibulpolprasert, 2010). Thailand has met several millennium developments goals (MDGs) such as gender equality, fighting against HIV/AIDS, as well as and providing safe drinking water and sanitation. However, Thailand still needs to achieve sustainable development and to address targets on poverty and hunger reduction, universal primary education, child mortality and maternal health (Office of the National Economic and Social Development Board, 2010, United Nations, 2012, The Association of Southeast Asian Nations (ASEAN) Secretariat, 2017). Ischemic heart disease, stroke, lower respiratory infection, chronic kidney disease, liver cancer, lung cancer were the leading causes of death in 2019 (Institute for Health Metrics and Evaluation, 2021).

Health care system in Thailand

In Thailand, health care services are provided by both public and private sources (Sakunphanit, 2015, Strategy and Planning Division, 2017). The majority of the health care services are provided by the government, mostly through the Ministry of Public Health (MoPH) (Sirirak, 2010, Chaiyakunapruk *et al.*, 2016). The Thai health system provides four packages to the population, ranging from primary health care to special treatment (Sirirak, 2010).

1) Community health care services: these provide health promotion, prevention, and long-term care. They are delivered at home by the non-formal health workforce, which is made up of trained village health volunteers and health care providers, who are the primary care workers and nurses. In 2019, community pharmacies have been also designed to be the other public health care facilitators of the national health care system (The Royal Thai Government Gazette, 2019).

2) Primary health care services: this service is provided at health centres by health workforce members such as nurses and public health officers; with some pharmacists posted in selected health centres. Doctors and healthcare teams, including pharmacists, are made available at urban health centres; and mobile clinics are provided to rural health centres once or twice a month. Private clinics are also included in this service.

3) Secondary care services: these services are offered at community hospitals in rural areas, as well as general and private hospitals in metropolitan areas, which primarily focus on curative and rehabilitative care, and serve as referral hospitals for primary care settings. Healthcare teams oversee delivering care.

4) Tertiary care services: these services are available in cities through general hospitals, regional hospitals, medical school hospitals, and large private hospitals. Curative care, particularly in medical specialty services, is the primary focus of the services (Sirirak, 2010).

There are three primary public health insurance schemes, as follows: i) the Civil Servant Medical Benefit Scheme (CSMBS), which covers civil servants, public employees and their families and is paid by a general tax; ii) the Social Security Scheme (SSS) which covers private employees, and temporary public employees. It is funded by employees, employers and the government; iii) Universal Coverage Scheme (UCS) covers the majority of Thai people who are not covered by other plans. The National Health Security Office (NHSO) operates it and is funded by regular taxes. Private health insurance is also accessible for individuals (Chaiyakunapruk *et al*., 2016).

Pharmacy Practice in Thailand

In 2021, there were approximately 43,581 registered pharmacists (The Pharmacy Council of Thailand, 2021). The vast majority of pharmacists work in health care areas (68%) such as hospitals (40%) and community pharmacies (28%). The remaining of the pharmacists work in pharmacy industry and pharmacy marketing (16%), consumer protection (4%) and education (3%) (Suttajit *et al*., 2018, Suwannaprom *et al*., 2020, Suwannaprom *et al*., 2020). The pharmacist to population ratio is 1:2,261 (Suttajit et al., 2018) which is lower than the WHO's criterion of 1:2000 (Azhar *et al*., 2009). As a result, the Thai pharmacy workforce is insufficient. Thai pharmacists are expected to be active in all elements of the pharmaceutical supply chain, from the pharmaceutical manufacturing to patient care (Suttajit *et al*., 2018). In the following section, the two main pharmacy practice area will be reviewed, these being: i) pharmaceutical care involving hospital pharmacy and community pharmacies, ii) industrial pharmacy.

1. Pharmacy practice area

1.1 Hospital pharmacy

Thai hospital pharmacists play critical roles in: 1) dispensing, 2) drug procurement and inventory control, 3) patient-centred services, and 4) pharmaceutical and health consumer protection (Ploylearmsang *et al*., 2019).

Thai hospital pharmacists began to integrate clinical pharmacy activities into their pharmacy care practice after embracing the idea of pharmaceutical care, particularly through participating in ward rounds and ambulatory clinics, as pharmacists do in other countries (Chaiyakunapruk *et al*., 2016, Hou *et al*., 2018). The pharmaceutical care concept has been extended to many hospitals. Several specialities have been developed and recognised nationwide. The success of hospital pharmacy practice may be attributed to a robust hospital pharmacy organisation, as well as an active quality assurance system. Furthermore, academic support is strong, with an emphasis on patient-centred education and the transition to the PharmD program, which provides an advanced pharmacist role (Chaiyakunapruk *et al*., 2016, Ploylearmsang *et al*., 2019). Table 1 shows the details of hospital pharmacy practice in Thailand. Many factors have contributed to the improvement of pharmaceutical care in Thailand, including the development of the Healthcare Accreditation Institute and national health service plan (Ploylearmsang *et al*., 2019). The national health service plan focuses on enhancing hospital management efficiency and is categorized into 20 groups, for example, non-communicable disease, asthma and COPD, kidney disease, heart diseases, rational drug use, newborn health, palliative care, Thai traditional and alternative medicines, psychiatry and mental health, maternity, cancer, accidents. Furthermore, there are many advanced services and activities provided by hospital pharmacists in terms of the community of pharmacist (COP), mostly under the supervision of the Association of Hospital Pharmacy (Thailand), for example, diabetes care, adverse drug reactions, heart and vascular disease, aseptic dispensary, oncology, asthma and chronic obstructive pulmonary disease, family pharmacy, infectious diseases, renal disease. These communities of pharmacists (COP) help to maintain and improve pharmacy professional performance (Jaisue, 2015).

Table 1 Hospital pharmacy in Thailand

Factors	
Medical insurance system	The Thai health care system has three parts; CSMBS, SSS, UCS
The professional standards	The Association of Hospital Pharmacy of Thailand, in collaboration with the Division of Provincial Hospitals, established hospital pharmacy professional standards (Pramyothin, 2013); 1. Leadership and management 2. Medication information 3. Optimising medication therapy 4. Medication procurement and control 5. Infrastructure, equipment and information resources 6. Conduct research (Chaiyakunapruk et al., 2016)
Hospital pharmacy workforce -Pharmacists	11,564 pharmacists (Suttajit et al., 2018)
Hospital pharmacy services	- Patient care services, drug procurement and inventory control, health consumer protection, pharmaceuticals preparation, drug information service - Specialise: e.g., cardiology, nephrology, infectious disease, paediatrics, geriatrics, oncology

1.2 Community pharmacy area

Thai community pharmacies are one of the major health facilities where people can access medicines and health-related products (Technical working group for analysis of the Thai drug system, 2002, Chan *et al.*, 2005, Wibulpolprasert, 2010, Pummangura *et al.*, 2012). The National Statistical Institute reported that approximately 25% of Thai people use the community pharmacy as the primary care provider in 2006 (National Statistical Office, 2006). All drug stores are regulated by the Food and Drug Administration of Thailand. There are 4 categories of medicines;

1) Household remedies (Pitaknitinun K *et al.*, 2020): these medications are for minor diseases and can be purchased from any store without the supervision of a pharmacist. (e.g., paracetamol 500 mg, 10 tablets per strip).

2) Ready-packed medicines: Pharmacists, nurses, and other medical professionals can sell these medications without a prescription.

3) Dangerous medicines: these medicines can be purchased without a prescription at a community pharmacy, such as antibiotics, oral contraceptives, and antihypertensive medications.

4) Specially controlled medicines: these medicines can be obtained with a valid prescription from a drugstore staffed by a pharmacist; for example, steroid tablets (The Constituent Assembly in the capacity of the National Assembly, 1967, Chan *et al.*, 2005, Saramunee *et al.*, 2011)

In 2014, the Ministerial Regulations about the application for and grant of a licence to sell modern drugs B.E.2556 was implemented. This regulation is about the good pharmacy practice (GPP) assessment in which the community pharmacy must comply with sets of standards (Chalongsuk *et al.*, 2018). The categories of standard criteria are the premises of the pharmacies for modern drugs, equipment, personnel, and control of drug quality (Chariyasirisuk S *et al.*, 2020). The advantage of complying with this regulation is that it will offer better pharmacy service to patients (Wuttipanich *et al.*, 2015). However, there are

community pharmacies that appear to have been affected by the implementation of these standards (Chalongsuk *et al.*, 2018). There was a report that most of the entrepreneurs operating community pharmacies were legally able to practice under the regulation, but those who could not practice under this regulation, were likely to go out of business (Chalongsuk *et al.*, 2018, Chariyasirisuk S *et al.*, 2020). In 2021, there were approximately 13,906 community pharmacies in Thailand, which decreased from 18,900 drugstores in 2018. This declining number of community pharmacies might partly be due to the closure of pharmacies that cannot comply with the standards of good pharmacy practice (GPP) (Prachachat, 2020).

There are 1,662 community pharmacies accredited by the Office of Pharmacy Accreditation (Thailand). These accredited community pharmacies usually provide four primary care services.

1) Screen people for diabetes mellitus and hypertension and refer those who are at risk to a community hospital for further evaluation (Sookaneknun *et al.*, 2010)

2) Provide medicine management, such as prevention and management of drug related problems

3) Provide smoking cessation services

4) Provide health information and benefit of health insurance schemes (Ploylearmsang *et al.*, 2013).

Participation in the NHSO's primary care project is starting to upgrade community pharmacies to be excellent first line health care service settings (Sookaneknun *et al.*, 2010, Sookaneknun *et al.*, 2012). Pharmacy faculties should prepare the PharmD graduates for their expected roles, especially in the primary care services.

Furthermore, there is a programme called "Take medicine close home" which is an initiative programme within the Thai Universal Coverage Scheme (USC). This programme aims to supply medicine from hospitals to patients through community pharmacies. It was launched in 2019 by the National Health Security Office (NHSO), the government agency operating UCS, in collaboration with the Pharmacy Council of Thailand, the Community Pharmacy Association, and the Association of Hospital Pharmacy (Thailand). The programme initiated a medicine delivery system in which patients can pick up medicine from pharmacies located in their communities, without going to hospitals, free of charge. Table 2 shows the details of community pharmacy practice in Thailand.

Community pharmacies played a vital role in public health in preventing and containing the COVID-19 pandemic. There were reports of the community pharmacies' activities regards COVID-19 in many countries. For example, the implementation of the home delivery of medicines to home-isolating patients during the COVID-19 outbreak and provision of service of COVID-19 testing sites at community pharmacies in the United States (Cadogan *et al.*, 2021, Carpenter *et al.*, 2021, Merks *et al.*, 2021, Sum *et al.*, 2021). In Thailand, community pharmacies had the front-line activities for supply of over the counter and prescription medicines to patients, implemented referral pathways for any suspected cases, continued pharmaceutical services and supply of essential medications and other products such as protective masks and hand sanitiser.

Recently, the NHSO announced that community pharmacies had been selected as COVID-19 Antigen Test Kit (ATK) distribution partners since they are located in many communities and are staffed by pharmacists (Bangkok Post, 2021). Because of the high number of patients with COVID-19 virus in Thailand over several months, the NHSO plans to further allow ATK to be distributed at convenience stores and online businesses for more accessibility, but the results of the ATK test must be approved by authorized health care personnel, including pharmacists (Bangkok Post, 2021, National Health Security Office, 2021). In August of 2021, the Pharmacy Council of Thailand announced guidelines for community pharmacists to distribute Covid-19 ATK free of charge to individuals at-risk of COVID-19 infection and to dispense favipiravir to Covid-19 patients in home isolation (The Royal Thai Government Gazette, 2021).

Table 2 Community pharmacy in Thailand

Factors	
Number of community pharmacies	17,398 (33% pharmacies are located in Bangkok (1 pharmacy: 2,116 population); 67% are located in regional (1 pharmacy:7,500 population) (National Statistical Office, 2011)
Number of community pharmacies per 1000,000 population	26.60
Proportion of community pharmacy	97% Independent, 3% Chain store
Drug regulation	Drug Act, B.E. 2510 (1967) describes four types of drugs available in Thailand; 1. Household remedies 2. Ready-packed medicines 3. Dangerous medicines 4. Specially controlled medicines (The Constituent Assembly in the capacity of the National Assembly, 1967)
Community pharmacy regulation	Bureau of Drug Control, Thai FDA regulation compulsory
Funding	Almost 100**%** medicines and other sales
Services	1. Conventional services (e.g., Providing services in common ailments, referring for the potential serious problems) 2. Role as subcontractor with the public hospitals or private clinics - Providing prescribed drugs and drug related problem management 3. Pharmaceutical care (e.g., patient assessment, medication monitoring) (Kittipibul *et al.*, 2006), medication therapy management (MTM), family pharmacy service (Yotsombut *et al.*, 2012) 4. Primary care services (e.g., screening for diabetes mellitus and hypertension, provide health information and benefit of health insurance schemes (Yotsombut *et al.*, 2012, Ploylearmsang *et al.*, 2013)
Health promotion services	Screening for diabetes mellitus and hypertension, weight management, nutrition and physical activity, sexual health services, smoking cessation services, home care, depression screening and advisory service (Inoue *et al.*, 2015, Phimarn *et al.*, 2015)
Standard guideline	Standard of Accredited Pharmacy (2001) by the Pharmacy Council of Thailand (Pramyothin, 2013)

1.3 Pharmaceutical and health consumer protection area

Pharmaceutical and health care protection is another pharmacy practice area to which pharmacists contribute. Consumer's problems with health products and services are a sophisticated challenge since they include many stakeholders, such as, consumers, entrepreneurs, and regulators. Although a pharmacist working as a pharmaceutical and health consumer protection officer is comfortable with their job, they may be reluctant to employ the prosecution mechanism. They would rather use alternative methods (e.g., advice, counselling, and teaching or consumer empowerment) than legal enforcement. They

are aware that consumer issues involve many factors, as well as the limitations of the authorities and their organizations. It is still difficult to find solutions to these problems (Karnwareetip S *et al.*, 2016).

1.4 Telepharmacy

The COVID-19 pandemic is also changing the use of information technology in health care services. Telemedicine has been used to provide electronic consultations and reduce the risk of transmission by reducing contact among people. Telepharmacy is a subset of telemedicine that refers to the provision of pharmaceutical services to patients who are located at a distance as well as the provision of medication information to other healthcare providers (Ameri *et al.*, 2020). Many countries have legally expanded the role of pharmacists to provide remote communication with patients via telepharmacy tools such as virtual consultation, social networking, and home delivery of medicines (Mohamed Ibrahim *et al.*, 2020). In addition, patient assessment, patient counselling, and drug information services are examples of remote services via telepharmacy. Others include disease prevention services, therapeutic drug monitoring, and assessment of clinical outcomes (Hedima *et al.*, 2021). The Pharmacy Council of Thailand announced guidelines for telepharmacy in 2020 (The Pharmacy Council of Thailand, 2020).

2. Industrial pharmacy

In 2020, the Thai Food & Drug Administration reported that there are 144 domestic pharmaceutical industry companies with Good Manufacturing Practice-Pharmaceutical Inspection Co-operation Scheme (GMP-PIC/S) accreditation. The Thai pharmaceutical industry mainly focuses on producing finished products from imported active ingredients (Tunpaiboon N, 2020).

Thailand has good potential for research and development on generic drugs, in terms of drug formulations not using advanced or complicated technology. Thailand had rarely developed new drugs due to the high cost of investment and high level of research required to do so (The Office of Industrial Economics, 2013).

There are three groups of drug manufacturers in Thailand:

1) Multinationals with foreign shareholders, which focus on original drugs and operate as agents to import higher priced drugs for distribution in Thailand (e.g., Novartis, Pfizer, Roche, and Sanofi-Aventis).

2) Local manufacturers with Thai shareholders or Thai- owned companies that mainly focus on general-purpose generic drugs (e.g., Berlin Pharmaceutical Industry, Siam Pharmaceuticals, Thai Nakorn Patana).

3) State enterprises (e.g., the Government Pharmaceutical Organisation (GPO), the Defence Pharmaceutical Factor), which mainly focus on the generic drug production as alternatives to imported drugs (Tunpaiboon N, 2020).

Industry pharmacists are mainly involved in product and quality control. Their primary responsibility is to monitor the medicinal products to ensure that the products meet the requirements, and do not place the patient at risk due to insufficient safety, quality and efficacy (Chantaraskul, 2014). In the coming period, the Thai pharmaceutical industry could be confronted with rising input prices due to a temporary halt in the production of the main ingredients and other ingredients in China or because the Indian government has prohibited the export of pharmaceutical inputs in order to keep these for domestic use (Tunpaiboon N, 2020).

Thai pharmaceutical industry has a chance to improve domestic production processes and reduce reliance on imports. This could be the result of the government policy that encourages the manufacturers to produce high-value original medicines for which patents have expired, as well as, to develop biological products for which demand has increased (Jitruknatee A *et al.*, 2020, Tunpaiboon N, 2020). In addition, the MoPH, Siam Bioscience, SCG and AstraZeneca have collaborated to manufacture COVID-19 vaccines for Thailand and South East Asia. Based on the country's needs, one-third of the local supply capacity has been designated for use in Thailand. Countries from Southeast Asia will share the remaining two-thirds of the supply capacity (Ministry of Public Health, 2020).

Pharmacy Education in Thailand

Thailand's first pharmacy school was established in 1914. It began with a three-year curriculum, then expanded to a four-year program in 1941, and finally to a five-year BPharm program in 1957 (Kapol *et al.*, 2008, Pongcharoensuk *et al.*, 2012, Pramyothin, 2013, Sumpradit *et al.*, 2014). The PharmD program began as a 2-year post-bachelor program and subsequently changed to an entry-level 6-year PharmD program, which was announced in 1995 and implemented in 1997 (Chaiyakunapruk *et al.*, 2016). The first of the Thai PharmD programs was launched at Naresuan University (Pongcharoensuk *et al.*, 2012). For the BPharm graduates who would like to study in the PharmD program, the Faculties of Pharmaceutical Sciences at Naresuan University and Chulalongkorn University provided a 2-year post-BPharm PharmD program (Thomas *et al.*, 2011).

There were post-graduate programs available such as the master's degree program (clinical pharmacy) or the Board Certification in Pharmacotherapy, which aimed to assist Thai BPharm graduates gain knowledge and competency in clinical pharmacy. The BPharm program was no longer offered after 2010, due to the mandate of the Pharmacy Council of Thailand (PCT) that the 6-year PharmD program would be the only program eligible for the pharmacy licensure examination (The Royal Thai Government Gazette, 2008, Sumpradit *et al.*, 2014). From 2010, all faculties offered only the PharmD program, hence it is called an "all-PharmD" program. The time period and the offered pharmacy degree in Thailand are presented in Table 3. There are 19 faculties of pharmacy based in 14 public and 5 private universities, which are accredited by the PCT to offer only the PharmD degree (Table 4). There are three tracks within the PharmD program: pharmaceutical care (PC), pharmaceutical science or industrial pharmacy (IP) and pharmaceutical and health consumer (CP). These special tracks were designed to provide an opportunity for students to focus on more specialised areas. There are many postgraduate programs offered in Thailand: i) Masters and PhD degrees by numerous pharmacy faculties. Furthermore, there are 6 colleges that provide the board of pharmacy and qualified pharmacists specialty in terms of board certification in advancing pharmacy practice or Thai residency program approved by the PCT (Figure 1), which are as follows;

1. The College of Pharmacotherapy of Thailand (CPhT) provides the Board Certification Pharmacotherapy Training Program for training pharmacy residencies in specialised areas such as internal medicine, paediatrics, oncology (The Royal Thai Government Gazette, 2008). Many successful graduates from the Thai residency program have been at the forefront of advancing pharmacy practice in Thailand (Nathisuwan *et al.*, 2020).

2. The College of Pharmaceutical and Health Consumer Protection of Thailand (CPHCP) provides a program for training pharmacy residencies in medication and health consumer protection specialised areas (The Royal Thai Government Gazette, 2011)

3. The College of Herbal Pharmacy of Thailand (CHPT) provides a program for training pharmacy residencies in herbal pharmacy (The Royal Thai Government Gazette, 2019).

4. The College of Industrial Pharmacy of Thailand (CIPT) provides a program for training pharmacy residencies in industrial pharmacy (The Royal Thai Government Gazette, 2021)

5. The College of Pharmacy Administration of Thailand (CPAT) provides a program for training pharmacy residencies in pharmacy administration specialised areas (The Royal Thai Government Gazette, 2021)

6. The College of Community Pharmacy of Thailand (CCPT) provides a program for training pharmacy residencies in community pharmacy (The Royal Thai Government Gazette, 2021)

Table 3 The period and duration of offered pharmacy degrees in Thailand (Nawanopparatsakul *et al.*, 2009-2010, Pongcharoensuk *et al.*, 2012, Chaiyakunapruk *et al.*, 2016, The Royal Thai Government Gazette, 2016)

Period	Offered degree	Duration of study (year)
1914-1934	Pharmacy compounding certification	3
1935-1936	Pharmacy certification	3
1937-1940	Pharmacy associate's degree	3
1940-1956	BSc[a] or BPharm[b]	4
1957-2010	BSc[a] or BPharm[b]	5
1999-2010	PharmD[c] the 1995-announced PharmD	6
2010-2016	All-PharmD[c] (the 2008-announced curriculum structure PharmD programme)	6
2017-2018	All-PharmD[c] (the 2016-announced curriculum structure PharmD programme)	6
2019-present	All-PharmD[c] (the 2018-announced curriculum structure PharmD programme)	6

[a]BSC = Bachelor of Sciences; [b]BPharm = Bachelor of Pharmacy, [c]PharmD = Doctor of Pharmacy

Table 4 List of faculties of pharmacy in Thailand which are accredited by the Pharmacy Council (Pongcharoensuk *et al.*, 2012, Chaiyakunapruk *et al.*, 2016, Wongpoowarak P, 2018)

University	Year founded	Type of ownership	PharmD Tracks
1. Faculty of Pharmaceutical Sciences, Chulalongkorn University	1913	Public	PC[a], IP[b]
2. Faculty of Pharmacy, Chiangmai University	1966	Public	PC, IP
3. Faculty of Pharmacy, Mahidol Univeristy	1968	Public	PC, IP
4. Faculty of Pharmaceutical Sciences, Prince of Songkla University	1980	Public	PC, IP
5. Faculty of Pharmaceutical Sciences, Khon Kaen University	1983	Public	PC, IP, PHCP
6. Faculty of Pharmacy, Silpakorn University	1985	Public	PC, IP, PHCP
7. Faculty of Pharmacy, Rangsit University	1987	Private	PC, IP
8. Faculty of Pharmaceutical Sciences, Huachiew Chalermprakiet University	1993	Private	PC, IP
9. Faculty of Pharmaceutical Sciences, Naresuan University	1994	Public	PC
10. Faculty of Pharmaceutical Sciences, Ubon Ratchathani University	1994	Public	PC, IP
11. Faculty of Pharmacy, Srinakharinwirot University	1996	Public	PC, IP
12. Faculty of Pharmacy, Mahasarakham University	1999	Public	PC
13. Facuty of Pharmacy, Siam University	2006	Private	PC
14. Faculty of Pharmacy, Payap University[d]	2006	Private	PC
15. School of Pharmacy, Walailak University	2007	Public	PC, IP
16. School o f Pharmacy, Eastern Asia Univeristy	2008	Private	PC, IP
17. Faculty of Pharmaceutical Sciences, Burapha University	2009	Public	PC, IP, PHCP
18. School of Pharmaceutical Sciences, University of Phayao	2010	Public	PC
19. Faculty of Pharmacy, Thammasat University	2013	Public	PC, IP

[a]PC = Pharmaceutical Care; [b]IP = Pharmaceutical Science or Industrial Pharmacy, [c]PHCP = Pharmaceutical and Health Consumer Protection, [d]The course which was modified in 2017, offers only the PC-PharmD program.

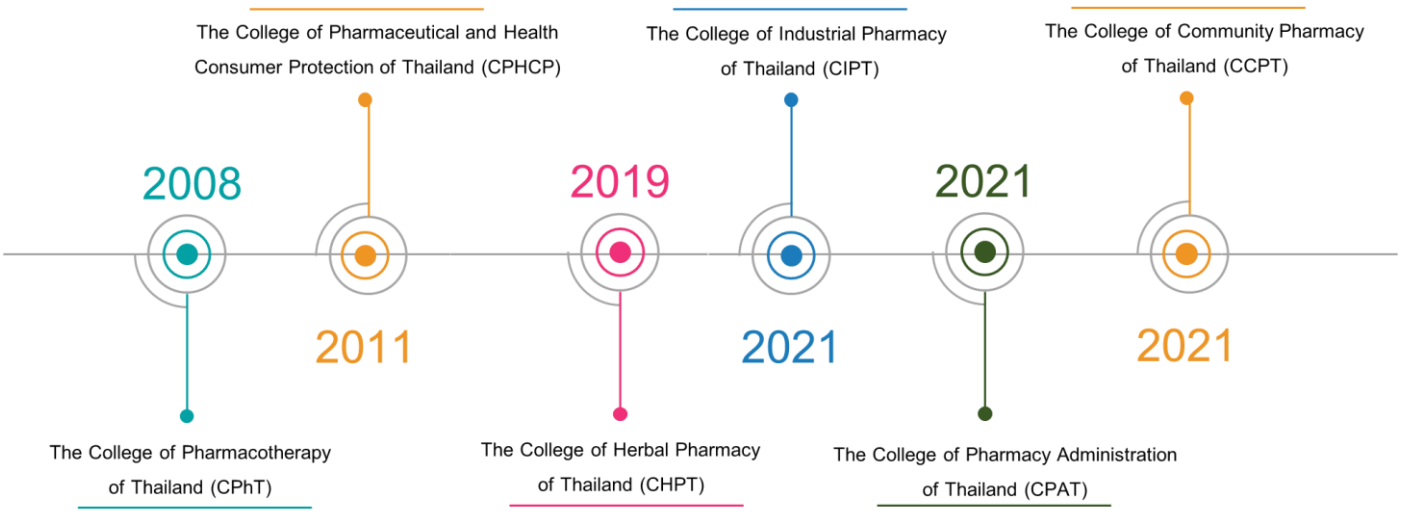

Figure 1 The 6 colleges that provide the board of pharmacy and qualified pharmacists specialty establishment timeline (The Royal Thai Government Gazette, 2008, The Royal Thai Government Gazette, 2011, The Royal Thai Government Gazette, 2019, The Royal Thai Government Gazette, 2021, The Royal Thai Government Gazette, 2021, The Royal Thai Government Gazette, 2021)

Entry qualification and educational cost

There are two paths of admission to pharmacy programs: through direct admission or the central admission system. The cost of one full-time student at a pharmacy faculty ranges from 25,000 baht per semester (£550 or $766) to 75,000 baht per semester (£1,680 or $2,300) for public universities and approximately 100,000 baht per semester (£2,205 or $3,000) for private universities.

The majority of faculties divide the academic year into 2 semesters and a summer session (Chulalongkorn University, 2019, Burapha University, 2021, Chiang Mai University, 2021, Khon Kaen University, 2021, Mahasarakham University, 2021, Naresuan University, 2021, Prince of Songkla University, 2021, Silpakorn University, 2021, Thammasat University, 2021, Ubon Ratchathani University, 2021, University, 2021, University of Phayao, 2021, Huachiew Chalermprakiet University, 2021, Rangsit University, 2021, Siam University, 2021).

Pharmacy licensure examination

Since 2003, the PCT has decreed that all pharmacy graduates, who are in the last education year, must take a licensure examination to ensure and standardise the quality of pharmacists from different faculties. The licensure examination is divided into 2 types of examinations, which are the multiple choice questions (MCQ) and Objective Structured Pharmaceutical Examination (OSPE) (Kanke *et al.*, 2012). This type of licensure examination will be ended in 2022 (The Pharmacy Council of Thailand, 2017). The PCT requires pharmacy students who enter their study programme from 2017 to take two examinations for licensure after the end of the 4th year and 6th year. The new form of the licensure examination are as follows; the first examination is at the end of the 4th year to test their core competencies which divided into 2 examinations;

1. MCQ: Pharmacy Licensure Examination Core Competency: PLE:CC1 and 2. OSPE: Pharmacy Licensure Examination Core Competency: PLE: CC2.

2. The second examination is at the end of their 6th year to determine their competencies in specialised areas. The second examination divided into three special tracks which will be described as follows;

1) Industrial pharmacy (IP):

- Pharmacy Licensure Examination Industrial Pharmacy1: PLE-IP1 (MCQ)

- Pharmacy Licensure Examination Industrial Pharmacy1: PLE-IP2 (Objective structured pharmacy examination (OSPE) and long case examination)

2) Pharmaceutical care (PC):

- Pharmacy Licensure Examination Pharmacy care1: PLE-PC1 (MCQ)
- Pharmacy Licensure Examination Pharmacy care2: PLE-PC2 (Objective structured pharmacy examination (OSPE) and long case examination) (The Pharmacy Council of Thailand, 2017)

3) Pharmaceutical and Health Consumer Protection (PHCP):

- Pharmacy Licensure Examination Pharmacy care1: PLE-PHCP1 (MCQ)
- Pharmacy Licensure Examination Pharmacy care2: PLE- PHCP2 (Objective structured pharmacy examination (OSPE) and long case examination) (The Pharmacy Council of Thailand, 2022)

In 2022, the Pharmacy Council of Thailand announced the arrangements for the second examination for three specialized areas, namely IP, PC and PHCP. Although the second examination is divided into more than one special track, all pharmacy qualifications grant graduates the same license to work in all fields.

Number of pharmacy students and graduates

Approximately 2,500 new students are enrolled each year and approximately 2,000 graduate (Chanakit *et al.*, 2015). Approximately 20% of the students dropped out. However, there is no more information regarding the dropout of pharmacy students in Thailand. There were some possible reasons for dropping out as follows; i) incapability in passing the examination or getting low grade point average; ii) some of them leave pharmacy for medicine or dentistry or other academic pursuits. There were PharmD graduates from the 1995-announced PharmD in pharmaceutical care from 2005 to 2014. Recently, approximately 1,700 pharmacy graduates were produced each year (Suttajit *et al.*, 2018).

The number of the 1st, 4th, 6th year pharmacy students and academic staff in 2017

The number of the 1st, 4th, 6th year pharmacy students from 19 university faculties for the year 2018 were as follow; 2,218; 1,842 and 1,719, respectively. Academic staff numbers at private and public universities were 273 and 993, respectively (Wongpoowarak P, 2018).

Thai pharmacy curriculum structure

1. The differences between the pharmacy programs in the past and present

Pharmacy education has progressed from a five-year BPharm (with three tracks of pharmaceutical care, pharmaceutical sciences, and social and administrative pharmacy), as well as a traditional 6- year PharmD (pharmaceutical care), to “an all-PharmD programme” (see Figure 2) (Wongpoowarak, 2002, The Pharmacy Council of Thailand, 2012).

The 6-year PharmD program, announced in 2008, emphasized patient care by providing a higher number of credits in the pharmacy courses on patient care (30%), compared to the 25% in pharmaceutical sciences (The Pharmacy Council of Thailand, 2012). Later, the 2015 and 2018 6-year PharmD course structures were divided into three major tracks: pharmaceutical care (PC), industrial pharmacy (IP), and pharmaceutical and health consumer protection (PHCP) (see Table 5) (Suttajit *et al.*, 2018)

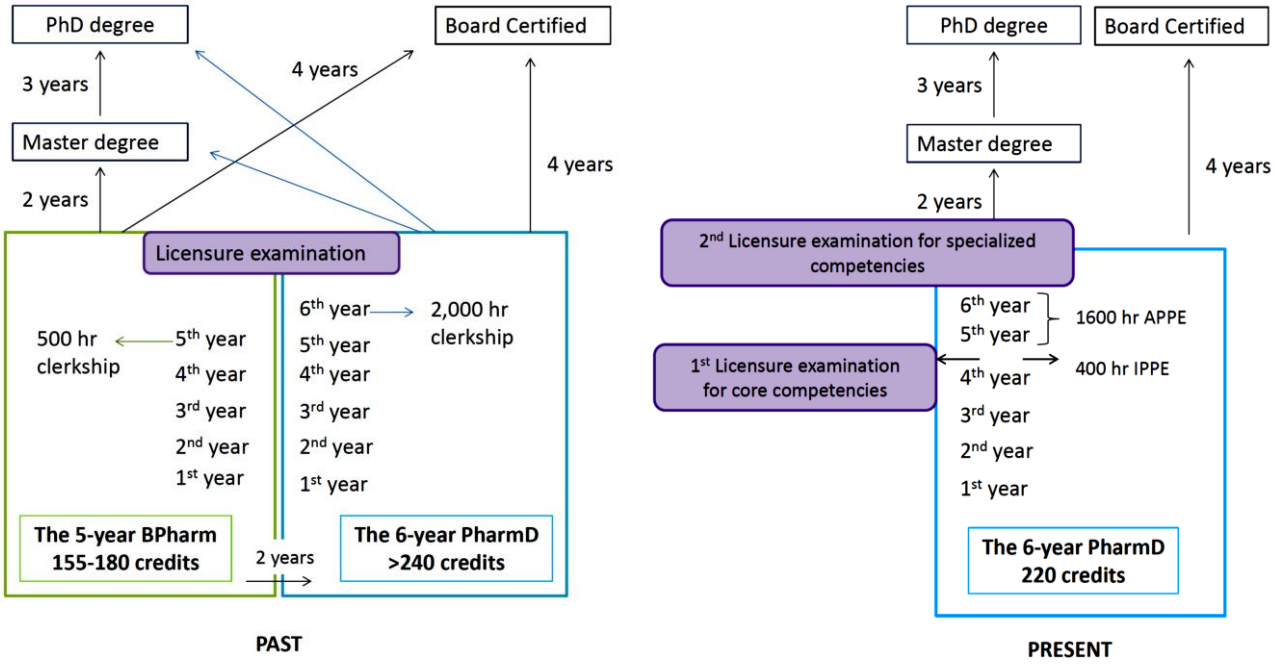

Figure 2 The pharmacy education in Thailand in the past (1997-2010) and the present

Adapted with permission from Wongpoowarak, 2002 (Wongpoowarak, 2002, Tassaneeyakul W *et al.*, 2013)

Table 5 Differences between the 5-year BPharm and all-PharmD curriculum structures (Sanguansermsri M *et al.*, 1998, The Royal Thai Government Gazette, 2005, The Royal Thai Government Gazette, 2008, The Pharmacy Council of Thailand, 2012, Suttajit *et al.*, 2018, The Pharmacy Council of Thailand, 2018)

	Before 2008: BPharm and PharmD programme		**From 2008: announced curriculum structure all-PharmD[b]**		
	The five-year BPharm[a]	**The 2008 PharmD[b]**	**The 2012 PharmD[b]**	**The 2015 PharmD[b,k]**	**The 2018 PharmD[b,k]**
Characteristics	To fulfil general pharmacist with elective courses of interest (e.g., clinical pharmacy, pharmaceutical technology)	Focused in pharmaceutical care	Divided into 2 main tracks: PC-PD[c], IP-PD[d]	Divided into 3 main tracks: PC-PD[c], IP-PD[d] , PHCP-PD[i]	Divided into 3 main tracks: PC-PD[c], IP-PD[d], PHCP-PD[i]
Curriculum structure Credits (minimum)					
1. General education[e]	≥ 30-57	≥ 30	≥ 30	≥ 30	≥ 30
2. Pharmacy courses	≥ 126-155	≥ 144	≥ 144	≥ 184	≥ 184
2.1 Basic sciences[f]	≥ 27-71	≥ 30	≥ 30	≥ 30	≥ 30
2.2 Professional courses[g]	≥ 79-103	≥ 114	≥ 114	≥ 114 and clerkship 34 credits	≥ 114 and clerkship 34 credits
-Pharmaceutical care	≥ 37-52	≥ 42 credits (or 30% of pharmacy course)	≥ 30 credits (or 25% of pharmacy course)	≥ 30 credits (or 25% of pharmacy course)	≥ 30 credits (or 25% of pharmacy course)

Table 5 Differences between the 5-year BPharm and all-PharmD curriculum structures (Sanguansermsri M *et al.*, 1998, The Royal Thai Government Gazette, 2005, The Royal Thai Government Gazette, 2008, The Pharmacy Council of Thailand, 2012, Suttajit *et al.*, 2018, The Pharmacy Council of Thailand, 2018) (*Continued*)

	Before 2008: BPharm and PharmD programme		**From 2008: announced curriculum structure all-PharmD[b]**		
	The five-year BPharm[a]	**The 2008 PharmD[b]**	**The 2012 PharmD[b]**	**The 2015 PharmD[b,k]**	**The 2018 PharmD[b,k]**
-Pharmaceutical sciences	≥ 32-57	≥ 35 credits (25%)	≥ 30 credits (25%)	≥ 30 credits (25%)	≥ 30 credits (25%)
-Social pharmacy	≥ 5-19	≥ 14 credits (10%)	≥ 15 credits (12%)	≥ 15 credits (12%)	≥ 15 credits (12%)
-Specialty professional/track	≥ 6-36	N/A	≥ 45 credits (37%)	≥ 15 credits	≥ 15 credits
2.3 Professional practice	500 hours	2,000 hours[h] **-Clerkship in core competencies:** 400 hours **-Clerkship in specialised area:** 1,600 hours	2,000 hours[h] **Clerkship in core competencies:** 400 hours (≥6 credits) **-Clerkship in specialised area:** 1,600 hours (≥28 credits)	2,000 hours[h] **-Clerkship in core competencies:** 400 hours (≥6 credits) **-Clerkship in specialised area:** 1,600 hours (≥28 credits) In 3 tracks (PC, IP, SAP[j])	2,000 hours[h] **-Clerkship in core competencies:** 400 hours (≥6 credits) **-Clerkship in specialised area:** 1,600 hours (≥28 credits) In 3 tracks (PC, IP, SAP[j])
3. Free elective courses	3-6	6	6	6	6
Total credits required	150-188	220	220	220	220

[a] The 5-year BPharm and structure follows curriculum standard for higher education; [b] The 2008 Announced 6-year PharmD curriculum and the 2012 Announced 6-year PharmD curriculum structure follows Thailand Qualification Framework (TQF) for certification of Doctor of Pharmacy degree and the Pharmacy Council of Thailand; [c] Pharmaceutical care PharmD (PC-PD) programme; [d] Industrial pharmacy PharmD (IP-PD) or pharmaceutical sciences programme; [e] General education e.g., computers, humanities, language and communication, sciences, mathematics, statistics; [f] Basic sciences (e.g., anatomy, biochemistry, microbiology, physiology); [g] Professional courses (e.g., pharmaceutical technology, pharmacotherapy, pharmacy administration, pharmacy orientation, forensic pharmacy, senior project); [h] One professional practice credit represents between 45 and 60 hours of practice training; [I] Pharmaceutical and health consumer protection (PHCP-PD); [j]Social and Administrative Pharmacy (SAP)

[k]The announced curriculum structure all-PharmD in 2015 and 2018 were the same except the part of the industrial pharmacy clerkship, as follows;

- The 2015 PharmD: Industrial pharmacy track: "The curriculum should have at least 2 compulsory professional practice courses or 2 rotations", which have contents as follows; drug production, quality assurance/quality control.

- The 2018 PharmD: Industrial pharmacy track: "The curriculum should have at least 2 rotations", which have contents as follows; drug production, quality assurance/quality control.

2. The structure guideline of the new PharmD curriculum

Year 1 content will cover general education topics: computers, humanities, language and communication, sciences and mathematics, statistics. Year 2 content will cover basic sciences: anatomy, biochemistry, microbiology and physiology, together with some professional courses. Year 3 and 4 content will cover professional pharmacy courses including: pharmaceutical technology, pharmacotherapy, pharmacy administration and forensic pharmacy. In the last two years, pharmacy students can select their specialties. Year 5 and 6 content will cover professional practice courses and will consist of specialised clerkships (The Pharmacy Council of Thailand, 2012, Sub-committee in Pharmacy Education, 2014).

3. The clerkship structure of the new PharmD programme

After completing their fourth year, students will begin their first 400 hours of clerkship, which will include practical experiences in hospital and community pharmacies. These two clerkship settings are required for all pharmacy students which are equivalent to the Introductory Pharmacy Practice Experience (IPPE) in the United States. The use of the remaining 1,600 hours professional practice time, equivalent to Advanced Pharmacy Practice Experience (APPE), will depend on individual's interest in pharmaceutical care, industrial pharmacy or pharmaceutical and consumer protection (Suttajit *et al.*, 2018, Suwannaprom *et al.*, 2020, Suwannaprom *et al.*, 2020). The clerkship structure of the PharmD programme for each special track is presented in Table 6.

Table 6 Clerkship structure of the PharmD programme for each special track follows the announced curriculum structure all-PharmD 2018 of the Pharmacy Council of Thailand (The Pharmacy Council of Thailand, 2018)

Year	Number of rotations	Pharmaceutical care track		Industrial pharmacy track	Pharmaceutical and Health Consumer Protection
4th	2	Clerkship in core competencies: 2 clerkships in hospital and community settings of at least 400 hours			
5th-6th	Professional practice clerkship in specialised areas: 1600 hours (6-7 clerkships)				
		Hospital pharmacy	Community pharmacy		
	2-3	Advanced hospital pharmacy clerkship (specialised area)	Advanced community pharmacy clerkship or Primary care clerkship (specialised area)	Advanced pharmaceutical sciences clerkship (drug production, quality assurance or quality control, research and development, regulation and registration)	Consumer protection system clerkship, Law enforcement for consumer protection clerkship, Protection of consumers in the community clerkship, Drug and health product safety management clerkship
	1	Medication system management clerkship	Consumer protection clerkship		
	1	Acute care clerkship/ Medicine clerkship	Acute care clerkship/ Medicine clerkship		
	1	Ambulatory clerkship	Ambulatory clerkship	Quality assurance or quality control clerkship	Information management for consumer protection clerkship
	1	Community Pharmacy clerkship/ Primary care clerkship	Community pharmacy clerkship/ Primary care clerkship	Drug production clerkship	Medicine and health policy clerkship Consumer protection in community pharmacy

Discussion

The pharmacy curriculum in Thailand has been changed to a 6-year PharmD program, which is aimed at producing graduates with competencies that meet the needs of the country (Pitchayajittipong *et al.*, 2020). It has involved both internal and external educational institutions. Pharmacy practice in all sectors has been improved accordingly (Jaisue, 2015, Ploylearmsang *et al.*, 2019)**.** The employers were satisfied with the graduate characteristics and their competencies (Pitchayajittipong *et al.*, 2020, Supapaan *et al.*, 2021).

Enhancing the opportunity for extending pharmacists' involvement in the health care system beyond dispensing prescription medicines might occur only when the government mandates it (Kishi, 2001, Dalton *et al.*, 2017, Sakeena *et al.*, 2019). To make changes in pharmacy practice, there still needs to be more collaboration among education, practice and regulation.

The regulatory agencies should consider a supportive approach that allows pharmacists to provide advanced practice while utilizing their competencies. Furthermore, policymakers should develop a policy for pharmacy professional administration in health care systems by addressing career structures for progression and development, as well as wage revision for the provision of new pharmacy services (Anderson *et al.*, 2012, Anderson, 2013, Babar *et al.*, 2013, The World Health Organization, 2013, Vlasses *et al.*, 2013, American Association of Colleges of Pharmacy, 2016).

The National Health Service Business Services Authority (NHSBSA) has begun a post-payment verification process for payments to community pharmacy contractors for the provision of advanced services, including new medicine services (NMS) and flu vaccination advanced service.

For example, based on the total number of patients provided with a service in a month, community pharmacy contractors earn around 872 baht (£20 or $26.1) for every completed NMS they provide. The framework rewards each complete NMS supplied while simultaneously promoting the service to be provided to as many patients as possible (Pharmaceutical Services Negotiating Committe (PSNC), 2021). Long-term economic evaluations for the NMS, indicate that this service may provide better patient outcomes and lower total healthcare expenditures than standard practice (Elliott *et al.*, 2020).

There has been a report of a low level of satisfaction with hospital pharmacists' compensation in Thailand (Traisilanan *et al.*, 2014). Another study reported that there were concerns the average pharmacist salary has been growing slowly (Chanakit *et al.*, 2015). The payment system for pharmacist affects efficacy and partly impacts their engagement in the public health system. Furthermore, differential remuneration for professionals was identified (Jeanpeerapong *et al.*, 2020). To address the lack and misdistribution of health people, which are concerns in Thailand's healthcare system, further research into satisfaction with payment and factors influencing engagement in the public health system is still required.

Recently, there was a movement from the Pharmacy Student Union of Thailand, which submitted a letter to the Pharmacy Council and the MoPH requesting that new pharmacists should be sent to work in 62 provinces (including 218 hospitals and 40 provincial public health offices). These hospitals are waiting for the new pharmacists to assist with the management of the COVID-19 vaccine, which was intended to be managed five months ago. These newly graduated pharmacy students from public universities who choose to work in the government sector, are still waiting for positions as government officers or civil servants (Thai Public Broadcasting Service, 2021).

During the COVID-19 outbreak, pharmacists in some countries demonstrated readiness to be involved in the COVID19 vaccine supply, administration and also involved in supplying rapid COVID-19 tests (Paudyal *et al.*, 2021). In Thailand, pharmacists are currently contributing at the forefront of the vaccination program for the COVID-19 pandemic in many ways, for instance, management of supply chain, vaccine preparation before administration,

hosting vaccination sites with healthcare team, facilitating clinical services during the pandemic, and providing the Adverse Events Following Immunization (AEFI) service. National Health Security Office (NHSO) has collaborated with the Ministry of Public Health and Government Pharmaceutical Organization (GPO) to distribute COVID-19 antigen test kits (ATK) to hospitals and pharmacies across Thailand. The Pharmacy Council of Thailand has authorized the community pharmacies which are registered with the NHSO to deliver free ATK to at risk persons. As a result, pharmacists will be responsible for advising those who have ATK negative tests on how to isolate themselves at home. Pharmacists, on the other hand, will encourage those who have ATK positive tests to evaluate their symptoms and will give favipiravir to COVID-19 patients who are being treated at home (Bangkok Post, 2021, National Health Security Office, 2021). Stakeholders including policy makers, professional organizations, and educational institutions should debate delegating additional tasks to pharmacists in order to promote changes in relevant regulatory frameworks to include more and to ensure the effectiveness of the vaccination program (Paudyal *et al.*, 2021).

Conclusion

A variety of factors have contributed to the advancement of pharmacy practice including the COVID-19 pandemic. Thai pharmacists provide many innovative services intending to raise the pharmacy professional standards. There have been many recent changes in Thailand's 6-year PharmD program and more are expected. This shift in pharmacy education intends to address the healthcare needs of the country. The transition in pharmacy education has the potential to facilitate the required advancements in practice despite numerous challenges and barriers.

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