

# ความต้องการและทัศนคติต่อการศึกษาต่อและฝึกอบรมเฉพาะทาง ของเภสัชกรโรงพยาบาลในประเทศไทย Needs and Attitudes of Thai Hospital Pharmacists on Continuing Specialty Education and Training

## นิพนธ์ต้นฉบับ

บรรณสรณ์ เตชะจำเริญสุข<sup>1,2\*</sup> และ อารีวรรณ เขี้ยวชาญวัฒนา<sup>3</sup>

<sup>1</sup> นักศึกษาระดับปริญญาโท สาขาการจัดการเภสัชกรรม  
<sup>2</sup> คณะเภสัชศาสตร์ มหาวิทยาลัยหัวเฉียวเฉลิมพระเกียรติ อำเภอบางพลี จังหวัดสมุทรปราการ 10540  
<sup>3</sup> สาขาวิชาวิทยาศาสตร์สังคมและการบริหาร  
<sup>1,2</sup> คณะเภสัชศาสตร์ มหาวิทยาลัยขอนแก่น อ.เมือง จ.ขอนแก่น 40002

\* Corresponding author: bunnasorn@gmail.com

วารสารไทยเภสัชศาสตร์และวิทยาการสุขภาพ 2565;17(2):103-112.

## Original Article

Bunnasorn Techajumlersuk<sup>1,2\*</sup> and Areewan Cheawchanwattana<sup>3</sup>

<sup>1</sup> Master's degree student in Pharmacy Management Program  
<sup>2</sup> Faculty of Pharmaceutical Sciences, Huachiew Chalermprakiet University, Bangpli, Samutprakarn, 10540, Thailand  
<sup>3</sup> Department of Social and Administrative Pharmacy  
<sup>1,2</sup> Faculty of Pharmaceutical Sciences, Khon Kaen University, Muang, Khon Kaen, 40002, Thailand

\* Corresponding author: bunnasorn@gmail.com

Thai Pharmaceutical and Health Science Journal 2022;17(2):103-112.

## บทคัดย่อ

**วัตถุประสงค์:** เพื่อสำรวจความต้องการและทัศนคติในการศึกษาต่อและการอบรมเฉพาะทางของเภสัชกรโรงพยาบาลและปัจจัยที่เอื้อและขัดขวางโอกาสในการศึกษาต่อ

**การศึกษา:** การศึกษาเชิงพรรณนาแบบภาคตัดขวาง กลุ่มตัวอย่าง คือ เภสัชกรโรงพยาบาล สังกัดสำนักงานปลัดกระทรวงสาธารณสุขทุกระดับ โดยการสุ่มตัวอย่างแบบชั้นภูมิ การสำรวจใช้แบบสอบถามชนิดตอบด้วยตนเองโดยถามความต้องการและรูปแบบการศึกษาต่อ และทัศนคติเกี่ยวกับการศึกษาต่อ นำเสนอผลการศึกษาด้วยสถิติเชิงพรรณนาและการวิเคราะห์ความถดถอยโลจิสติก

**ผลการศึกษา:** มีผู้ตอบแบบสอบถาม 451 คน โดยมีเพียง 17.7% ที่เคยเรียนหรือฝึกความเชี่ยวชาญเฉพาะทาง ส่วนมากต้องการศึกษาในหลักสูตรประกาศนียบัตรระยะสั้น (80.9%) ตามด้วยหลักสูตรเภสัชกรประจำบ้าน (10.9%) ส่วนมากต้องการระยะเวลาในการศึกษาเพียง 4 เดือน (66.5%) ตามด้วย 6 เดือน (18.8%) ส่วนมากคิดว่าผู้อำนวยความสะดวกโรงพยาบาลและหัวหน้ากลุ่มงานเภสัชกรรมมีส่วนรวมในการวิเคราะห์และวางแผนการส่งเภสัชกรไปศึกษาต่อ โรงพยาบาลส่วนใหญ่ไม่กำหนดให้จำนวนเภสัชกรที่ได้ศึกษาต่อเป็นตัวชี้วัดคุณภาพของโรงพยาบาล (88.5%) ปัจจัยที่สนับสนุนให้เภสัชกรตัดสินใจศึกษาต่อ ได้แก่ ต้องการเพิ่มพูนความรู้ ความเชี่ยวชาญ พัฒนาทักษะดูแลผู้ป่วย รายได้และตำแหน่งที่สูงขึ้น ส่วนปัจจัยถ่วง ได้แก่ จำนวนเภสัชกรไม่เพียงพอที่จะอนุญาตให้ไปเรียน และขาดแคลนเงินทุนสนับสนุน เภสัชกรมีทัศนคติเชิงบวกต่อการศึกษาต่อ ผลการทดสอบความถดถอยโลจิสติกพบว่าเภสัชกรที่มีอายุงานน้อยกว่า 10 ปี เคยเรียนเฉพาะทาง และมีทัศนคติทางบวกต่อการเรียนเฉพาะทางมีความต้องการการศึกษาต่อมากกว่าอย่างมีนัยสำคัญทางสถิติ ( $P$ -value < 0.05) สรุป: เภสัชกรโรงพยาบาลส่วนใหญ่เห็นด้วยว่าการศึกษาต่อและการอบรมเฉพาะทางมีประโยชน์ โดยมีปัจจัยเอื้อหลายอย่าง ส่วนปัจจัยถ่วงมักเป็นผลจากการจัดสรรทรัพยากรมนุษย์ ความต้องการการศึกษาต่อสัมพันธ์กับอายุงานน้อย การเคยเรียนเฉพาะทาง และทัศนคติทางบวกต่อการเรียนเฉพาะทาง

**คำสำคัญ:** ความต้องการศึกษาต่อเฉพาะทาง, เภสัชกรเฉพาะทาง, เภสัชกรรมโรงพยาบาล

### Editorial note

Manuscript received in original form: April 19, 2021;  
Revision notified: April 28, 2021;  
Revision completed: May 22, 2021;  
Accepted in final form: May 23, 2021;  
Published online: June 30, 2022.

## Abstract

**Objective:** To determine needs and attitudes of hospital pharmacists toward continuing specialty education and training and relevant factors including opportunities and obstacles to pursuing the education. **Methods:** In this cross-sectional descriptive study, participants were pharmacists from all-level hospitals under the Office of Permanent Secretary, Thailand Ministry of Public Health selected by a stratified sampling method. A self-administered questionnaire asked about needs and types of specialty education, and attitudes towards the education. Descriptive statistics and logistic regress were used for data analysis. **Results:** Of the 451 participants, only 17.7% had an experience with training program. Most reported the need for the short-term certification program (80.9%), followed by general residency program (12.0%). Most preferred 4 and 6 months of study (66.5% and 18.8%, respectively). Most participants thought that the hospital director and head of pharmacy department involved in the analysis and planning for pharmacist specialty education. Most also reported that hospitals did not use the number of pharmacists with specialty education as an indicator for hospital accreditation (88.5%). Factors supporting pursuing specialty education were the need for advanced knowledge, expertise, and skills for patient care, higher salary, and career advancement. Obstructive factors included a shortage of staff in the pharmacy department and a lack of financial support. Most participants had positive attitude toward the education. Logistic regression analysis revealed that those with less than 10 years of work experience, a history of specialty training, and positive attitude were significantly more likely to have a need for specialty education ( $P$ -value < 0.05). **Conclusion:** Most hospital pharmacists agreed that continuing specialty education and training was beneficial. Both supporting and obstructive factors were found. The need for continuing specialty education was associated with shorter work experience, a history of the training, and positive attitude toward the education.

**Keywords:** needs for continuing in specialist education, specialist pharmacist, hospital pharmacy

Journal website: <http://ejournals.swu.ac.th/index.php/pharm/index>

## Introduction

Currently, there has been a growing need by health organizations for pharmacists who can perform advanced or specialized works since they have been more capable of

managing with patients' complicated problems.<sup>1</sup> There have been new medications, treatments, and a new body of knowledge which have been constantly improved, with the

advancement of knowledge of pharmacy. Pharmacists with expertise in delivery of more complex pharmacy services are increasingly needed.<sup>2</sup> This poses a challenge for pharmacists in a health system to improve themselves to fulfill needs of the patients and the health system. The American Society of Health-System Pharmacists specifies that the mission of pharmacists is to provide people with services to produce optimal health outcomes.<sup>3</sup> It also states that "Licensure alone will be insufficient" indicating that the professional license alone is not sufficient for advanced practice for complicated health problems.<sup>2</sup> Consequently, it has become necessary for pharmacists to continue specialist education. In 2012, the American College of Clinical Pharmacy proposed that in performing any patient-related work, pharmacists should complete postgraduate education prior to working in real settings, and postgraduate pharmacy residencies should serve as the basis requirement for employment of pharmacists by 2020.<sup>4</sup>

In Thailand's contexts, the Ministry of Public Health anticipates that Thai society will have entered aging society by 2032, which will result in an increase of health issues. Moreover, Twenty-Year National Strategic Plan for Public Health (2017 - 2036) establishes development plans toward medical excellence of public health organizations to deliver services effectively to people and patients with complicated medical conditions.<sup>5</sup> Consequently, pharmacists should possess a higher level of expertise. However, the study of Upakdee and Thanawut offered a prediction on manpower rates of pharmacists in hospital pharmacy within 20 years (2015 - 2035).<sup>6</sup> The study anticipated that there would still be a shortage of all-level pharmacists in such field in Thailand. The study did not provide any insights into continuation of education among Thai pharmacists as well as relevant factors.<sup>6</sup> However, a study in Canada conducted in 2016 reported that the continuation of pharmacy specialty education was associated with acceptance of specialist pharmacists for work, readiness and sufficient manpower rates of specialist pharmacists, limitations concerning needs for specialist pharmacists, patients' perceptions of differences between specialist pharmacists and general pharmacists, and pharmacists' convenience in joining training programs for specialty development.<sup>7</sup>

The Ministry of Public Health issued the Twenty-Year National Strategic Plan (2017 - 2036) for manpower for all 13 health regions of the country.<sup>8</sup> Based on the data from the

manpower estimation for health regions, it indicates that the manpower of pharmacists has become exceeding the limit. Specifically in the health region 4, when the number of full-time pharmacists was estimated against the workload based on the number of beds by the Human Resources Management Division, a total number of 575 hired pharmacists exceeded the necessary number of 532 by 43.<sup>8</sup> This over-supply of pharmacists was originated in part from pharmacy schools in Thailand. The number of pharmacist graduates from pharmacy schools was based on capacity and expertise of the lecturers, not the demand on the pharmacist graduates in the market. However, the exact demand on pharmacists with specialties has not been known. On the demand side, the extent of the need of the Ministry of Public Health for pharmacist specialty services has not been known. In planning pharmacy workforce for advanced practices or specialties, input from all stakeholders should be considered. For example, it would be reasonable that the Ministry of Public Health to put more resources on primary care services to better handle the rising elderly society. However, no one could be certain that the practicing hospital pharmacists would prefer to advance their practice in such direction. The decision of the pharmacist for such advanced practices might have been influenced by various factors not only the policy of the Ministry of Public Health. To effectively plan for resources for the advanced practice, more information from all stakeholders is needed.

There have been no studies on needs of specialist pharmacists in hospitals in Thailand. While short-course training is more attractive, the full program training is more time-consuming, costly and burdensome. There is therefore a need to understand how much pharmacist specialists are needed for the public hospital sector. This present study aimed to determine 1) needs of hospital pharmacists in Thailand for continuing specialist education or training programs, 2) attitudes of hospital pharmacists towards continuing specialist education or training programs, 3) relevant factors in terms of opportunities and obstacles to continuing specialist education or training, and 4) associations between the need and potential factors.

## Methods

In this cross-sectional survey research, study population was all pharmacists working in all-level hospitals under the

Office of Permanent Secretary, the Ministry of Public Health of Thailand.

The sample size was calculated using the following formula  $n = Z^2_{\alpha/2} \cdot p \cdot (1 - p) / \epsilon^2$ . With Z of 1.96 (critical value for 5% type I error, two-sided), p of 0.5 (proportion assumed for the highest variability), and a sampling error ( $\epsilon$ ) of 0.05, a sample of 385 pharmacists was required. These participants were selected through a stratified sampling selection method from a list of pharmacists working in hospitals under the Office of Permanent Secretary, the Ministry of Public Health. The respondents were stratified based on hospital levels and calculated from a proportion of hospital pharmacists in each level, namely regional hospitals (A), general hospitals (S), small-sized general hospitals (M1), mid-level hospitals (M2), large community hospitals (F1), medium community hospitals (F2), and small community hospitals (F3).

### Research instrument

The research instrument in this study was a questionnaire on needs and types of specialty hospital pharmacists. The **first** part asked about demographic information of the participants.

The **second** part asked about the participant's need for continuing specialist education or training consisting of 11 questions. The 1<sup>st</sup> question asked the participants how much they agreed with the statement "You need to pursue the specialty education and training" while the 2<sup>nd</sup> question asked them how much they agreed with the statement "You have expertise in your current practice." The response of these two questions was a rating scale ranging from 1-least agreed, to 2-slightly agreed, 3-moderately agreed, 4-strongly agreed, and 5-most agreed. For the 1<sup>st</sup> question, those who rated 4-strongly agreed and 5-most agreed were categorized as having the need for the specialty education and training while those with 1 to 3 rating as not having the need.

The 3<sup>rd</sup> question asked types of specialist education programs they would like to attend; while the 4<sup>th</sup> question asked about durations of the continuing education they deemed appropriate. The 5<sup>th</sup> question asked about the fields of study they were interested in. The 6<sup>th</sup> question asked about their perception on who involved in decision making about pharmacist specialty manpower planning. The 7<sup>th</sup> question asked whether their hospital had the analysis and planning for resources for pharmacists' continuing specialty education

(yes/no). The 8<sup>th</sup> question asked about steps and individuals responsible for the analysis and planning. The 9<sup>th</sup> question asked whether their hospital implemented the number of pharmacists with specialty education and training as the quality indicator for the hospital accreditation (yes/no). The 10<sup>th</sup> and 11<sup>th</sup> questions asked about factors influencing pharmacists' decisions to pursue and no to pursue specialty education and training, respectively. For each question responses were choices which the participants could choose more than one if applicable, except for 7<sup>th</sup> and 8<sup>th</sup> questions that the response was yes/no.

The **third** part asked about attitudes toward continuing specialist education or training containing 38 questions including factors associated with specialty (19 questions), factors associated with organizational support (10 questions), and factors related to outcomes and capacity of educational institutions (9 questions). The response of these questions was a rating scale ranging from 1-the least agreed, to 5-the highest agreed. The results for each of the 38 questions were presented as frequency and percentage of participants on each of the 5 levels of the agreement.

The questions in the 3<sup>rd</sup> sections were examined for content validity and reliability. Content validity was tested using an item-objective congruence (IOC) index by the panel of five experts, e.g., one pharmacist lecturer specialized in social and administrative pharmacy, one pharmacist lecturer specialized in pharmacotherapy, one pharmacist working in a hospital, one pharmacist working in manpower development in the Ministry of Public Health, and one representative of pharmacists from the Pharmacy Council. With the criterion of IOC index of 0.5 – 1.0, all items met the requirement with IOC indexes of 0.6 – 0.8.

Internal consistency reliability was tested on questions in the 3<sup>rd</sup> section by 33 hospital pharmacists comparable to the potential participants. These three sections (i.e., factors associated with specialty, factors associated with organizational support, and factors related to outcomes and capacity of educational institutions) were found to have a high internal consistency reliability with Cronbach's alpha coefficients of 0.93, 0.88, and 0.85, respectively.

In addition to content validity and internal consistency reliability mentioned above, exploratory factor analysis was performed on the questions of the three factors in the 3<sup>rd</sup> section (i.e., factors associated with specialty, factors associated with organizational support, and factors related to

outcomes and capacity of educational institutions). The details of factor analysis were omitted here. The three factors were maintained as planned. In this study, only factor scores for each of the three factors for individual participants were obtained for logistic regression to examine potential independent variables on the need of specialty education as dependent variable. Factor scores were categorized as positive and negative values for the logistic regression where positive and negative values indicated positive and negative opinions, respectively. In logistic regression analysis, positive values were assigned as 1 and negative values as 0.

### Participant protection

The study was approved by the Ethics Committee for Human Study of Khon Kaen University (approval number: HE632176; approval date: June 8, 2020). The study was based on the principle of voluntary participation and anonymity. In this online survey study, implied consent was acquired through the action of voluntary completion of the questionnaire.

### Data collection procedure

Questionnaires, together with letters of request for completing online questionnaires, were directly sent to the selected pharmacists. Those who volunteered to participate in this research completed the questionnaire online. After one month, only 147 respondents completed the questionnaires, accounting for 38.19% which were lower than the targeted number of the sample size of 385 individuals. As a result, the questionnaires were distributed for the second time with 304 questionnaires returned. A total of 451 pharmacists completed the questionnaire.

### Data analysis

Descriptive statistics including frequency with percentage and mean with standard deviation (SD) were used to summarize demographic characteristics and study variables of the participants. Simple logistic regression analysis was conducted to examine the relationship between the need for continuing specialty education (yes/no) with its predictive variables including gender (women as reference), age (> 50 years as reference to compare with < 30, 31 – 40, and 41 – 50 years), years of work experience (> 20 years as reference to compare with < 10 and 11 – 20 years), education level (postgraduate level as reference to compare with Bachelor's

degree), hospital level (F as reference to compare with A, S, and M), pharmacy services (dispensing service as reference to compare with out-patient pharmaceutical care, inventory management and procurement of medical supplies, compounding of general and cytotoxic drugs, and drug information (with primary care and consumer protection)), history of specialty training ("yes" as reference to compare with "no"), and factors associated with specialty, organizational support and outcomes and capacity of educational institutions (negative opinion as reference to compare with positive, for each of the three factors). Crude odds ratio (OR) with 95% confidence interval (CI) was reported.

In addition to the simple logistic regression, multiple logistic regression was conducted to adjust effects of all independent variables on each other. Adjusted odds ratio (adj. OR) with 95% CI was reported. Statistical significance was set at a type I error of 5%. All statistical analyses were performed using SPSS version 22.

## Results

Of the total of 451 participants, the majority were female (71.2%) (Table 1). Their average age was  $37.3 \pm 7.7$  years old and total work experience was  $13.1 \pm 8.0$  years, and work experience as a hospital pharmacist was  $12.6 \pm 7.8$  years. The majority had a bachelor's degree (74.1%), followed by a master's degree (25.5%), and a doctoral degree (0.4%). About one-third of them worked in medium community hospitals (F2) (35.0%), followed by general hospitals (S) (14.2%), regional hospitals (A) (13.7%), small community hospitals (F3) (12.4%), and mid-level hospitals (M2) (11.8%). Among 80 participants with experience with training program (17.7%), the majority attended 4-month short-term training programs (77.5%), while very low proportions had other programs. More than half of the 451 participants were responsible for dispensing service (262 participants or 58.1%), followed by pharmaceutical care (10.0%), pharmacy administration (8.9%), and inventory management and procurement of medical supplies (8.0%) (Table 1).

### Needs for continuing specialist education and training

Majority of the participants reported the need for continuing specialty education and training (76.9%); while the rest (23.1%) reported no need. As expected, most of the

participants thought that they had expertise in their current practice which were mostly general practice (53.0% strongly agreed and 38.6% moderately agreed).

**Table 1** Demographic characteristics of the participants (N = 451).

Characteristics	N (%)
<b>Gender</b>	
Men	130 (28.8)
Women	321 (71.2)
<b>Age (years), mean = 37.3 ± 7.7</b>	
<b>Education level</b>	
Bachelor's degree	334 (74.1)
Master's degree	115 (25.5)
Doctoral degree	2 (0.4)
<b>Levels of workplace hospital</b>	
Regional hospitals (A)	62 (13.7)
General hospitals (S)	64 (14.2)
Small-sized general hospitals (M1)	26 (5.8)
Mid-level hospitals (M2)	53 (11.8)
Large community hospitals (F1)	31 (6.9)
Medium community hospitals (F2)	158 (35.0)
Small community hospitals (F3)	56 (12.4)
First-level hospitals	1 (0.2)
<b>Experience with training programs (n = 80, or 17.7%)</b>	
4-month short-term certification programs	62 (77.5)
Other programs (e.g., diplomas from foreign countries)	7 (8.8)
Board certification in pharmacotherapy	6 (7.5)
Board certification in consumer protection	3 (3.8)
Unspecified	2 (2.5)
<b>Types of work</b>	
Dispensing services	262 (58.1)
Pharmaceutical care	45 (10.0)
Pharmacy department administration	40 (8.9)
Inventory management and procurement of medical supplies	36 (8.0)
Drug information service/drug information center	16 (3.5)
Consumer protection	15 (3.3)
Primary care	13 (2.9)
Compounding (cytotoxic drugs, injectable drugs, parenteral nutrition)	12 (2.7)
Unspecified	12 (2.7)

**Table 2** The need for continuing specialty education and training (N = 451).

Questions	N (%) by level of agreement					Mean (S.D)
	1-least agreed	2-slightly agreed	3-moderately agreed	4-strongly agreed	5-most agreed	
1. You need to pursue the specialty education and training	5 (1.1)	11 (2.4)	88 (19.5)	194 (43)	153 (33.9)	4.06 (0.8)
Need for specialty education and training	No need* = 104 (23.1%)		Need* = 347 (76.9%)			
2. You have expertise in your current practice	1 (0.2)	5 (1.1)	174 (38.6)	239 (53.0)	32 (7.1)	3.66 (0.6)

\* No need = participants rating 1 – 3; need = participants rating 4 – 5.

Of the 451 participants, the majority reported the need to join 4-month short-term certification programs (80.9%), followed by general residency programs (12.0%) and master's or doctoral degrees (8.2%), if possible. The majority preferred the durations of the training or education of 4 months (66.5%), followed by 6 months (18.8%), 1 year (7.5%), 2 years (6.0%), and 4 years (0.9%) which were consistent with the type of

preferred programs previously mentioned (Table 3). In addition, the 10 most preferred specialties were reported with internal medicine was the most preferred field of specialty (171 of 451 or 37.9%), followed by ambulatory care (139, or 30.8%), and infectious disease (116, or 25.7%) (Figure 1).

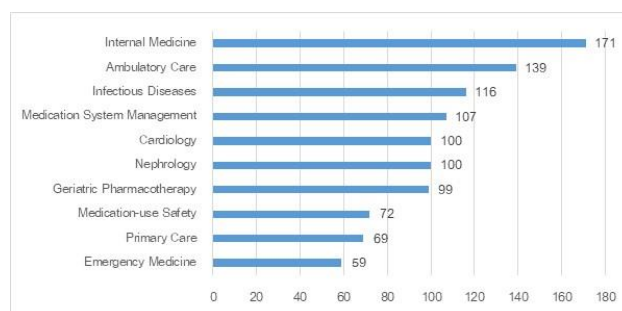
**Table 3** Needs for continuing specialist education and training (N = 451).

Specialties	N (%)
<b>Preferred specialty programs<sup>†</sup></b>	
Master's or Doctoral degrees	37 (8.2)
Short-term certification programs	365 (80.9)
General residency programs	54 (12.0)
Specialty residency	20 (3.7)
Fellowship	14 (2.6)
Not needed	2 (0.4)
<b>Preferred program durations<sup>‡</sup></b>	
4 months	300 (66.5)
6 months	85 (18.8)
1 year	34 (7.5)
2 years	27 (6.0)
3 years	-
4 years	4 (0.9)
5 years or longer	-

\* More than one option could be preferred by a given participant.

† Questions on needs, number 3.

‡ Questions on needs, number 4.



**Figure 1** The 10 most preferred specialty fields of study (N = 451).\*

Note: More than one field could be preferred by a given participant.

\* Questions on the need (number 5).

Majority of the participants thought that head of the pharmacy department was the person responsible for planning and authorizing hospital pharmacists to attend continuing specialty education and training (85.4%), followed by hospital director (60.1%). Slightly more than half (51.9%) believed that the analysis and planning for pharmacy continuing specialty education by hospital administrators existed; while the rest (48.1%) believed no such analysis or planning. For how the analysis and planning was conducted, 96 of 451 participants (21.3%) believed that the head of the pharmacy department solely developed the plan and submitted the plan to the hospital director for approval. On the other hand, 15.7%

reported that the head of the pharmacy department developed the plan with the input from all pharmacists. The collaborative planning between the head of the pharmacy department and the human resources department was also reported by 14.9% of the participants.

It was somewhat alarming that 339 of 451 participants (88.5%) reported that their hospitals never used the number of pharmacists with continuing specialty education and training as the quality indicators for hospital accreditation. For factors affecting the decision to pursue specialty education and training, majority reported that they wanted to acquire more knowledge and expertise for advanced pharmacy practice (70.1%), followed by the need to gain more advanced skills for better patient outcomes (64.7%), personal preference on advanced education and training (60.7%), and the need for higher salary and career advancement (43.7%). In terms of obstacles, factors influencing their decisions not to continue specialty education and training reported by most participants were a shortage of staff in the pharmacy department (74.3%), and a lack of financial support (59.4%).

#### Attitudes towards continuing specialty education and training

Majority of the participants reported that continuing specialty education and training could help pharmacists gain more competency in the care for patients with complicated illnesses (Tables 5 – 7). They could provide more safe and effective drug use which could enhance competency of the multidisciplinary healthcare team. They showed positive attitude towards the continuing specialty education and training. However, based on organizational support, the sufficient pharmacist manpower and the support of the practicing hospital could be the major influence for their decision to pursue continuing specialty education (Table 6).

Simple logistic regression analyses showed that participants with younger age, fewer years of work experience, no history of specialty training, and positive opinion of factors associated with specialty were significantly associated with higher probability of the need for continuing specialty education ( $P$ -value < 0.001 for all, except  $P$ -value = 0.001 for age of 41 – 50 years old compared with age of more than 50 years old). Based on the multiple logistic regression analysis when all independent variables were adjusted for each other, slightly different results were obtained as follows. Participants with less than 10 years of work experience were more likely

**Table 4** Perception of the participants on planning and authorizing hospital pharmacists to pursue continuing specialty education and training (N = 451).

Perceptions	N (%)
<b>Perception on the person responsible for planning and authorizing hospital pharmacists to attend continuing specialty education and training*</b>	
Hospital director	271 (60.1)
Head of pharmacy department	385 (85.4)
Human resource department	106 (23.5)
Other pharmacists working in the same unit	145 (32.2)
The participant	143 (31.7)
Others	4 (0.8)
<b>Perception on whether the analysis and planning by hospital administrators existed†</b>	
Yes	234 (51.9)
No	217 (48.1)
<b>Perception on how the analysis and planning was conducted‡</b>	
Hospital director plan with the approval by the administrative committee	53 (11.7)
Head of the pharmacy department developed the plan with the input from all pharmacists	71 (15.7)
Head of the pharmacy department solely developed the plan and submitted the plan to the hospital director for approval	96 (21.3)
No analysis or planning. Individual pharmacists made the decision to attend the training independently regarding seniority	21 (4.7)
Head of the pharmacy department and the human resources department analyze and develop the plan to submit to the hospital director for approval	67 (14.9)
Heads of pharmacy units and pharmacists in the respective units made the plan together	32 (7.1)
Head of the pharmacy department and heads of pharmacy units made the plan together	41 (9.1)
No analysis or planning. Individual pharmacists made the decision to attend the training independently	39 (8.6)
<b>Perception on whether the number of pharmacists with continuing specialty education and training was used as quality indicators for hospital accreditation#</b>	
No	399 (88.4)
Yes	52 (11.5)
<b>Factors affecting the decision to pursue specialty education and training*</b>	
Personal preference on advanced education and training	274 (60.7)
The need to acquire more knowledge and expertise for advanced pharmacy practice	316 (70.1)
The need to gain more advanced skills for better patient outcomes	292 (64.7)
The need for pharmacy expertise to be accepted by the multidisciplinary team members	170 (37.7)
The need for official pharmacy expertise	130 (28.8)
The need for value added and pride in pharmacy practice	154 (34.1)
The need for higher salaries and career advancement	197 (43.7)
<b>Factors affecting the decision NOT to pursue specialty education and training*</b>	
Lack of support from the hospital administrators	169 (37.5)
Shortage of staff in the pharmacy department	335 (74.3)
Lack of financial support	268 (59.4)
No need for advanced training because of a lack of competitiveness among colleagues	165 (36.6)

\* Questions on needs (number 6).

† Questions on needs (number 7).

‡ Questions on needs (number 8).

# Questions on needs (number 9).

◆ Questions on needs (number 10).

◆ Questions on needs (number 11).

significantly to report the need to pursue continuing specialty education with adj. OR of 8.85 (95% CI = 2.70 – 28.98,  $P$ -value < 0.001) when compared with those with more than 20 years of work experience. Participants who had no history of specialty training were less likely significantly to pursue continuing specialty education (adj. OR = 0.11, 95% CI = 0.03 – 0.39,  $P$ -value = 0.001) when compared with those

**Table 5** Factors associated with specialty (N = 451).

Questions	N (%) by levels of agreement				
	1-least agreed	2-slightly agreed	3-moderately agreed	4-strongly agreed	5-most agreed
1. Specialist pharmacists can provide a better care for patients with complicate illnesses than general pharmacists.	2 (0.4)	6 (1.3)	30 (6.7)	146 (32.4)	267 (59.2)
2. Specialist pharmacists can assure safe and effective medication use for patients.	4 (0.9)	9 (2.0)	32 (7.1)	164 (36.4)	242 (53.7)
3. Specialist pharmacists can assure reasonable medical expense.	5 (1.1)	17 (3.8)	110 (24.4)	147 (32.6)	172 (38.1)
4. Specialist pharmacists can assure rational drug use in public health system.	4 (0.9)	12 (2.7)	70 (15.5)	151 (33.5)	214 (47.5)
5. Pharmacists should have specialty training to gain competency for the care for patients with complicate illnesses.	2 (0.4)	8 (1.8)	17 (3.8)	161 (35.7)	263 (58.3)
6. Continuing specialty education will allow you to fulfill the need for more effective multidisciplinary team.	3 (0.7)	6 (1.3)	34 (7.5)	179 (39.7)	229 (50.8)
7. Your current experience and knowledge influence the need for continuing specialty education.	2 (0.4)	8 (1.8)	58 (12.9)	106 (23.5)	177 (39.2)
8. The duration of the certified specialized fellowship in pharmacotherapy is sufficient for specialty improvement.	27 (6.0)	59 (13.1)	106 (23.5)	143 (31.7)	116 (25.7)
9. Long work experience influences your decision to pursuit continuing specialty education.	4 (0.9)	23 (5.1)	84 (18.6)	236 (52.3)	104 (23.1)
10. Educational fees for short-term training are too high.	7 (1.6)	27 (6.0)	184 (40.8)	171 (37.9)	62 (13.7)
11. Educational fees for certified specialist training are too high.	7 (1.6)	25 (5.5)	191 (42.4)	167 (37.0)	61 (13.5)
12. You are confident that if you obtain specialist training, your work performance will be different.	2 (0.4)	16 (3.5)	68 (15.1)	213 (47.2)	152 (33.7)
13. Your hospital is in need for specialist pharmacists.	13 (2.9)	37 (8.2)	115 (25.5)	178 (39.5)	108 (23.9)
14. You think that continuing specialty pharmacy education will expand opportunities to build a professional network.	5 (1.1)	7 (1.6)	56 (12.4)	215 (47.7)	168 (37.3)
15. You think that continuing specialty pharmacy education is beneficial.	3 (0.7)	8 (1.8)	36 (8.0)	168 (37.3)	236 (52.3)
16. You think that continuing specialty pharmacy education is necessary for patient care.	3 (0.7)	11 (2.4)	38 (8.4)	190 (42.1)	209 (46.3)
17. You think that continuing specialty pharmacy education will allow you to apply the knowledge to your work.	2 (0.4)	8 (1.8)	36 (8.0)	172 (38.1)	233 (51.7)
18. You think that continuing specialty pharmacy education will give you competitive advantages in your career.	5 (1.1)	16 (3.5)	86 (19.1)	183 (40.8)	161 (35.7)
19. You think that continuing specialty pharmacy education will contribute to your career achievement.	6 (1.3)	16 (3.5)	100 (22.2)	181 (40.1)	148 (32.8)

with the history. Finally, participants with positive opinion of factors associated with specialty were significantly associated with higher probability of the need for continuing specialty education (adj. 3.99, 95% CI = 2.34 – 6.81, *P* -value < 0.001) when compared with those with the negative one. With the Cox and Snell *R*<sup>2</sup> of 20.4% and Nagelkerke *R*<sup>2</sup> of 31.0% of this multiple logistic regression analysis, all independent variables were low-to-moderately predicting the need for continuing specialty education.

## Discussions and Conclusion

In this survey study, 451 participants were recruited and 80 of them had experience with at least one training program (17.7%). Our self-reported results indicate that pharmacy

**Table 6** Factors associated with organizational support (N = 451).

Questions	N (%) by levels of agreement				
	1-least agreed	2-slightly agreed	3-moderately agreed	4-strongly agreed	5-most agreed
1. Your hospital supports you in participating a 4-6-months short-term training program.	20 (4.4)	50 (11.1)	120 (26.6)	149 (33.0)	112 (24.8)
2. The Ministry of Public Health supports the participation in a 4-6-months short-term training program.	18 (4.0)	44 (9.8)	139 (30.8)	152 (33.7)	98 (21.7)
3. Your hospital supports you in participating a certified general residency in pharmacotherapy training.	85 (18.8)	99 (22.0)	162 (35.9)	68 (15.1)	37 (8.2)
4. Your hospital supports you in participating in certified specialized residency in pharmacotherapy training.	115 (25.5)	130 (28.8)	141 (31.3)	38 (8.4)	27 (6.0)
5. Your hospital supports you in participating a certified specialized fellowship in pharmacotherapy.	124 (27.5)	130 (28.8)	137 (30.4)	32 (7.1)	28 (6.2)
6. The funding allocated from the Ministry of Public Health to support pharmacists in joining specialty training is appropriate.	61 (13.5)	106 (23.5)	182 (40.4)	63 (14.0)	39 (8.6)
7. The health service development plan of the Ministry of Public Health is consistent with the need for specialist pharmacist development.	36 (8.0)	69 (15.3)	150 (33.3)	129 (28.6)	67 (14.9)
8. Your hospital has sufficient pharmacist manpower in case you have to leave for a 4-6-months short-term training.	81 (18.0)	109 (24.2)	133 (29.5)	94 (20.8)	34 (7.5)
9. Your hospital has sufficient pharmacist manpower in case you have to leave for a certified specialized fellowship training.	161 (35.7)	145 (32.2)	83 (18.4)	41 (9.1)	21 (4.7)
10. The duration of the 4-6-months short term training program is sufficient for specialty improvement.	18 (4.0)	37 (8.2)	126 (27.9)	200 (44.3)	70 (15.5)

**Table 7** Factors associated with outcomes and capacity of education institutions (N = 451).

Questions	N (%) by levels of agreement				
	1-least agreed	2-slightly agreed	3-moderately agreed	4-strongly agreed	5-most agreed
1. You are confident that you have a sufficient specialty for an effective patient care.	3 (0.7)	31 (6.9)	186 (41.2)	179 (39.7)	52 (11.5)
2. A higher salary from specialty influences your decision to participate in specialty training.	21 (4.7)	42 (9.3)	116 (25.7)	147 (32.6)	125 (27.7)
3. Career advancement influences your decision to participate in specialty training.	11 (2.4)	28 (6.2)	85 (18.8)	179 (39.7)	148 (32.8)
4. There is a sufficient number of training institutions for specialty training.	19 (4.2)	82 (18.2)	184 (40.8)	117 (25.9)	49 (10.9)
5. There is a sufficient number of fields of specialty training.	16 (3.5)	70 (15.5)	185 (41.0)	138 (30.6)	42 (9.3)
6. Fields of specialty training that you need are available.	8 (1.8)	61 (13.5)	175 (38.8)	158 (35.0)	49 (10.9)
7. Institutions offering specialty training programs are qualified to do so.	3 (0.7)	40 (8.9)	152 (33.7)	202 (44.8)	54 (12.0)
8. There is an adequate number of specialist training sites.	6 (1.3)	64 (14.2)	193 (42.8)	148 (32.8)	40 (8.9)
9. Within 1-2 years, you intend to pursuit continuing specialty education.	46 (10.2)	68 (15.1)	135 (29.9)	132 (29.3)	70 (15.5)

continuing specialty education and training would be beneficial for better quality patient care.

The results indicated that pharmacists perceived the needs for continuing specialist education or training. For participation in the training, financial support was expected to be either from the affiliated organizations or personal budgets coupled with those from the affiliated organizations. Regarding types of training programs, most participants prefer short-term training (80.9%) and general residency training.

**Table 8** Associations between the need for continuing specialty education and potential predictive variables (N = 451).

Variables	N (%), by the need		Simple logistic regression		Multiple logistic regression*	
	Need (N = 347)	No need (N = 104)	Crude OR (95% CI)	P-value	Adj. OR (95% CI)	P-value
<b>Gender</b>						
Men	96 (73.8)	34 (26.2)	0.79 (0.49, 1.26)	0.321	1.06 (0.60, 1.90)	0.833
Women	251 (78.2)	70 (21.8)	Ref.		Ref.	
<b>Age (years)</b>						
< 30	101 (91.8)	9 (8.2)	12.02 (4.43, 32.61)	< 0.001	2.06 (0.45, 9.31)	0.349
31 – 40	142 (76.0)	40 (22.0)	3.80 (1.70, 8.54)	< 0.001	1.05 (0.30, 3.68)	0.937
41 – 50	89 (69.0)	40 (31.0)	2.38 (1.05, 5.40)	0.001	1.56 (0.54, 4.49)	0.410
> 50	14 (48.3)	15 (51.7)	Ref.		Ref.	
<b>Work experience (years)</b>						
< 10	192 (88.9)	24 (11.1)	6.33 (3.41, 11.74)	< 0.001	8.85 (2.70, 28.98)	< 0.001
11 – 20	112 (70.9)	46 (29.1)	1.93 (1.09, 3.39)	< 0.001	2.30 (0.98, 5.41)	0.056
> 20	43 (55.8)	34 (44.2)	Ref.		Ref.	
<b>Education level</b>						
Bachelor's degree	264 (79.0)	70 (21.0)	1.55 (0.96, 2.49)	0.075	0.81 (0.45, 1.47)	0.489
Postgraduate degree	83 (70.9)	34 (29.1)	Ref.		Ref.	
<b>Hospital level<sup>†</sup></b>						
A	47 (75.8)	15 (24.2)	0.92 (0.48, 1.78)	0.907	1.70 (0.66, 4.38)	0.268
S	51 (79.7)	13 (20.3)	1.16 (0.59, 2.28)	0.811	1.46 (0.63, 3.36)	0.268
M	59 (74.7)	20 (25.3)	0.87 (0.48, 1.57)	0.675	1.05 (0.52, 2.12)	0.898
F	190 (77.2)	56 (22.8)	Ref.		Ref.	
<b>Pharmacy service</b>						
Out-patient pharmaceutical care	38 (84.4)	7 (15.6)	1.51 (0.64, 3.56)	0.347	1.01 (0.36, 2.82)	0.991
Inventory management and procurement of medical supplies	52 (68.4)	24 (31.6)	0.60 (0.34, 1.06)	0.079	1.47 (0.69, 3.16)	0.321
Compounding of general and cytotoxic drugs	9 (75.0)	3 (25.0)	0.83 (0.22, 3.18)	0.791	0.51 (0.09, 2.97)	0.458
Drug information, primary care and consumer protection	35 (79.5)	9 (20.5)	1.08 (0.49, 2.38)	0.846	1.32 (0.51, 3.44)	0.564
Dispensing service	205 (78.2)	57 (21.8)	Ref.		Ref.	
<b>History of specialty training</b>						
No	274 (73.1)	101 (26.9)	0.11 (0.03, 0.36)	< 0.001	0.11 (0.03, 0.39)	0.001
Yes	73 (96.1)	3 (3.9)	Ref.		Ref.	
<b>Factor 1: factors associated with specialty</b>						
Positive opinion	225 (86.9)	34 (13.1)	3.80 (2.39, 6.05)	< 0.001	3.99 (2.34, 6.81)	< 0.001
Negative opinion	122 (63.5)	70 (36.5)	Ref.		Ref.	
<b>Factor 2: factors associated with organizational support</b>						
Positive opinion	168 (76.0)	53 (24.0)	0.90 (0.58, 1.40)	0.649	0.76 (0.44, 1.30)	0.314
Negative opinion	179 (77.8)	51 (22.2)	Ref.		Ref.	
<b>Factor 3: factors related to outcomes and capacity of educational institutions</b>						
Positive opinion	173 (79.0)	46 (21.0)	1.25 (0.81, 1.95)	0.315	1.06 (0.62, 1.81)	0.842
Negative opinion	174 (75.0)	58 (25.0)	Ref.		Ref.	

\* Multiple logistic regression: Cox and Snell R<sup>2</sup> = 20.4%, Nagelkerke R<sup>2</sup> = 31.0%.

<sup>†</sup> Hospital level: A = regional hospitals, S = general hospitals, M = small-sized general and mid-level hospitals, F = large, medium, and small community hospitals.

It was found that 92.8% of them reported that the appropriate durations for continuing education were 4 months (66.5%), 6 months (18.8%), and 1 year (7.5%). For the specialty, internal medicine was the most preferred one. However, to better prepare for future specialty services, a more variety of fields should be offered, such as health system pharmacy administration and leadership, health system medication management pharmacy, clinical

pharmacogenomics, and solid organ transplant pharmacy. This would serve as an opportunity to expand roles of pharmacists in other domains in working in hospitals.

In addition, there has not been any indicator of work achievement established by the hospital. If available, it would enable directors, pharmacists, and concerned individuals to assess importance and values from specialist training or education. Lastly, the results indicated that pharmacists had positive attitudes towards continuing specialty education or training. This suggests a more prevalence of advanced pharmacy practice in the near future.

The results also showed that the shorter the number of years of work experience in the hospital, the more likely the need for continuing specialty education. Those who were with less than 10 years were more likely to express the need (adj. OR = 8.85, 95% CI = 2.70, 28.98, P-value < 0.001) compared with those with more than 10 years of work experience. Those with 10 – 20 years also expressed the need for the specialty education than those with more than 20 years of work, but with a lesser extent and no statistical significance (adj. OR = 2.30, 95% CI = 0.98, 5.41, P-value = 0.056). This findings suggests that to promote specialty education or training, hospitals and/or policy-making institutes should focus on pharmacists with less than 20 years of work experience. In addition, since pharmacists with no history of specialty training were less likely to express the need for future specialty education when compared with who did have the history (adj. OR = 0.11, 95% CI = 0.03, 0.39, P-value = 0.001). This suggests that to promote specialty education, those with previous specialty training should be promoted first. The last factor significantly associated with the likelihood of the need for specialty education was the positive opinion toward the education (adj. OR = 3.99, 95% CI = 2.34, 6.81, P-value < 0.001). This finding suggests that pharmacists who thought that specialist practice could be beneficial for the patient, multidisciplinary team, and pharmacy profession as well. They also thought of the opportunity to expand a professional network, have competitive advantages in work, and achieve career success.

Results from studies from other countries indicated that pharmacists with experience of obtaining postgraduate training were more satisfied with their performance than those without such experience. The issues that reflected their attitudes include levels of clinical service delivery skills, patient care, improved dispensing skills, promotion and development



of pharmacists' overall working process, and research.<sup>9,10</sup> These issues are consistent with the result of our present where specialty education was viewed as necessary for patient care, allowing pharmacists to apply the knowledge to their work, and helping improve a pharmaceutical public health system. These findings are consistent with the concepts of building a professional network through training, expanding work opportunities or competitive advantages in a labor market according to the continuing specialty residency education in the United States of America.<sup>11</sup> Based on this trend of specialty training, factors influencing pharmacists to pursue such education and training include the perception that postgraduate education can enhance effectiveness of work performance in pharmacy and contribute to the career achievement, influence of concerned individuals such as friends and family members, concerns about the inability to perform their work to fulfill needs or the competitive disadvantages, necessity for relocation, and an admission process<sup>1,2</sup>, needs for specialist pharmacists in specific services, time allocation for studies, the policy on promotion of participation in training, education fees/expenses, professional support, and access to information of programs and training<sup>7</sup>, burnout syndrome, and the perception of adequate market demand for pharmacy graduates.<sup>13</sup> These influencing factors are in line with the results of our present study including benefits of specialist pharmacists, locations of specialty training programs, contexts for supporting continuation of specialty education, manpower in the hospitals, support from and policy of affiliated organizations, education expenses, and benefits from the training.

The specialist pharmacists could benefit from the education and training. Based on the Office of the Permanent Secretary of the Ministry of Public Health (MoPH), and the Office of the Civil Service Commission, the graduate certificate with the training period of 16 weeks or greater can be used for personnel assessment for appointments to senior professional level pharmacists (Level 8). However, an expert level (Level 9) requires higher qualifications, namely a master's degree or equivalent, a diploma (e.g., board-certified pharmacotherapy specialist), or a certificate (e.g., one equivalent to a doctoral degree).<sup>14</sup> This reflects that at a policy level, the MoPH has supported pharmacists in obtaining the specialty training. However, pharmacists at hospitals under the MoPH wishing to earn an expert-level qualification (Level 9) need to study in a program that offers a degree equivalent

to a master's degree or higher. With such requirement, hospital pharmacists need to spend 3 - 5 years in postgraduate education. In addition to such a long duration of postgraduate study, other limitations for hospital pharmacists to pursue the high-rank position include limited manpower, limited budgets, training location availability, academic institutions' potential to offer a board-certified pharmacy training program, and limited numbers of training institutions and fields of pharmacotherapy.<sup>15</sup> Consequently, these issues should be addressed based on current and future situations.

There has been a relative lack of encouragement for the pursuit of advanced pharmacy specialty education. At the MoPH level, the differences of the performance indicators or job descriptions for pharmacists completing 16-week short-term programs and those completing residency training programs (years 1, 2 and 4 residency training) have not been clearly defined. A working group has started working on establishing hospital pharmacy professional standards, and the Pharmacy Council has started to draft specialist levels of hospital pharmacists.<sup>15</sup> Nevertheless, to push more progress for the advancement of pharmacy specialty manpower, hospitals should establish indicators to reflect and comply with policies of the MoPH and the Pharmacy Council. In addition, broader fields of pharmacy specialists should be recognized for advancement and admission.<sup>16</sup>

Our findings also revealed that most hospital pharmacists agreed that continuing specialty education or training is beneficial. Pharmacists with experience of such training reflected that more pharmacists should pursue the training. In addition, areas of specialty should be broad enough to cover hospital pharmacy tasks and services. However, hospital pharmacists are still in need of support in various aspects, including financial support and manpower management in the period of study leave at all levels, namely the MoPH, hospital, and pharmacy department.

As the first study on the subject in Thai context, this present study had a limitation. This study focused only on pharmacists in public hospitals under the MoPH of Thailand, the need and its related factors for pharmacists in other sectors could not be fully represented. Thus, further studies should be carried out on other sectors.

#### **Acknowledgments**

The study was financially supported by the Research Grant Fund for Master's Thesis, Independent Study, and

Doctoral Dissertation program of the Faculty of Pharmaceutical Sciences, Khon Kaen University. The authors would like to express our great gratitude to all pharmacists for their invaluable participation. Our greatest appreciation is also extended to the experts for their constructive recommendations in the questionnaire development.

## References

1. Galbraith K, Coombes I, Matthews A, Rowett D, Bader LR, Bates I. Advanced pharmacy practice: aligning national action with global targets. *J Pharm Pract Res* 2017;47(2):131-135.
2. American Society of Health System Pharmacists. ASHP Long-range vision for the pharmacy work force in hospitals and health systems: Ensuring the best use of medicines in hospitals and health systems. *Am J Health Syst* 2007;64(12):1320-1330.
3. American Society of Health System Pharmacists. What we do. ASHP Mission. 2019. (Accessed on Nov. 3, 2019, at <https://www.ashp.org/About-ASHP/What-We-Do>)
4. Murphy JE, Nappi JM, Bosso JA, et al. American College of Clinical Pharmacy's vision of the future: Postgraduate pharmacy residency training as a prerequisite for direct patient care practice. *Pharmacotherapy* 2006;26(5):722-733.
5. Strategy and Planning Division. Twenty-year national strategic plan for public health (2017 - 2036). 2<sup>nd</sup> ed. Nonthaburi. Ministry of Public Health, 2018. (in Thai)
6. Upakdee N, Thanawut P. Projection of hospital pharmacist workforce in Thailand for 20 Years (2015 - 2035). *J Health Syst Res* 2017;11(1):77-90. (in Thai)
7. Penm J, MacKinnon NJ, Jorgenson D, Ying J, Smith J. Need for formal specialization in pharmacy in Canada: A survey of hospital pharmacists. *Can J Hosp Pharm* 2016;69(5):356-366.
8. Wetchaphanphesat S. Blueprint of health service and human resource. 2018. (Accessed on Apr. 29, 2019, at <http://rbpho.moph.go.th/download-doc.php?url=upload-file/doc/files/05072018-072003-7876.pdf&filename=05072018-072003-7876.pdf&title=Blueprint%20%20HRP&no=1089>) (in Thai)
9. Padiyara RS, Komperda KE. Effect of postgraduate training on job and career satisfaction among health-system pharmacists. *Am J Health Syst* 2010;67(13):1093-1100.
10. Santibañez M, Sedlacek J, Parmar J. Perceptions regarding training across four domains of pharmacy practice: A survey of new pharmacist practitioners. *J Am Coll Clin Pharm* 2021;1-9.
11. Phan YL, Reffert J, Dinh B, Meyenburg L, Herring H. Residents' perspectives: Weighing your options in pursuing a postgraduate year 2 pharmacy residency. *Am J Health Syst* 2014;71(17):1438-1441.
12. Hickerson SC, Fleming ML, Sawant RV, Ordonez ND, Sangsiry SS. Predicting pharmacy students' intention to apply for a residency: A systematic theory of planned behavior approach. *Curr Pharm Teach Learn* 2017;9(1):12-19.
13. Haghparast P, Fisher D, Lewing B, Sangsiry SS. Factors associated with intention to pursue pharmacy residency: The undecided student issue. *Health Prof Educ* 2020;6(2):170-175.
14. Office of the Civil Service Commission. Additional qualifications in pharmaceutical field (No.1006.1.1/839). Nonthaburi. Office of the Civil Service Commission, 2020. (doi: [https://hr.moph.go.th/site/letter/asset/files/8\\_60982020-09-30.pdf](https://hr.moph.go.th/site/letter/asset/files/8_60982020-09-30.pdf)) (in Thai)
15. Pattharachayakul S. Drug and Medical Supply Information Center, Ministry of Public Health. Pharmacy workforce management. 2020. (Accessed on Oct. 29, 2020, [http://dmsic.moph.go.th/editors/userfiles/files/D2S1\\_Sutthiporn\\_College\\_PcoTherapyThailand.pdf](http://dmsic.moph.go.th/editors/userfiles/files/D2S1_Sutthiporn_College_PcoTherapyThailand.pdf)) (in Thai)
16. Cesarz JL, Mott DA, Friestrom ED. A framework for graduate and postgraduate specialty pharmacy training. *Am J Health Syst* 2021; 78(11):989-998.