



Preferences of Thai head pharmacists for pharmacy technician education: Certification versus bachelor's degree program

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ABSTRACT

Objective: This study aimed to investigate Thai hospital pharmacists' preferences for a proposed bachelor's degree curriculum for pharmacy technicians (PhTs), preparing PhTs to fill an advanced role in pharmacy, compared to the existing high vocational certificate (HVC) curriculum for PhTs. **Methods:** A labeled discrete choice experiment (DCE) questionnaire was sent by post to head pharmacists of 814 Thai Ministry of Public Health hospitals over a 2-month period. Respondents' preferences for the proposed bachelor's degree or the existing HVC of PhT were determined based on their selections among three attributes: Competency in pharmaceutical information services, competency in pharmaceutical inventory management, and starting salary. Conditional logistic regression was used to estimate preferences. **Results:** A total of 205 head pharmacists (mean age 41.0 years, SD = 0.089) completed the survey. Almost 86% of head pharmacists worked in a community hospital. The utility of all attributes equals, the proposed PhT bachelor's degree was preferred to the existing HVC. However, certain competencies under the HVC were preferred to the bachelor's degree qualification. **Conclusions:** The DCE approach revealed a preference among hospitals' head pharmacists for upgrading PhT training to the proposed bachelor's degree level. An advanced role for hospital PhT should be further reviewed.

Keywords: Bachelor's degree program, certification program, head pharmacists, pharmacy technician education, preference, Thailand

INTRODUCTION

Pharmacy technicians (PhTs) conventionally play a supporting role in pharmacy practice.^[1,2] On a global scale, education requirements for PhTs vary; a certificate or diploma is the most common requirement, followed in decreasing order of frequency by a degree, work-based education, and no education requirement.^[1] A PhT may fill one

of two types of roles: (1) A traditional role (including supporting compounding services, dispensing medication, and managing drug inventory)^[2] or (2) an advanced role (including managing patient appointments, reporting clinical data to pharmacists, and providing medication care to patients).^[3] The American Society of Health-System Pharmacists has recommended that PhTs have standardized education, training, certification, and licensing requirements to fulfill an advanced role as PhTs.^[4]

In Thailand, 9709 PhTs work in health and academic services. The number of PhTs per 1000 Thai people is seven but distribution is uneven by region. Central Thailand has the lowest number (5:1000) and Northeast Thailand has the highest (10:1000).^[5] Praboromarajchanok Institute is a public higher education institute aiming to produce and develop a workforce to overcome the shortage of health-care personnel under the Ministry of Public Health. The institute currently offers PhTs only a 2-year high vocational certificate (HVC) in Public Health. About 400 PhTs graduate annually and go on to play a traditional role under the supervision of pharmacists.^[6,7] The HVC in public health for PhTs includes seven professional competencies: Pharmaceutical care, pharmaceutical information services, pharmaceutical services, primary pharmaceutical care, pharmaceutical production, pharmaceutical public health, and pharmaceutical inventory management.^[8] To upgrade the professional competencies of PhTs, the Praboromarajchanok Institute has proposed a new bachelor's curriculum for PhT, and on July 27, 2014, the Thai Pharmacy Council approved new advanced roles for PhTs in health informatics and health logistics.^[9] In this study, we aimed to investigate which PhT course hospital pharmacists would prefer. A discrete choice experiment (DCE) approach was used.

A DCE is a stated preference survey method that was first applied in marketing for designing consumer goods and has been widely used in health economics research.^[10,11] In fact, the DCE approach commonly guides policy in transportation,^[10] environment,^[12] and health^[11,13,14] and has also had various applications in pharmacy.^[15-18] The choice sets in this experimental design are composed of two or more different alternatives, each described by a set of attributes at different levels, matching the characteristics of the health service or technology being investigated.^[19] The patients or stakeholders choose only one alternative. When preferences are estimated using this method, respondents' willingness to pay (WTP) for each given attribute (marginal WTP) can be calculated. Respondents' WTP for the preferred health service is derived from the overall value of each relevant attribute's marginal WTP.^[20-22]

The options or alternatives in a DCE choice set can be unlabeled or labeled.^[19] In an unlabeled choice set, the alternatives are indicated in an unspecific manner, such as option A/option B, whereas in a labeled alternative, the preferences being investigated are explicit. Labeled alternatives are usually correlated with alternative specific attributes, for example, commuter train (1-way price: \$1.20 and \$2.20; time: 10 and 20 min), or city bus (1-way price: \$2 and \$3; time: 15 and 30 min).^[22] This design allows for estimating a model based on alternative-specific constants.^[16]

This study used a labeled DCE approach to elicit preferences of head pharmacists in Thai hospitals in terms of PhT education and training levels. The study aimed to provide curriculum development recommendations for Praboromarajchanok Institute, relevant to both the proposed bachelor's program and the existing HVC for PhT.

MATERIALS AND METHODS

Study Design

This study employed DCE methodology to design and conduct a cross-sectional survey.

Population and Sample

There are currently no standard guidelines for determining the appropriate minimum sample size in a DCE.^[23] This study applied Orme's proposed rule of thumb, which recommends at least 300.^[23] The study population consisted of 814 head pharmacists of Ministry of Public Health hospitals across Thailand, who were invited to participate in a DCE survey.

Study Tool

The questionnaire consisted of two sections. The first section included questions on sociodemographic characteristics and prior experience and difficulty of completing DCE questionnaires. The second section included one DCE choice set for internal consistency testing followed by the 14-choice set of DCE questions. The labeled DCE questionnaire was developed according to Ryan *et al.*^[24] who outline clear, step-by-step guidelines with examples of the method's application in addition to statistical analyses of DCE data using Stata estimation commands. The present study consisted of six steps, as follows.

Step 1: Identifying attributes and relevant levels

Three PhT attributes and their levels relevant to the objectives of the study were identified. The first and second attribute was identified through a survey report released by Praboromarajchanok Institute that proposed a bachelor's degree for PhTs, adding advanced roles to the position: Health information management and health logistics management.^[9] In addition, the current 2-year curriculum of the HVC for PhT in public health offered by Praboromarajchanok Institute, was associated with basic knowledge and skills: Pharmaceutical information service and pharmaceutical inventory management.^[8] Finally, starting salary levels were identified according to those determined by the Thai MOPH.^[25]

The designs for all attributes and their levels were reviewed by expert opinion. Discussion between the four experts (three pharmacists and one PhT, all lecturers employed by Praboromarajchanok Institute) led to refining the attributes down to three: (1) Competency in pharmaceutical information services, which varied between basic competencies in pharmaceutical information services to advanced competencies in health information management; (2) competency in pharmaceutical inventory management, which varied between basic competencies in pharmaceutical inventory management to advanced competencies in health logistics management; and (3) starting salary.

Step 2: Designing the DCE model

The DCE model was designed with two labeled alternatives: (1) The existing HVC and (2) the proposed bachelor's degree for PhT. The attributes and their levels used for each of the alternatives are presented in Table 1.

Step 3: Constructing the choice set for the questionnaire

A D-efficient design was generated using Ngene software^[26] to construct the choice set for the questionnaire survey. The optimum total of 14-choice set was calculated from the formula $S = K/J - 1$, where "S" is the number of choice sets, "K" is the maximum number of parameters, and "J" is

Table 1: Three attributes and their levels of two labeled DCE alternatives

Attributes	Attribute levels for the existing HVC in public health of PhT	Attribute levels for the proposed bachelor's degree of PhT
1. Competencies in pharmaceutical information service (inf)	inf1*	inf4*
	Making a report	Inputting data and assessing operational system
	inf2	inf5
	Making media	Analyzing data, statistics, and performance index
	inf3	inf6
	Assisting in data processing, statistical analysis and hospital information system management	Processing statistical analyses and preparing presentations
	-	inf7
2. Competencies in pharmaceutical inventory management (log)	log1*	log5*
	Reporting pharmaceutical demand	Managing supply chain
	log2	log6
	Operating pharmaceutical warehouse	Designing pharmaceutical warehouse
	log3	log7
	Managing pharmaceutical distribution system	Designing forecasting and inventory management system
	log4	log8
3. Starting salary	Assisting in quality control process	Using logistics technology
	8985 Baht	11,000 Baht
	13,800 Baht	15,000 Baht
		18,000 Baht

*Reference variables in data analysis, DCE: Discrete choice experiment, HVC: High vocational certificate, PhT: Pharmacy technician

the number of alternatives. In addition, the questionnaire collected demographics, experience, and perceived difficulty of completing the DCE questionnaire.

Step 4: Testing for face validity

Face validity testing was conducted using a convenience sample of the head pharmacists ($n = 20$) with 14-choice set, in addition to one warm-up choice set that also served to test for internal consistency. Think-aloud protocol was used to assess the feasibility of the DCE self-report questionnaire [13,27,28] and revealed that 19 of the head pharmacists made trade-off decisions between the three attributes, with only one respondent choosing the existing HVC PhT alternative in all 15-choice set. Most respondents took 7–20 min to complete the questionnaire (50%, $n = 10$). Fifty percent of respondents ($n = 10$) indicated that the DCE task was difficult to complete, 35% ($n = 7$) indicated moderate difficulty, and 15% ($n = 3$) specified that it was easy. Most of the respondents had never seen a DCE questionnaire before (95%, $n = 19$). The 1st and 15th choice sets of each questionnaire were the same to check for internal consistency, which was found to be at 70% ($n = 14$).

Step 5: Conducting the pilot study

A pilot study was conducted using stratified random sampling design, wherein Microsoft Excel Program was used to randomly select 39 head pharmacists from the research population. An example of a choice set is presented in Figure 1. Twenty-three percent ($n = 9$) of respondents choose the same alternative for all 15-choice set. Fifty-one percent ($n = 20$) of pilot study

participants found the DCE task to be moderately difficult, 46% ($n = 18$) difficult, and 3% ($n = 1$) easy. The majority of the respondents had never seen a DCE questionnaire before (92%, $n = 36$) and internal consistency was found to be at 92% ($n = 36$). While the most respondents expressed that the DCE task was difficult, internal consistency was high. Thus, the 15-choice set was determined suitable for use in the main survey.

Step 6: Refining the DCE questionnaire

The choice set order was randomized for the DCE questionnaire used in the main study to increase response quality. Fourteen choice sets profiles were proposed. The 1st choice set of each questionnaire was repeated in the 15th choice set to check for internal consistency.

Subsequently, the applied indirect utility function was:

$$V(\text{hvc}) = b_1 \text{inf1} + b_2 \text{inf2} + b_3 \text{inf3} + b_4 \text{log1} + b_5 \text{log2} + b_6 \text{log3} + b_7 \text{log4} + b_8 \text{salary}_{\text{hvc}} \quad (1)$$

$$V(\text{ba}) = \text{ASC}_{\text{ba}} + b_9 \text{inf4} + b_{10} \text{inf5} + b_{11} \text{inf6} + b_{12} \text{inf7} + b_{13} \text{log5} + b_{14} \text{log6} + b_{15} \text{log7} + b_{16} \text{log8} + b_{17} \text{salary}_{\text{ba}} \quad (2)$$

Where, V represents the indirect utility that a respondent had for the PhT choice set (ba refers to a bachelor's degree and hvc a HVC in Public Health); ASC_{ba} represents the alternative specific constant for the bachelor's degree for PhT, and β_1, β_{17} represents the relative importance expressed for each attribute level.

The existing HVC in Public Health of PhT	The proposed Bachelor's degree of PhT
Excellent performance in actively providing pharmaceutical information and health products to service recipients by - Creating media content, developing educational media content, training and providing knowledge in various forms (inf2)	Excellent performance in using a general health information database to improve work by - Analyzing data, statistics and performance indexes - Supporting data development to assure its quality, such as through hospital accreditation and using other standards (inf5)
Excellent performance in operating the pharmaceutical warehouse by - Setting up the system and keeping and maintaining pharmaceutical products according to pharmaceutical management standards - Registering receipts, accepting pharmaceutical products from the delivery person and waiting for the acceptance examination - Disbursing and verifying the disbursement of pharmaceutical products (log3)	Excellent performance in setting up a forecasting system and managing inventory by - Categorizing inventory according to certain systems, such as ABC Inventory Analysis or VEN Analysis - Analyzing and designing inventory distribution - Increasing cost efficiencies in the administration of inventory by certain means, such Lean Technique, Inventory Theory or Value Stream Mapping - Administering purchases - Determining standards, regulations and practices in logistics operations (log7)
Starting salary THB 8,985	Starting salary THB 15,000
Which pharmacy technician would you choose?	
☐	☐

Figure 1: Example of a choice set

Data Collection

The final labeled DCE questionnaire was sent by post to head pharmacists of 814 Thai Ministry of Public Health hospitals. Information on the study, a consent form, and the questionnaire were mailed on March 25, 2016, to head of pharmacy departments controlled by the Thai MOPH. In the event that the elicitation went unanswered after 1 month, participants were contacted once through phone.

Statistical Analysis

Two researchers checked and inputted the questionnaire responses for data analyses. Statistical analyses were carried out using Stata (version 11).^[29] Conditional logistic regression analysis^[30] was performed on selected choice sets. A theoretical validity testing framework was used and evaluated according to the expected negative value of the cost-attribute coefficient (indicating a preference for lower cost). The marginal WTP for an improvement in each attribute level was estimated using the ratio of the interest alternative-specific attribute coefficient and the negative of the alternative-specific salary attribute coefficient. For example, WTP for a salary per month of PhT with a bachelor's degree that moving from competency in inputting data and assessing operational systems (inf4) to competency in analyzing data, statistics, and performance index (inf5) = $\beta_{10}/-\beta_{17}$ and WTP for a salary per month of PhT with an HVC that moving from competency in making a report (inf1) to competency in making media (inf2) = $\beta_2/-\beta_8$. The relative size of WTP values implied the relative importance

of each of the attributes. The logit probability of selecting a prospective employee with the proposed PhT bachelor's degree qualification at a starting salary of 15,000 THB rather than one with the existing HVC in public health qualification at a starting salary of 8985 THB was given by

$$P_{ba} = \frac{e^{ASC_{ba} + \beta_{10} + \beta_{11} + \beta_{12} + \beta_{14} + \beta_{15} + \beta_{16} + \beta_{17} * 15,000}}{e^{ASC_{ba} + \beta_{10} + \beta_{11} + \beta_{12} + \beta_{14} + \beta_{15} + \beta_{16} + \beta_{17} + e\beta_2 + e\beta_3 + e\beta_4 + e\beta_5 + e\beta_6 + e\beta_7 + e\beta_8 * 8,985}} \quad (3)$$

Ethics Approval

This study was reviewed and approved in an official letter dated August 24, 2015, by the Khon Kaen University Ethics Committee for Human Research (HE582212).

RESULTS

General Characteristics

The respondents returned their questionnaires between April 15 and May 31, 2016. A total of 205 chief pharmacists completed the survey, resulting in a response rate of 25.18%. As shown in Table 2, their mean age was 41 ± 0.089 years and most were female (67.8%). The most common level of education was a bachelor's degree (47.4%) followed by a master's degree (41.5%) and doctorate (1%). In terms of job level, determined by number of working years and project portfolio, the majority of respondents were employed at professional or senior professional levels (86.3%). Most of them worked in community hospital administrative levels (86.3%), and most

Table 2: Characteristics of head pharmacists ($n=205$)

Characteristics	Statistical	n (205)	%
Gender			
Female		139	67.8
Age (years)			
Mean (SD)	41.03 (0.089)	12	5.9
Minimum age	24	80	39.0
Maximum age	59	85	41.5
Level of education			
Bachelor's		117	57.1
Master's		85	41.5
Doctoral		2	1.0
Head pharmacists' job level			
Practitioner		23	11.2
Professional		90	43.9
Senior professional		87	42.4
Expert		5	2.4
Type of public hospital			
Regional		9	4.4
General		19	9.3
Community		177	86.3
Prior experience with DCE			
Yes		11	5.4
Never		179	87.3
Not sure		14	6.8
Difficulty in completing DCE			
Very difficult		5	2.4
Difficult		68	33.2
Moderate		110	53.7
Easy		2	0.1
Very easy		19	9.3
Choose the same alternative (for all 15-choice set)		44	21.5
Choose the existing HVC in public health for PhT		21	10.2
Choose the proposed bachelor's degree for PhT		23	11.2

DCE: Discrete choice experiment, HVC: High vocational certificate, PhT: Pharmacy technician

indicated that this was their first experience responding to a DCE (87.32 %). Completing the DCE was reported as either difficult or very difficult (35.6%) at a lower rate than in both the pilot study (97%) and face validity test (85%).

Response Quality

Internal consistency (77.00%, 158 head pharmacists) was lower than that of the pilot study (92%) and similar to that of the face validity test (70%). One-fifth of head pharmacists choose the alternative with the same label for all 14-choice set (21.5%), similar to pilot study respondents (23%). Of these, the

proportion that selected the proposed bachelor's degree for PhT alternative (11.2%) was approximately equal to the proportion that selected the existing HVC for PhT alternative (10.2%). Log-likelihood of the model from the sample (-1800.6749) was lower than that of the model when inconsistent respondents were excluded (-1393.8308). The log-likelihood values indicated that the data derived from the full sample had a greater ability to explain the pattern of choices.

Pharmacists' PhT Employment Preferences

Table 3 (Columns 2–3) shows the coefficient values of the model for which the goodness-of-fit test had a pseudo R-squared value of 0.0948. The positive alternative-specific constant (ASC_{ba}) indicated that the head pharmacists preferred employing a PhT with a bachelor's degree qualification, as compared to one with the existing HVC qualification ($P < 0.01$). The negative sign on both salaries indicates their preference to pay less for the PhT. This finding also confirmed the theoretical validity of the model ($P < 0.01$).

The competencies of the proposed bachelor's degree for PhTs that were statistically significant factors increasing the utility for respondents compared with the determined reference level were competency in applying technology to solve problems and improve work ($\lnf7$, $\beta = 0.2576$, $P < 0.05$) and competency in designing forecasting and inventory management systems ($\lnf7$, $\beta = 0.6028$, $P < 0.01$). The competency of the proposed bachelor's degree for PhT that was a statistically significant factor reducing the utility for respondents compared with the determined reference level was analyzing data, statistics, and performance indexes ($\lnf5$, $\beta = -0.2091$, $P < 0.05$).

The competencies of the existing HVCs that were statistically significant factors increasing the utility for respondents compared with the determined reference level were competency in ability to assist in data processing and statistics, including hospital information systems ($\lnf3$, $\beta = 0.5307$, $P < 0.01$), competency in operating pharmaceutical warehouses ($\lnf2$, $\beta = 0.3538$, $P < 0.01$), and ability to assist in quality control processes ($\lnf4$, $\beta = 0.4939$, $P < 0.01$).

The marginal WTP for Desirable Attributes in PhT Employment

Table 3 (Column 4) shows how much starting salary pharmacists would be willing to pay for an improvement relative to each reference variable. For instance, the WTP value for a PhT with a bachelor's degree (ASC_{ba}) was THB 11,182.49 per month, which means that the sample was willing to pay approximately THB 11,000 to employ the PhT with a bachelor's degree rather than the existing HVC. However, the WTP values suggest that, for this sample of head pharmacists, the competencies under the existing HVC affected their choice more than those that would be acquired by a PhT with a bachelor's degree.

Data Analysis for Decision-Making

Table 4 shows the probabilities for choosing a PhT with a bachelor's degree versus one with the existing HVC, with changing attribute levels that were statistically significant (Equation 3). In situation A, which had the most preferred

Table 3: Conditional logistic regression data of the study

Attribute and level	Alternative	Coefficient (95% CI)	p value	Marginal WTPa (THB; 95% CI)
ASCba	Bachelor's degree	2.4651 (1.8970; 3.0331)	<0.001	11,182.49 (9227.443; 13,137.54)
inf1(β_1) ^c	HVC	Constrained to be 0		
inf2(β_2)	HVC	0.0166 (−0.1251; 0.1583)	0.8180	N/Ab
inf3(β_3)	HVC	0.5307 (0.3677; 0.6937)	<0.001	7279.54 (3705.80;10,853.27)
log1(β_4) ^c	HVC	Constrained to be 0		
log2(β_5)	HVC	0.3538 (0.1945; 0.5132)	<0.001	4853.93 (1946.97;7760.89)
log3(β_6)	HVC	−0.0034 (−0.1547; 0.1480)	0.9650	N/Ab
log4(β_7)	HVC	0.4939 (0.3199; 0.6679)	<0.001	6774.91 (3305.78;10,244.04)
salary_hvc(β_8)	HVC	−0.000073 (−0.0001; −0.00004)	<0.001	N/A
inf4(β_9) ^c	Bachelor's degree	Constrained to be 0		
inf5(β_{10})	Bachelor's degree	−0.2091 (−0.3784; −0.0398)	0.0150	−948.71 (−1732.26; −165.16)
inf6(β_{11})	Bachelor's degree	0.0550 (−0.1142; 0.2241)	0.5240	N/Ab
inf7(β_{12})	Bachelor's degree	0.2576 (0.0968; 0.4183)	0.0020	1168.51 (458.44;1878.58)
log5(β_{13}) ^c	Bachelor's degree	Constrained to be 0		
log6(β_{14})	Bachelor's degree	−0.1610 (−0.3426; 0.0205)	0.0820	N/A
log7(β_{15})	Bachelor's degree	0.6028 (0.4188; 0.7868)	<0.001	2734.42 (1809.12;3659.72)
log8(β_{16})	Bachelor's degree	−0.0574 (−0.2199; 0.1050)	0.4880	N/Ab
salary_ba(β_{17})	Bachelor's degree	−0.00022 (−0.0003; −0.0002)	<0.001	N/A

No. of observations: 5740, no. of respondents: 205, log pseudolikelihood: -1800.6749, pseudo R2: 0.0948, ASCba: Alternative relative to the proposed bachelor's degree curriculum for pharmacy technician, HVC: High vocational certificate, ^amarginal WTP estimate, calculated using the result of the model obtained from STATA, ^bmarginal WTP estimate is not reported because parameter estimate was not statistically significant, ^creference variables

Attributes are explained in Table 1

Table 4: The probability of preferring the PhT option for each situation

Characteristics	Situation A		Situation B	
	PhT with HVC in public health	PhT with bachelor's degree	PhT with HVC in public health	PhT with bachelor's degree
ASC	-	2.4651**	-W	2.4651**
Competencies in pharmaceutical information services	inf3 Assisting in data processing, statistical analyses and hospital information systems management	inf7 Applying technology to solve problems and improve work	inf3 Assisting in data processing, statistical analyses and hospital information systems management	inf7 Applying technology to solve problems and improve work
Competencies in pharmaceutical inventory management	log4 Assisting in quality control processes	log7 Designing forecasting and inventory management systems	log4 Assisting in quality control processes	log7 Designing forecasting and inventory management systems
Starting salary	THB 8985	THB 15,000	THB 13,800	THB15,000
Probability of choosing (95% CI)	58.68***% (0.51–0.66)	41.32***% (0.34–0.49)	50.00***% (0.43–0.57)	50.00***% (0.43–0.57)

**Significant at 1% level, HVC: High vocational certificate, PhT: Pharmacy technician

attribute levels for each alternative, 41.32% of pharmacists choose a PhT with a bachelor's degree featuring competencies of designing forecasting and inventory management systems (log7) and applying technology to solve problems and improve work (inf7) and a starting salary of THB 15,000. The remaining pharmacists (58.68%) preferred a PhT with an HVC, featuring competencies of assisting in data processing and statistics, including hospital information systems (inf3) and assisting in quality control processes (log4), and a starting salary of THB 8985 ($P < 0.01$).

Regarding situation B, in which the only change was the starting salary of the PhT with the HVC qualification, half of the pharmacists choose the PhT with bachelor's degree, featuring competencies in log7 and inf7, and a starting salary of THB 15,000. The remaining pharmacists preferred the PhT with HVC, featuring competencies in inf3 and log4, and a starting salary of THB 13,800 ($P < 0.01$).

Other Suggestions from Pharmacists

Other suggestions were offered by 40.98% of head pharmacists. Their suggestions could be divided into two categories, as follows:

1. Suggestions applicable to the proposed PhT bachelor's degree: Twenty pharmacists were concerned about the career path for PhTs, and suggestions were that the curriculum should also be relevant to the fields of consumer protection (nine pharmacists) and community-related work (seven pharmacists)
2. Suggestions applicable to the existing HVC in public health for PhT: Three pharmacists suggested that there was a shortage of PhTs with HVCs in the current health service system and expressed concerns that there may be no staff to conduct basic activities in pharmacy in the future.

DISCUSSION

This research revealed that head pharmacists in Thai hospitals prefer the proposed bachelor's level option for PhT education over the existing HVC in Public Health for PhT. The competencies of the bachelor's degree for PhT that increased preference for it were competency in applying technology to solve problems and improve work (inf7) compared to that of inputting data and assessing operational systems (inf4) and competency in designing forecasting and inventory management systems (log7) compared to that of managing supply chain (log5). Competency in designing pharmaceutical warehouse (log6) did not increase preference for hiring. This competency may have limited benefits, as the pharmaceutical warehouse design tends to be completed before hiring of PhT.

Pharmacists desired certain competencies in pharmaceutical information services and pharmaceutical inventory management services under the existing HVC more than the proposed bachelor's degree qualification for PhT. Under competencies related to the former, the head pharmacists preferred competency in assisting in data processing, statistical analysis and hospital information system management (inf3), and under competencies related to the latter, they preferred competency in assisting in quality control process (log4)

and operating pharmaceutical warehouse (log2), compared with their respective competency references. This relative importance of each competency can inform development of the existing HVC of PhT curriculum.

It should be noted that the sample of pharmacists may have had other preferred competencies of a bachelor's degree for PhT which were not proposed, as certain characteristics were not covered (e.g., community-related work and health promotion and prevention).^[31] Therefore, the advanced role of the bachelor's degree for PhT should be reviewed. In addition, there was a 40–50% probability of choosing a PhT with the proposed bachelor's degree qualifications when compared with a PhT with HVC qualifications. This finding can serve as useful information for decision-makers when designing the optimal curriculum.

Praboromarajchanok Institute, itself, was unable to provide the bachelor's degree in the past and has instead continued to develop the existing HVC of PhT curriculum. In 2019, however, Praboromarajchanok Institute was promoted to university status, opening up the opportunity to develop such a bachelor's degree curriculum that could include the proposed competency in pharmaceutical information services, as well as in pharmaceutical inventory management. This would be in line with a statement from the American Society of Health-System Pharmacists, which supports the use of PhTs in the role of managers or supervisors.^[3] To improve the quality of pharmaceutical service and the morale of PhTs, and to retain them in the health-care system, it will be suitable to implement bachelor's degree curriculum development for PhTs in the future.

There were various limitations in this study. First, the main limitation was the generalizability of its results due to the relatively low response rate (205 out of 814, 25.18%), much lower than the previously reported mean DCE response rate of $50.44 \pm 19.46\%$, found by a systematic review of DCEs conducted between 2001 and 2008.^[13] The low response rate led to a low effect size, demonstrated by the model's pseudo R-squared value (ideally 0.2–0.4).^[20] Future research should reduce the number of choice sets to reduce the cognitive burden.^[32] This could help to influence a higher response rate of the questionnaire.

The second limitation related to the use of a labeled DCE. This offered certain advantages, namely, allowing for different attribute levels across the proposed bachelor's degree for PhT and the existing HVC. On the other hand, it also led to respondents selecting alternatives according to the label rather than comparing the attributes. The percentage of respondents that consistently choose the same alternative was 21.46%, similar to previously reported rates of 23.6% and 18.4%.^[33] Future qualitative research should take these results into account.

The third limitation was that the relative importance of the salaries may have resulted from the fact that the respondents themselves would not be directly paying for a PhT's salary. However, the relative importance of the starting salary in situation B (13,800 THB for the existing HVC and 15,00 THB for the proposed bachelor's degree) was most important relative to both competencies. Finally, the third limitation was

related to the repeated question. While 77% of the respondents responded to it in a consistent manner, it should be noted that there was a 50% chance of selecting the same choice. Future DCE work should implement additional internal and external validity testing of findings, as recommended by previous DCE research in health.^[14,15,34] and pharmacy-related areas.^[16,17,35]

CONCLUSIONS

This study showed that the sample of head pharmacists preferred the proposed PhT bachelor's degree when compared with the existing HVC of PhT. The head pharmacists' preferences increased for most competencies in pharmaceutical information services and in pharmaceutical inventory management that would be offered by the proposed bachelor's degree. However, certain competencies under the HVC were preferred to the bachelor's degree. There was approximately a 50% probability of choosing a PhT with the proposed bachelor's degree qualifications versus a PhT with HVC qualifications. More advanced roles for hospital PhT, such as consumer protection or community-related work, should be included in the model to further identify the desirable qualities of PhT graduates.

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AUTHORS' CONTRIBUTION

S. Muadthong, N. Kessomboon, T. Kitajima, and K. Muangyim designed the study. T. Kitajima and S. Ngorsuraches designed the DCE model. N. Kessomboon encouraged S. Muadthong to investigate the hospital pharmacists' preferences and supervised the findings of this work. T. Kitajima, S. Muadthong, and N. Kessomboon analyzed the data. S. Muadthong and N. Kessomboon wrote the manuscript in consultation with P. Kessomboon. All authors discussed the results and contributed to the final manuscript.

ETHICS APPROVAL

This study was reviewed and approved in an official letter dated August 24, 2015, from the Khon Kaen University Ethics Committee for Human Research (HE582212).

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CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

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