

Evaluation of Knowledge on Pharmaceutical Regulatory among Pharmacists in Kedah

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Abstract

Introduction: One of public service pharmacists' routine job is to educate the public by disseminating accurate information under the QUMC programme. However, their level of understanding in pharmaceutical regulatory aspect remains limited to ensure only quality, safe and efficacious products been consumed, access to approved medicinal advertisements and increase consumers awareness on the usage of registered products/cosmetics.

Objectives: This study aimed to assess pharmacist's knowledge on medicine registration, cosmetic notification and medicinal advertisement, and also to compare their knowledge based on demographic background.

Method: A cross-sectional study that recruited all pharmacists from 21 facilities in Kedah from December 2018 to February 2019 was conducted using a validated self-administered questionnaire. The questionnaire consisted three parts, with eleven questions on medicine registration, eight questions on cosmetic notification and eight questions on medicinal advertisement, respectively. One score was given for each correct answer. The level of knowledge was categorised as Good (>22 scores), Moderate (17-21 scores) and Low (<16 scores).

Results: This study was participated by all 476 pharmacists in Kedah and recorded 100% response rate. Majority of the respondents were female (80.7%), without experience in pharmacy enforcement (95.4%), working in hospital (56.7%) and had averagely serviced for 6.8 years. On average, their mean knowledge score was 17.8 (± 2.4), with mean score 7.6 (± 1.3) for medicine registration, 4.6 (± 1.2) for cosmetic notification and 5.6 (± 1.1) for medicinal advertisement. There were significant associations between knowledge score with their gender ($p=0.014$), enforcement experience ($p<0.001$), workplace ($p=0.005$) and years of services ($p=0.02$).

Conclusion: The study revealed that pharmacists' pharmaceutical regulatory knowledge was moderate. Current study suggested that there was a necessity to strengthen the existing trainings and implement continuous education on pharmaceutical regulatory periodically for every pharmacist.

Keywords: pharmacist's knowledge, medicine registration, cosmetic notification, medicinal advertisement

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Introduction

The roles of pharmacists have expanded beyond dispensing and packaging. Nowadays, pharmacists are often referred to ensure the rational use of drugs, improve clinical outcomes and promoting health status by working with the public and other healthcare professionals. In the Ministry of Health Malaysia (MOH), pharmacy services have been expanded from the conventional inpatient and outpatient pharmacy to Clinical Pharmacy Service, Medication Therapy Adherence Clinic (MTAC), Home Care Pharmacy Services (HCPS) which was formerly known as Home Medication Review (HMR), Nonsterile Pharmacy, Clinical Pharmacokinetic Services, Oncology Pharmacy Service, Parenteral Nutrition Service, Methadone Replacement Therapy, Drug Information Enquiry Service, Nuclear Pharmacy Service, and Procurement and

Supply Services (1-3). In addition, pharmacists in the major hospitals provide drug and poison information to healthcare professionals and the public (4).

In Malaysia, the Malaysian National Medicines Policy (MNMP) was implemented to promote equitable access to, and rational use of safe, effective and affordable essential drugs of good quality to improve health outcomes of the people. The MNMP emphasized that the compliance with the standards shall be supported by legislation where appropriate. Relevant legislations or regulations shall be developed and reviewed regularly to ensure an efficient supply chain network and integrated medicines management to safeguard the public. Independent, high quality, evidence-based information shall be made readily available to healthcare providers via continuing education programmes, unbiased promotion of medicines and linkages to the National Drug Information Centre and other relevant health portals (5).

One of the MNMP strategies was to include principles of safe, appropriate and quality use of medicines in the curricula for the education and training of all healthcare providers involved in medication management (5). In 2007, the MOH Pharmaceutical Services Programme launched the Know Your Medicines Campaign to increase consumers' understanding, awareness on medication and educate the public on rational use of medicines. The MOH pharmacists-led training and educational activities of the campaign include training of trainers for *Duta Kenali Ubat Anda* (Know Your Medicines Ambassadors), exhibitions and talks, continuous promotion through mass media, and home visit (*Duta Prihatin Masyarakat*). The programme was built not only for healthcare providers, but also for the community to play their roles in promoting equitable access and rational use of medicine (6).

In health education curricula and activities, pharmacists are often involved as trainers, speakers and researchers. Pharmacists are responsible to advise patients about medicines, including how to take them, what reactions may occur and answering patients' questions. Pharmacists also advise other healthcare professionals about safe and effective medicines use while ensuring safe and secure supply of medicines (7). Pharmacists are regarded as the platform in providing the legitimate source of medicine information. Therefore, pharmacist's must be knowledgeable about the regulatory control of medicines, cosmetics and medical advertisement to ensure that they are providing and disseminating accurate, unbiased and relevant information to public. To date, nevertheless, limited studies were conducted in Malaysia to evaluate the pharmacists' knowledge on the laws and regulations of medicines, cosmetics and medicinal advertisements. Therefore, this study aimed to assess the knowledge of pharmacists who were working in the government setting in the state of Kedah about medicine registration, cosmetic notification and medicinal advertisement, and to compare their knowledge based on their demographic characteristics.

Method

Study type and design

This study was a cross-sectional study using a self-administered questionnaire among fully-registered pharmacists who were working in government health facilities in Kedah. There were 81 health facilities in Kedah, which included the state health department (abbreviated as JKN), nine hospitals, eleven district health offices (abbreviated as PKD) and sixty health clinics (abbreviated as KK) from eleven districts in the state.

All the 81 health facilities in Kedah were divided among one principal investigator and four co-investigators. All the government sector pharmacists were distributed with the information sheet of the study after the written permission of the chief pharmacist in each health facility was obtained. They were requested to contact the investigators within seven days of being informed by their Chief Pharmacists if they were interested to participate in the study. An appointment was made where the study information sheet (or written consent form) in both English and Malay languages were provided and explained to them by the investigators at the study site. The written consent forms were signed and personally dated by the respondents before participating in this study. The Chief Pharmacists from every study sites were responsible to schedule the date and time for the respondents based on their availability and informed to investigators verbally in order to conduct the data collection in several sessions. The pharmacists were required to self-answer the questionnaire without any references within 30 minutes after the informed consent process during the data collection sessions.

Ethics approval and permission to collect data were acquired from the Medical Research & Ethics Committee (MREC), Ministry of Health Malaysia before data collection was initiated (NMRR-18-2696-43394 (IIR)).

Sample size

Based on a population of 476 public sector fully-registered pharmacists in Kedah (information provided by the Pharmacy Management Branch, Kedah State Health Department), the sample size was calculated using Raosoft® sample size calculator (margin of error 5%, confidence level 95%, response distribution 50%) which yielded the minimum sample size of 213 participants (9). Non-probabilistic quota sampling was conducted since all fully-registered pharmacists were included in this study. The inclusion criteria included all fully registered pharmacists under the Pharmaceutical Service Programme, MOH in Kedah during the period from 1 December 2018 to 28 February 2019. Pharmacists who worked in the Kedah Pharmacy Enforcement Branch, and pharmacists who were on any leave (e.g. maternity leave, study leave, sick leave, or unrecorded leave) for more than three months consecutively were excluded.

Study instrument

This was a validated, self-administered 27-item questionnaire to measure the level of knowledge on pharmaceutical regulatory among the pharmacists. The knowledge domain were divided into three parts. There were 11 questions measuring the knowledge on medicine registration (Part A), 8 questions focusing on cosmetic notification (Part B) and 8 questions addressing information regarding medicinal-related advertisement (Part C). Demographic characteristics questions were also included in this questionnaire. Each correct answer in the knowledge domain carried 1 score while incorrect or blank answer carried 0 score. This gave a score range from 0 to 27 for the overall knowledge domain. The knowledge were categorised as Low (score 16 and less), Moderate (score between 17 to 21) and Good (score 22 and more). The questions of medicine registration were adapted from two Malaysian studies (8, 9), while the questions on cosmetic notification and medicinal-related advertisement were adopted from relevant Acts including the Control of Drugs and Cosmetics Regulations 1984 and Medicines (Advertisement & Sale) Act 1956 (10) and guidelines issued by National Pharmaceutical Regulatory Agency (NPRA) and Medicine Advertisements Board (MAB) (11-13). The content of questionnaire was thoroughly validated by an expert review panel which consisted of the Kedah Deputy Director of Health (Pharmacy), Head of Pharmacy Enforcement Branch and Head of Pharmacy Practice and Development Branch. Then, five pharmacists from the Kedah State Health Department were invited to conduct face validation to ensure that the questions were not ambiguous. To test the reliability, a pilot study was conducted among 33 randomly selected pharmacists from Sultan Abdul Halim Hospital, Sungai Petani, Kedah before data collection was initiated (14).

Statistical analysis

Data were analysed using Statistical Package for Social Sciences software (SPSS) version 16 and Excel spreadsheet. Initially, all information collected was coded into variables and the normality of data was tested using histogram. The knowledge scores were descriptively expressed as mean and standard deviation (SD). Inferential statistics involving independent t-test and one-way ANOVA test were used for analysis of normally distributed demographic characteristics. Simple Logistic Regression was also used to determine the magnitude of association between independent and outcome variables in term of odds ratio (OR). A p-value of less than 0.05 was considered statistically significant.

Results

The internal consistency (reliability) of the questionnaire was 0.601 (Cronbach's alpha) and was deemed acceptable by the investigators (15). A total of 476 questionnaires were distributed to all pharmacists from the 81 government health facilities in Kedah and all 476 were returned, giving a response rate of 100%. Majority of the respondents were female (80.7%), Malay (62.2%), and most of them did not have pharmacy enforcement (95.4%) and regulatory experience (99.6%) (Table 1).

Table 2 showed that the mean knowledge score was 17.8 (SD 2.4). Majority of the respondents (67.0%) had moderate knowledge on pharmaceutical regulatory and only 5.3% had good knowledge level. The mean scores for Medicine Registration (Part A), Cosmetic Notification (Part B) and Medicinal Advertisement (Part C) were 7.6 (SD 1.3) out of 11 questions, 4.6 (SD 1.2) out of 8 questions and 5.6 (SD 1.1) out of 8 questions respectively (Table 3).

Most respondents (99.4%) knew the two main features that needed to be displayed on the package of a registered medicine and 469 respondents (98.5%) knew that *Meditag™ decoder* was a tool to check the authenticity of the hologram label and thus indicates the respondents knew well how to identify the

regulatory features on registered pharmaceutical product in Malaysia. Nevertheless, only 239 respondents (50.2%) had knowledge on regulatory control of veterinary product in Malaysia and only 128 respondents (26.9%) knew that Drug Control Authority (DCA) was responsible for product registration in Malaysia.

In terms of cosmetic notifications, 433 respondents (91.0%) knew that cosmetics should not contain claims with medicinal purposes and 370 respondents (77.7%) could recognise cosmetic notification number as a proof of notification in Malaysia. Only 34 respondents (7.1%), however, knew that the Senior Director of Pharmaceutical Services was the correct Competent Authority that is responsible for the cosmetic notification. For medicinal advertisement, the result shows that 453 respondents (95.2%) were aware of the requirement to display advertisement's approval number on medicine's advertisement, but only 93 respondents (19.5%) answered correctly for the validity period for an approved advertisement, which is 3 calendar years in accordance to Medicine Advertisement Board, Ministry of Health Malaysia.

This study had further compared knowledge of pharmacists by their demographic characteristics (Table 4). Male respondents (mean score 18.4 with SD 2.5) had higher knowledge score than female respondents (mean score 17.7 with SD 2.3) ($p=0.014$). Pharmacists with previous pharmacy enforcement experience (mean score 20.0 with SD 2.3) had better knowledge comparing to pharmacists that never worked in pharmacy enforcement (mean score 17.7 with SD 2.3) ($p<0.001$). The simple logistic regression showed that pharmacists who worked in pharmacy enforcement previously had higher odds to be knowledgeable in pharmaceutical regulatory compared others without pharmacy enforcement experience (OR 8.52, 95% CI 1.13-63.97, $p=0.037$) (Table 5).

The one way ANOVA test showed statistical significance that pharmacists who worked at state health department (mean score 20.1 with SD 2.6) had higher knowledge score as compared to three other facilities ($p=0.005$) (Table 4). The Scheffé post-hoc test further showed that the knowledge score in pharmacists who worked at state health department were statistical significantly higher than pharmacists who worked in hospital, district health offices and health clinics ($p<0.05$) (Table 6).

Majority of the respondents (83.6%) have working experience of less than 11 years. One way ANOVA test showed statistically significant difference in knowledge score by the years of services ($p=0.02$). Furthermore, inspection of scatter plots between duration of service and mean scores showed homoscedasticity. Therefore, a Pearson's correlation was run on the data. The result, however, showed only a weak positive correlation between the two variables ($r=0.167$, $p<0.001$) (Table 8).

Table 1: Demographic characteristics of pharmacists in government sector in Kedah (n=476)

Variable	n (%)	Mean (SD)
Age, years		31.3 (4.7)
Gender		
Female	384 (80.7)	
Male	92 (19.3)	
Ethnicity		
Malay	296 (62.2)	
Chinese	155 (32.6)	
Indian	25 (5.3)	
Workplace		
JKN	12 (2.5)	
Hospital	270 (56.7)	
PKD	46 (9.7)	
KK	148 (31.1)	
Service duration, years		6.8 (4.7)
Pharmacy enforcement experience		
Yes	22 (4.6)	
No	454 (95.4)	
NPRA experience		
Yes	2 (0.4)	
No	474 (99.6)	

Abbreviation: SD – standard deviation; JKN – state health department; PKD – district health office; KK – health clinic; NPRA – National Pharmaceutical Regulatory Agency.

Table 2: Pharmacist's overall level of knowledge on pharmaceutical regulatory (n=476)

Level of knowledge	n (%)	Score, mean (SD)
		17.8 (2.4)
Low (score ≤ 16)	132 (27.7)	
Moderate (score 17 to 21)	319 (67.0)	
Good (score ≥ 22)	25 (5.3)	

Abbreviation: SD – standard deviation.

Table 3: Pharmacist's knowledge on medicine registration, cosmetic notification and medicinal advertisement (n=476)

Domain	Correct answer, n (%)	Incorrect / blank answer, n (%)	Score, mean (SD)
Part A: Medicine Registration			7.6 (1.3)
1) Features of Registration	473 (99.4)	3 (0.6)	
2) Hologram's Version	129 (27.1)	347 (72.9)	
3) Hologram Label	218 (45.8)	258 (54.2)	
4) OTC Medicine	385 (80.9)	91 (19.1)	
5) Fake Registration	260 (54.6)	216 (45.4)	
6) Controlled Medicine	446 (93.7)	30 (6.3)	
7) Traditional Medicine	464 (97.5)	12 (2.5)	
8) Veterinary Medicine	239 (50.2)	237 (49.8)	
9) Hologram Authenticity	469 (98.5)	7 (1.5)	
10) Competent Authority	128 (26.9)	348 (73.1)	
11) Vitamin C Injection	418 (87.8)	58 (12.2)	
Part B: Cosmetic Notification			4.6 (1.2)
1) Function	433 (91.0)	43 (9.0)	
2) Notification Number	370 (77.7)	106 (22.3)	
3) Packaging Label	118 (24.8)	358 (75.2)	
4) Website	463 (97.3)	13 (2.7)	
5) Competent Authority	34 (7.1)	442 (92.9)	
6) Prohibition	221 (46.4)	255 (53.6)	
7) Safety & Quality	122 (25.6)	354 (74.4)	
8) Manufacturing	445 (93.5)	31 (6.5)	
Part C: Medicinal Advertisement			5.6 (1.1)
1) Approval	453 (95.2)	23 (4.8)	
2) Competent Authority	404 (84.9)	72 (15.1)	
3) Approval Number	351 (73.7)	125 (26.3)	
4) Validity Period	93 (19.5)	383 (80.5)	
5) 20 Prohibited Diseases I	469 (98.5)	7 (1.5)	
6) 20 Prohibited Diseases II	294 (61.8)	182 (38.2)	
7) Example of Advertisement I	152 (31.9)	324 (68.1)	
8) Example of Advertisement II	426 (89.5)	50 (10.5)	

Abbreviation: SD – standard deviation.

Table 4: Pharmacist's knowledge score on pharmaceutical regulatory based demographic characteristics (n=476)

Demographic Characteristics	n (%)	Score, mean (SD)	t * / F # statistics (df)	p-value
Gender			2.5 (474)	0.014 *
Male	92 (19.3)	18.4 (2.5)		
Female	384 (80.7)	17.7 (2.3)		
Pharmacy enforcement experience			4.6 (474)	<0.001 *
Yes	22 (4.6)	20.0 (2.3)		
No	454 (95.4)	17.7 (2.3)		
Workplace			4.3 (3, 472)	0.005 #
JKN	12 (2.5)	20.1 (2.6)		
Hospital	270 (56.7)	17.7 (2.4)		
PKD	46 (9.7)	17.7 (2.3)		
KK	148 (31.1)	17.9 (2.3)		
Service duration			3.0 (4, 471)	0.02 #
0.00 – 2.99 years	102 (21.4)	17.5 (2.3)		
3.00 – 6.99 years	148 (31.1)	17.4 (2.3)		
7.00 – 10.99 years	148 (31.1)	18.1 (2.3)		
11.00 – 13.99 years	41 (8.6)	18.2 (2.8)		
14.00 – 34.99 years	37 (7.8)	18.6 (2.2)		

Abbreviation: SD – standard deviation; df – degrees of freedom; JKN – state health department; PKD – district health office; KK – health clinic

* independent t-test; # One way ANOVA test

Table 5: Association between knowledge score on pharmaceutical regulatory and pharmacy enforcement experience (n=476)

Pharmacy enforcement experience	n (%)	Score, mean (SD)	OR	95% CI	p-value §
Yes	22 (4.6)	20.0 (2.3)	8.52	1.13-63.97	0.037
No	454 (95.4)	17.7 (2.3)	1.00		

Abbreviation: OR – odds ratio; CI – confidence interval; SD – standard deviation.

§ Simple logistic regression

Table 6: Pairwise comparisons of knowledge score on pharmaceutical regulatory by workplace (n=476)

Workplace	Mean difference (x) in score	p-value ¶
JKN vs Hospital	2.5	0.006
JKN vs PKD	2.5	0.016
JKN vs KK	2.3	0.016
Hospital vs PKD		1.000
Hospital vs KK		0.887
PKD vs KK		0.976

Abbreviation: SD – standard deviation; JKN – state health department; PKD – district health office; KK – health clinic; vs – versus.

¶ Post-hoc test using Scheffé procedure

Table 7: Correlation between service duration and knowledge score on pharmaceutical regulatory (n= 476)

Variable	Mean (SD)	<i>r</i>	p-value ^o
Service duration, year	6.8 (4.7)	0.167	<0.001
Score	17.8 (2.4)		

Abbreviation: SD – standard deviation

^o Pearson Product-Moment Correlation

Discussion

In this study, pharmacists' knowledge on pharmaceutical regulatory were measured using a questionnaire that was adapted from previous studies and the relevant laws and guidelines. The Chronbach's alpha value of the questionnaire was 0.601 based on a pilot sample of 33 pharmacists. The investigators considered the questionnaire as having sufficient internal consistency as according to Saeed and Kassim (2017), composite reliability values of 0.60 to 0.70 are acceptable for exploratory research (15). The response rate of this study was 100%, with all the 476 distributed questionnaires answered. The very high response rate might be due to the commitment by the chief pharmacists in all study sites to facilitate the survey sessions. In addition, face-to-face personnel meeting of researchers with the respondents and limiting the survey response time to 30 minutes may have helped to ensure the response rate.

In this study, the pharmacist's knowledge score was divided into three categories which is good (above 80% - score 22 and more), moderate (between 60 to 79.9% - score between 17 to 21) and low (less than 59.9% - score 16 and less) in accordance to the category of performance in the appraisal system for public service officers that suggested by Public Service Department (16). Besides, Pharmacy Board, Ministry of Health Malaysia also set that every Provisionally Registered Pharmacist (PRP) shall obtain at least 60% for all sections and average of overall score of at least 60% for the purpose of full registration in accordance with the Registration of Pharmacists Act 1951 (1,10). The results of this study indicated that Kedah public service pharmacist's overall knowledge on pharmaceutical regulatory were in moderate level. Specifically, the knowledge of pharmacist in Kedah on medicine registration and medicinal advertisement was at moderate level (69.1% and 70% respectively) while their knowledge on cosmetic notification was at low level (57.5%).

Pharmacists in the government sector should have good knowledge on medicine registration, cosmetic notification and medicinal advertisement because pharmacists are always the first point of contact for public enquiries regarding the rational use of medicines. Better knowledge will help them in providing timely and accurate information to the public to choose safe, quality and efficacious medication, hence decrease the demand of adulterated and counterfeit drugs. Hanafi *et al.* (2013) had concluded that good knowledge is a prerequisite for good pharmacy practice. Enhancing our pharmacists' knowledge and attitude is parallel with the increase in the quality of their practice. It provides important clues for national pharmaceutical organisations to organise educational programmes for the community pharmacists to equip them for their important role in community practice which is promoting rational drug use (17).

Woodcock (2004) from Food and Drug Administration (FDA) explained the acceptable quality of pharmaceutical products, which is also known as drug quality, as one that meets its established quality attributes and standards and has been manufactured in accordance with Current Good Manufacturing Practices (CGMPs) as stated in the Federal Food, Drug, and Cosmetic Act (18). Based on our results, 99.4% of the pharmacists were able to identify the two features to differentiate a registered pharmaceutical product from an unregistered pharmaceutical product or counterfeit pharmaceutical product. These two features are registration number MAL and Meditag™ Hologram, which are compulsorily imprinted on the outer packaging of every pharmaceutical product. The ability to identify the features of registered pharmaceutical products has enabled the public and relevant authorities to identify those registered pharmaceutical products (19).

To ensure the integrity of the pharmaceutical products, all advertisements of registered pharmaceutical products need to be approved by Medicine Advertisement Board (MAB) to ensure that all the medicinal information presented to the public are accurate and not misleading and also increase the consumers' awareness on the usage of the registered products (1). The World Health Organization (2002)

also agreed that monitoring and regulating medicine promotion is one of the regulatory measures to support rational use of medicines to ensure that it is ethical and unbiased and thus all promotional claims should be reliable, accurate, truthful, informative, balanced, up-to-date, capable of substantiation and in good taste (20). According to the Pharmacy Programme Statistics Report 2019, a total of 9,248 medicinal related advertisements been approved by the Medicine Advertisement Board (MAB) from year 2017 to 2019 (21).

The cosmetic industry in Malaysia is growing rapidly. Chemical substances were commonly used to replace the natural ingredients in this new era to increase its production through the use of technology and innovation. Therefore, the abundance of cosmetic products in market could pose some safety risks to the consumers (22). Thus, pharmaceutical regulatory plays an important role to ensure that pharmaceutical products and cosmetics in the market are genuine in terms of registration and notification to reduce the demands for unsafe or hazardous products (1). Based on the Pharmacy Programme Statistics Report 2019, a total of 1,859 registered pharmaceutical products were rejected, cancelled, recalled and withdrawn by Drug Control Authority (DCA) from a total of 4,237 registered products from year 2017 to 2019. There was also a total of 214,128 notified cosmetics in 2019. Out of 230,505 applications, 9,854 cosmetics were rejected and cancelled by the Senior Director of Pharmaceutical Services from years 2018 and 2019. Based on the samples taken in Post Marketing Surveillance Programme, 54 cosmetic products were found to be adulterated with scheduled poisons listed in the Poisons Act 1952, such as hydroquinone, mercury, tretinoin, chloramphenicol, betamethasone, triamcinolone and diphenhydramine, which can endanger the public's health upon consumption. Their notifications were cancelled by Senior Director of Pharmaceutical Services (21). Thus, pharmacists should be equipped with adequate knowledge regarding medicine registration, cosmetic notification and medicinal advertisement as an awareness and to educate public timely regarding pharmaceutical and cosmetics safety.

This study also aimed to compare the pharmacist's knowledge on the medicine registration, cosmetic notification and medicinal advertisement based on their demographic characteristics. There were four main findings that were highlighted in this study. Firstly, we found that male pharmacists scored significantly higher than female pharmacists. A similar behaviour was observed in several previous studies in which men tend to have better general knowledge than females (23-25).

The second characteristics that with statistically significant difference in the knowledge of pharmacists was previous working experience as Pharmacy Enforcement Officer. Those experienced in pharmacy enforcement had better knowledge than those who never worked in pharmacy enforcement field. The simple logistic regression further confirmed the observation. This result was in line with a study conducted by Schmidt *et al.* (1986) that the impact of job experience on job knowledge is stronger than its impact on work sample performance (26).

Thirdly, there was a statistically significant difference that pharmacists working in the Kedah State Health Department obtained higher knowledge scores than pharmacists working in hospitals, district health offices and health clinics. The pharmacists working in the state health department often collaborated with the Pharmacy Enforcement Branch (PEB) in organising various public education and awareness activities as the PEB is also a branch under the state health department and located in the same building. Exposure to this collaboration to some extent may have contributed to the better knowledge of pharmacists who worked in state health department. The collaboration among members in the team is important and the performance of the team tends to improve when the members of the team emphasize to work together (27). Ting *et al.* (2017) also revealed that the awareness of Royal Malaysian Customs (RMC) officers towards counterfeit pharmaceutical products were sufficient through the collaboration with PEB officers (19).

Finally, this study also was observed that the knowledge of pharmacists on pharmaceutical regulatory increased by the duration of service. A study by Kotur *et al.* (2014) indicated that the performance of the employees gradually improved with their experience but after 20 years the performance might deteriorate (28). Ting *et al.* also concluded that RMC officers who have worked for more than 10 years had significantly greater awareness towards counterfeit pharmaceutical products compared to those with less experience (19).

The results of this study may be influenced by some limitations. The smaller number of male respondents, respondents who worked in state health department and respondents with pharmacy enforcement experience may be the limiting factors. Since the study participants were only from Kedah's public sector, the sample population did not fully represent all pharmacists in Malaysia. Therefore, this study could be expanded nationwide in the future by using online questionnaire, and also to include the community pharmacists.

According to our findings, pharmacists' knowledge on pharmaceutical regulatory needs to be improved and to optimise the quality of services to the public. The delivery of accurate, unbiased and relevant information will guide the public or patients to use safe, quality and effective medicines and cosmetics, thus protecting public's health and ensure better treatment outcome. Continuous training on regulatory updates of medicines, cosmetics and medicinal advertisements' modules can be conducted periodically for every pharmacists especially who were involved in the QUMC activities through organizing Training of Trainers (TOT) workshop more frequently. Satisfaction surveys can also be suggested to understand and explore the needs from public in terms of information requirement regarding medicines, cosmetics and medicinal advertisements after the each conducted QUMC activities. Ongoing training for fresh graduate pharmacists needs to be conducted as pharmacists are always the symbolic icon of medicine. These recommendations were in line with Hallit *et al.* (2019) who recommended trainings and workshops for all pharmacists to increase the pharmacists' awareness to good practices and improve the quality of care (29).

Conclusion

Pharmacists' knowledge on pharmaceutical regulatory was moderate and were particularly low with regards to regulation of cosmetics. Their average knowledge score was 17.8 out of 27, which was equivalent to 65.9%. There were statistically significant associations between pharmacists' pharmaceutical regulatory knowledge with gender, pharmacy enforcement experience, workplace and duration of service. This study suggested the necessity to strengthen existing trainings techniques and implement continuous educations for the pharmacists to improve their knowledge on pharmaceutical regulatory and thus optimise the quality of QUMC services to the public.

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Conflict of Interest Statement

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