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PHARMACEUTICAL SERVICES PROGRAMME

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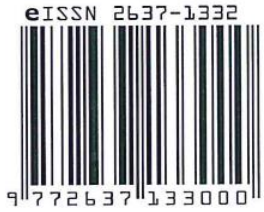

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CONTENTS

Career Choice of Contract Pharmacists in Malaysian Public Health Facilities and Its Associated Factors

Izzati Yussof[1], Teng Sook Yee[1], Sahidah Said[2], Ong See Wan[3], Dahlia Nadira Abd Manan[3]

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Abstract

Introduction: The contract system for pharmacists was introduced by the Ministry of Health Malaysia (MOH) to reduce the waiting period for the training programme for Provisionally Registered Pharmacists in government health facilities. Little is known about the perception of contract pharmacists regarding their career prospect following the new policy.

Objective: To explore contract pharmacists' perception and career choice, and determine the factors affecting their preference in pharmacy career.

Method: A cross-sectional study was conducted in November and December 2020 using a validated, self-administered online questionnaire involving contract pharmacists working in government health facilities in Kuala Lumpur and Putrajaya. The questionnaire contained questions that assessed career expectation, preferences, experience in job search, and an open-ended question for suggestions to improve aspects of their training. Fisher's exact test was performed to assess the relationship between demographic characteristics and career preferences.

Results: The response rate was 68.8% (n=97). Hospital pharmacy was the most preferred setting for current placement (44.3%). Almost all respondents (92.8%) would like to work with MOH, but only 24.7% were confident that they will be able to secure a permanent post. There was a significant relationship between ethnicity and current workplace preference (p=0.011), intention to remain in MOH after 10 years (p=0.017) and willingness to work in East Malaysia or rural areas (p=0.023). Long-term job security, work environment and opportunities for career development were rated the three most important factors in choosing their career.

Conclusion: The contract system poses various challenges for the new generation of pharmacists. With the growing number of pharmacy graduates and limited available positions in the public sector, there are a lot of uncertainties in employment opportunities. Early career advice and wider exposure on pharmacy career pathways are essential to broaden the career perspectives and equip young pharmacists with the necessary skills to adapt and develop new roles in order to keep up with changing times.

Keywords: career preference, pharmacy career, pharmacist, job preference, work preference

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Introduction

In many countries, the supply of pharmacists is rapidly exceeding demand as pharmacy schools continue to open and expand disproportionately to workforce capacity, leading to fierce competition among the graduates (1). Thought leaders have been observing marketplace trends and urging pharmacy colleges and schools to produce suitable number of competent entry-level pharmacists trained to fill the available positions to prevent an oversupply. Pharmacy schools have responded to the accreditation requirements, but generally seemed to be overlooking the supply and demand data (1).

Historically, there was a shortage of pharmacists in Malaysian public health facilities run by the government. Eligible pharmacy graduates were therefore guaranteed to have a training opportunity in public hospitals as Provisionally Registered Pharmacist (PRP), and they were required to serve in government health facilities for a period of at least three years as Fully Registered Pharmacist (FRP) following the

completion of PRP training (2). Pharmacy graduates were considered to be 'privileged' for having a job opportunity guaranteed as civil servant after completion of their studies, leading to high demand for pharmacy degree programmes and the expansion of pharmacy programmes offered by higher learning institutions nationwide. Prior to 1996, only one public institution offered pharmacy degree programme in the country, and the number has now increased to 19 institutions, with another 71 overseas institutions offering pharmacy programmes recognised by the Pharmacy Board of Malaysia (PBM) (3). Consequently, there had been a sharp increase in the number of pharmacy graduates nationwide, leading to saturation in the public health facilities, and a long period of unemployment after graduation due to limited available training positions. A similar phenomenon occurred among the medical and dentistry graduates.

In 2012, The Pharmaceutical Services Division (PSD), MOH introduced the Liberalisation of PRP Training Policy, thus extending PRP training to private facilities such as community pharmacies, private hospitals, pharmaceutical industry and research and development centres recognised by the PBM (4). Primary health clinics run by the governments have also been designated as PRP training centres, with compulsory attachment in public hospitals to enrich their experience. This provides broader options in training facilities, with various training experiences that may result in different expectations in career pathway between PRPs trained in the established public hospital setting and the relatively new PRP training centres in health clinics. The Malaysian Government has also introduced a new policy by offering the medical, dental and pharmacy graduates to serve on contract basis due to the limited number of permanent posts (5, 6). Currently, the pharmacist contract system is for a three-year period, which includes one year as a PRP and another two years as a fully registered pharmacist FRP. The decision for a permanent post will be known during second year.

Several studies had been conducted locally to assess satisfaction and perception towards the PRP training in Malaysian public health hospitals (7-10). Multiple studies had also been conducted to explore the career preferences of pharmacy graduates (11-14) and to asses job satisfaction among pharmacy staff (15, 16), both locally and abroad. Following the changes in government policies, there are a lot of uncertainties surrounding the future of current pharmacy undergraduates. The recent changes in PRP training policy and the contract system are new phenomena and little is known about the perception and career expectation of the personnel involved. This study aimed to explore contract pharmacists' perception of their pharmacy career in terms of future career plans, factors affecting their choice, and general opinion on employability.

Methods

This was a multicentre, cross-sectional study using self-administered online questionnaire among contract pharmacists in two public hospitals and 20 government health clinics located in Kuala Lumpur and Putrajaya. The online survey was conducted from 2 November 2020 to 31 December 2020. The study population consisted of contract pharmacists including PRPs and FRPs. Based on the staff registry, there was a total of 173 contract pharmacists in Kuala Lumpur and Putrajaya. Twenty-two had resigned while 10 of them received an offer for permanent position in MOH before November 2020, who were excluded. Therefore, there were 141 eligible contract pharmacists to participate in the study. Sample size for the survey was estimated using Raosoft sample size calculator, based on the following values: population size=141; margin of error=5%; confidence level=95%; and response distribution=50%. Based on the calculation, the sample size for the survey was 104. However, to ensure sufficient response is obtained, all eligible contract pharmacists were invited to answer the questionnaire, which was administered via Google form. The link containing the participant information sheet and consent form was emailed to all facilities, and those who agreed to participate provided their consent electronically via the same Google form used for the survey questions.

The questionnaire was developed based on past studies on career expectation of pharmacy undergraduates and pharmacy trainees, and subsequently modified to suit Malaysia's employment scenario through a series of discussions with study investigators and senior pharmacists (7, 11, 13). It contained 24 main questions that assessed demography, career priorities, future career plan, and experience in job search with a 20 5-point Likert scale items that measure the respondent's perception of their career prospect. The sections on demography, expectation and perception were compulsory to all respondents. The section for job opportunities needed to be answered only by those who had started looking for job opportunities outside MOH public health facilities.

An introduction explaining the purpose of the study was displayed at the beginning of the online questionnaire. No personal data was collected, and respondents were able to answer the questionnaire anonymously after agreeing to participate in the study. The questionnaire was validated for its content by

three senior pharmacists to assess suitability of language and content. The questionnaire was then pretested by 20 pharmacists from various facilities to ensure clarity of language, relevance and acceptability. Those who participated in the pilot study was not included in the actual data collection. Cronbach's alpha value of the questionnaire during the pilot study involving 20 pharmacists was 0.832.

Data was predominantly analysed with descriptive statistics, using IBM SPSS Statistics version 24. Descriptive statistics was presented either as continuous data with means and standard deviations (SD) or as categorical data with frequency (n) and percentages (%). In order to identify the most important factors in choosing their future career, weighted scores were calculated based on frequency distribution and weighted values of the answers (Strongly agree = 5, Agree = 4, Neutral = 3, Disagree = 2, and Strongly Disagree = 1). The frequency values of each factor were then multiplied with the weight to sum up the scores, and divided with the total number of respondents. As more than 20% of cells have expected frequencies of less than 5, Fisher's exact test was performed to compare the demographic characteristics (gender, marital status, graduation place, designation, and current facility) against career preferences (workplace preference, intention to remain in MOH after ten years, willingness to work in East Malaysia / rural areas and willingness to work outside normal office hours). The study was registered with the National Medical Research Register (NMRR-20-1371-55348) and permission to conduct the study was obtained from the MOH Medical Research and Ethics Committee (MREC). The study was conducted in accordance to the Declaration of Helsinki and Malaysian Good Clinical Practice Guideline.

Results

A total of 97 respondents aged from 24 to 29 years old participated in this study, giving a response rate of 68.8%. The respondents were predominantly female (87.6%), single (83.5%), graduated from local private university (60.8%), had been fully registered (78.4%) and worked in health clinic (72.2%). Most of the respondents were Malays (53.6%) followed by Chinese (37.1%), and Indians (6.2%). Majority of the respondents have worked for at least one year, and the mean duration of service was 22.5 months. The demographic characteristics of respondents and their career preferences are summarised in Table 1.

In terms of workplace choice after the respondents' current placement, the top three preferred options were hospital setting (44.3%), followed by community pharmacy or health clinic (32.0%), and pharmaceutical industry (12.4%). The majority of Malay participants were interested in working in hospital, health clinics or community pharmacy, and only 11.5% were interested in other pharmacy-related sectors, such as industry and academia. In comparison, a higher proportion of Chinese (33.3%) and three out of six Indian participants were interested in other pharmacy-related sectors. In ten years' time, more participants saw themselves working in community pharmacy compared to private hospital (23.7% vs 6.2%). Approximately one-third of the respondents wanted to remain working with MOH after ten years, and 75.8% of this consisted of Malay participants. In comparison, only 19.4% of Chinese respondents saw themselves working in MOH after 10 years, and 30.6% wanted to work in community pharmacy.

Based on the results of Fisher's exact test, significant association was found between ethnicity and current workplace preference, intention to remain in MOH after ten years, as well as willingness to work in East Malaysia (i.e. Sabah and Sarawak) and rural areas, which was summarised in Table 2. No significant association was found for the other demographic characteristics, except between graduation place and current workplace preference ($p=0.032$). It was noted that 43.3% of the respondents preferred to work only during office hours, including respondents who would like to work in a hospital setting. More than one-third (36.1%) of respondents preferred to work in Klang Valley area only, 40.2% were willing to work in other states within Peninsular area, and only 23.7% were willing to work in Sabah or Sarawak. Notably, 16.5% of respondents were also willing to work in rural areas with limited facilities. Among the respondents, the top three factors affecting their choice of career plans were long-term job security (score=4.82), working environment (score=4.75) and career development opportunities (score=4.73). A summary of respondents' factors in choosing their career was presented in Figure 1.

A detailed summary of respondents' perception on their pharmacy career was presented in Table 3. Notably, almost all respondents (92.8%) would like to work with MOH, but only 24.7% were confident that they will be able to secure a permanent post. Similarly, only 27.8% of the respondents were confident regarding their ability to secure a job. 69.0% participants felt that PRP training facility may affect their chances of obtaining permanent position in MOH, and majority (81.4%) also felt that PRP training in hospital is more advantageous. Generally, the respondents were satisfied with their salary and staff benefits, but only 33.0% felt that they have sufficient opportunities to further their studies.

Among the respondents, 34 FRPs have started looking for job in the private sectors during the study period. Out of these, 17 (50.0%) were called for interview, but only eight (23.5%) secured a job offer. Seven of them was offered to work in community pharmacy, with salaries ranging between RM 2,000 – RM 5,999. One respondent obtained a non-pharmacy job offer, with offered salary of less than RM 2,000. All successful applicants were single and worked in health clinic. A summary of the job applicants and successful applications were shown in Table 4.

A total of 36 comments were obtained when respondents were prompted to provide suggestions for the current training system. Several recurring themes were identified from the comments, covering the issues of fair appraisal and marking scheme for PRPs, more transparency in the assessment and selection process for permanent position, longer duration of PRP training with longer attachment in hospital, and provision of equal training opportunities. The respondents also hoped for a better learning environment with supportive preceptors and diversified training modules. The comments were summarised in Figure 2.

Table 1: Demographic characteristics and career preference of respondents (n=97)

Characteristics	n (%) / Mean ± SD
Age, years	25.60 ± 1.32
Gender	
Male	12 (12.4%)
Female	85 (87.6%)
Marital Status	
Single	81 (83.5%)
Married	16 (16.5%)
Ethnicity	
Malay	52 (53.6%)
Chinese	36 (37.1%)
Indian	6 (6.2%)
Other	3 (3.1%)
Graduation place	
Local private university	59 (60.8%)
Local public university	25 (25.8%)
Overseas university	5 (5.2%)
Private university with twinning program	8 (8.2%)
Designation	
Registered pharmacist	76 (78.4%)
Trainee pharmacist	21 (21.6%)
Duration of service, month	22.5 ± 9.58
Current facility	
Health clinic	70 (72.2%)
Hospital	24 (24.7%)
State health department	3 (3.1%)
Ideal retirement age	
≤ 40 years old	8 (8.2%)
41 - 50 years old	22 (22.7%)
51 - 60 years old	55 (56.7%)
> 60 years old	12 (12.4%)
Preference in working hours at MOH facilities	
Office hour only	42 (43.3%)
After office hour service up until 11pm/ weekend/ public holidays	29 (29.9%)
24 hours on-call/on-site	26 (26.8%)

Table 2: The relationship between ethnicity and career preferences

	Malay, n (%)	Chinese, n (%)	Indian, n (%)	Other, n (%)	p-value*
Current workplace preference					**0.011**
Hospital	24 (46.2%)	17 (47.2%)	2 (33.3%)	0	
Community pharmacy / health clinic	22 (42.3%)	7 (19.4%)	1 (16.7%)	1 (33.3%)	
Other	6 (11.5%)	12 (33.3%)	3 (50.0%)	2 (66.7%)	
Prefer to remain in MOH after 10 years?					**0.017**
Yes	25 (48.1%)	7 (19.4%)	1 (16.7%)	0.0%)	
No	16 (30.8%)	19 (52.8%)	5 (83.3%)	2 (66.7%)	
Unsure	11 (21.2%)	10 (27.8%)	0	1 (33.3%)	
Willing to work in East Malaysia or rural areas					**0.023**
Yes	20 (38.5%)	5 (13.9%)	3 (50.0%)	0	
No	32 (61.5%)	31 (86.1%)	3 (50.0%)	3 (100.0%)	
Willing to work outside normal office hours					0.064
Yes	34 (65.4%)	17 (47.2%)	4 (66.7%)	0	
No	18 (34.6%)	19 (52.8%)	2 (33.3%)	3 (100.0%)	

* Fisher's exact test

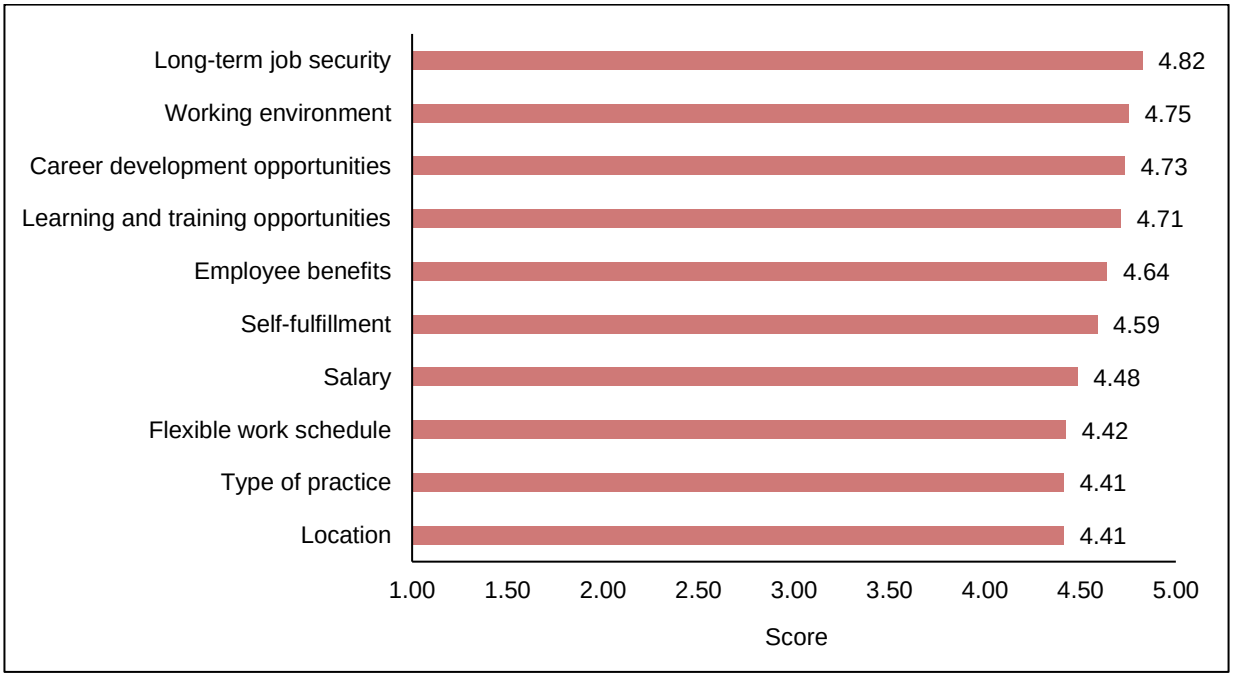

Figure 1: Factors in choosing career

Table 3: Perceptions on pharmacy career

Statement	n (%)				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Personal Career Plan					
I intend to eventually register as a pharmacist in Malaysia.	61 (62.9%)	33 (34.0%)	3 (3.1%)	0 (0.0%)	0 (0.0%)
I would like to work in government health facilities.	62 (63.9%)	28 (28.9%)	6 (6.2%)	1 (1.0%)	0 (0.0%)
I am optimistic about my career pathway.	33 (34.0%)	34 (35.1%)	23 (23.7%)	5 (5.2%)	2 (2.1%)
I feel that I have a lot of opportunities to work outside government sector.	18 (18.5%)	31 (31.9%)	28 (28.9%)	18 (18.5%)	2 (2.1%)
I believe I can secure a job opportunity.	6 (6.2%)	21 (21.6%)	36 (37.1%)	24 (24.7%)	10 (10.3%)
I am confident that I will be able to work permanently in government service.	14 (14.4%)	10 (10.3%)	23 (23.7%)	23 (23.7%)	27 (27.8%)
Training					
My university has prepared me well for my future pharmacy care.	17 (17.5%)	51 (52.6%)	22 (22.7%)	6 (6.2%)	1 (1.0%)
My PRP training centre has prepared me well for my future pharmacy career.	22 (22.7%)	62 (63.9%)	11 (11.3%)	2 (2.1%)	0 (0.0%)
I have equal chance with my other peers to obtain a place in government service.	10 (10.3%)	16 (16.5%)	25 (25.8%)	26 (26.8%)	20 (20.6%)
I think that PRP training facility affects the chances of obtaining an offer to work with MOH after PRP training.	40 (41.2%)	27 (27.8%)	25 (25.8%)	5 (5.2%)	0 (0.0%)
I think that PRP training in hospital provide more advantage than health clinic.	52 (53.6%)	27 (27.8%)	13 (13.4%)	3 (3.1%)	2 (2.1%)
Job Satisfaction					
I am satisfied with my current salary.	12 (12.4%)	54 (55.7%)	25 (25.8%)	6 (6.2%)	0 (0.0%)
I am satisfied with the benefits I receive as a PRP in MOH.	21 (21.6%)	46 (47.4%)	17 (17.5%)	9 (9.3%)	4 (4.1%)
I feel that I currently have a good work-life balance.	18 (18.6%)	36 (37.1%)	29 (29.9%)	13 (13.4%)	1 (1.0%)
I feel that I have sufficient opportunities to further my studies.	7 (7.2%)	25 (25.8%)	39 (40.2%)	20 (20.6%)	6 (6.2%)
I regret choosing pharmacy as a career pathway.	5 (5.2%)	12 (12.4%)	30 (30.9%)	20 (20.6%)	30 (30.9%)

Table 4: Summary of job applicants and successful applications

Characteristics	Started looking for job opportunity, n (%) (n=34)	Secured job offer, n (%) (n=8)
Gender		
Male	6 (17.6%)	1 (12.5%)
Female	28 (82.4%)	7 (87.5)
Marital status		
Single	31 (91.2%)	8 (100%)
Married	3 (8.8%)	-
Ethnicity		
Malay	17 (50.0%)	3 (37.5%)
Chinese	15 (44.1%)	5 (62.5%)
Indian	1 (2.9%)	-
Other	1 (2.9%)	-
Graduation place		
Local private university	18 (52.9%)	5 (62.5%)
Local public university	11 (32.4%)	3 (37.5%)
Overseas university	1 (2.9%)	-
Private university with twinning program	4 (11.8%)	-
Current facility		
Health Clinic	31 (91.2%)	8 (100%)
Hospital	3 (8.8%)	-
Sector with perceived most job opportunities		
Community pharmacy	30 (88.2%)	-
Hospital	2 (5.9%)	-
Pharmaceutical industry	1 (2.9%)	-
All sectors about the same	1 (2.9%)	-
Sector with job offered obtained		
Community pharmacy	-	7 (87.5%)
Non-pharmacy	-	1 (12.5%)

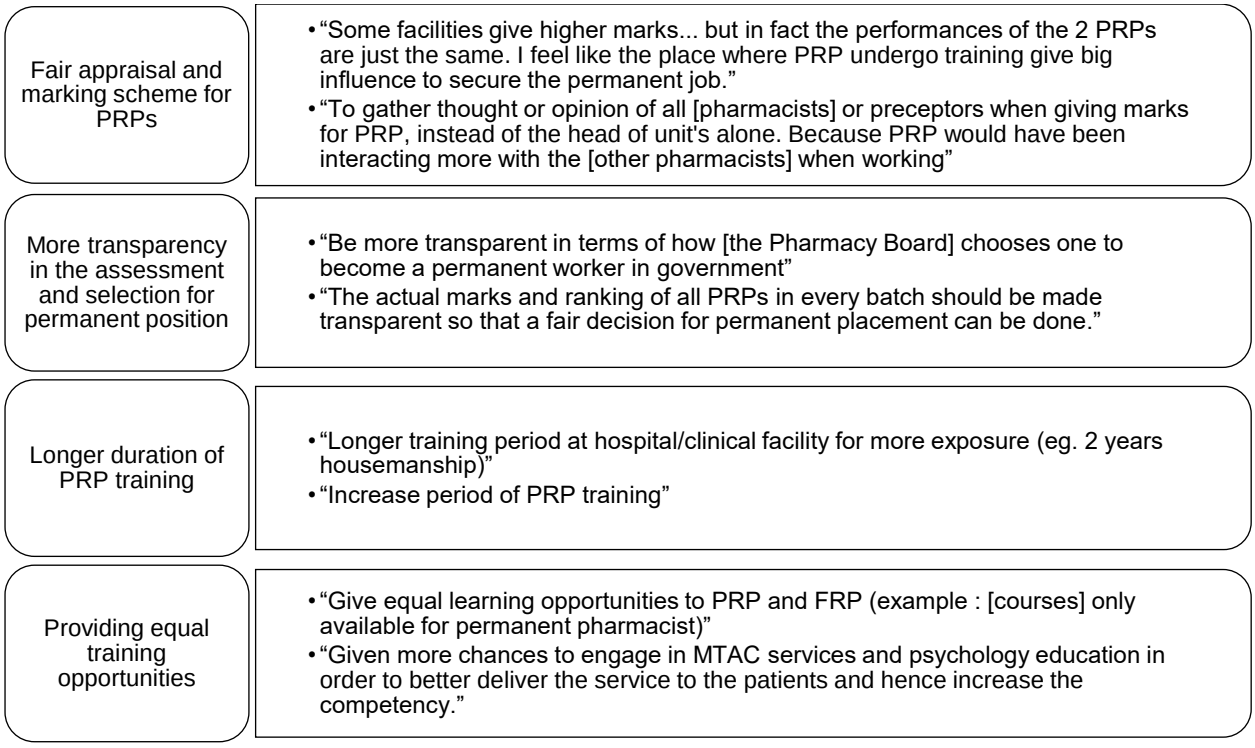

Figure 2: Summary of respondents' comments to improve PRP training

Discussion

This study explored the diverse career preferences among contract pharmacists working in Kuala Lumpur and Putrajaya. Among the respondents in this study, hospital setting was the most preferred sector for an immediate placement, which is in agreement to the results of previous studies, including a local study among final year students, who desired the opportunity to gain clinical experience and knowledge from hospital (11, 12, 14). Hospital sector is often considered to offer more career development opportunities due to the variety of services provided, offering various experiences ranging from outpatient and inpatient pharmacy to aseptic drug preparation and therapeutic drug monitoring. A local qualitative study reported that PRPs from health clinic felt that their training in health clinic was not sufficient to handle work tasks in a hospital (3). It was noted that excluding MOH facility, more respondents saw themselves working in or managing their own community pharmacy after 10 years, rather than working in a private hospital. This could be due to the respondents acknowledging the lack of positions in private hospitals, where pharmacists are often more involved with drug procurement and management rather than taking a clinical role.

Respondents in this study rated extrinsic factors such as long-term job security and working environment as two of the most important factors in choosing their career. In a local study among local pharmacy undergraduates, monthly income and promotion potential were chosen as the first and second most important factor, respectively (13). Previous studies in overseas have reported that intrinsic factors (such as nature of work, sense of accomplishment, and opportunities of training and education) as the most frequently cited factors considered important in choosing their future career compared to extrinsic factors (such as salary, job security and working conditions) (17, 18). However, these studies were conducted among students, who may have more idealistic expectations compared to the respondents in this study. Factors in selecting career development tend to be dynamic and will change as the individual matures, starts a family and gains more exposure to real practice as well as external influences such as job prospects and the profession's image (19) . In addition, with the current uncertainties in economic situation due to the COVID-19 pandemic, practical aspects such as long-term job security would understandably be a priority in career choice.

There were significant differences in career preferences between different ethnic groups, a trend that was also observed in previous studies, both local and abroad (13, 20-22). Malay participants in this cohort were more likely to choose conventional settings as their career preference such as hospital and community pharmacies compared to industrial pharmacy. There were also more Malay participants who were willing to work in rural areas and East Malaysia, and work outside normal office hours. Malaysia is a country where ethnic integration has not yet happened, with distinct differences between ethnic groups due to the preservation of separate identities and cultures (20, 23). Therefore, different community expectations and cultural priorities may have shaped the respondents' preferences. Significant differences of current workplace preferences were also observed among the respondents from different universities. However, this may be attributable to the uneven distribution of different ethnic groups in public and private universities, with significantly higher proportion of Malay participants from public universities.

There was an overwhelming interest among the respondents to work in government health facilities (92.8%). Considering that the respondents rated "long-term job security" as the most important factor in choosing their future career, this was somehow expected. However, there was a clear mismatch of demand and supply for available permanent positions in MOH due to limited available places, and this was reflected on the respondents' low confidence in their ability to secure a permanent position. During the COVID-19 pandemic, there have been numerous calls for the government to absorb contract healthcare workers into the public service to cater for staff shortage in the public healthcare sector (24). These calls were not answered, leading to a symbolical strike on July 2022 by healthcare workers, particularly doctors (24). Permanent positions were offered annually by MOH albeit at smaller quantity, and are usually located at rural areas or East Malaysia. However, these positions are usually not preferred, as evident from the responses in this study, in which only 28.9% were willing to take up job position in rural areas or East Malaysia.

Shortage of pharmacists, absence of 24-hour pharmacy services, and heterogeneous distribution of pharmacies with higher density in urban area compared to rural regions have been frequently cited by those who oppose dispensing separation (25, 26). Insufficient number of pharmacists is not anymore an issue, as Malaysia has now reached the World Health Organization (WHO) optimum pharmacists-to-population ratio of 1 per 2000 (26). However, unequal distribution of pharmacies between urban and rural areas, as well as unavailability of 24-hour pharmacy may still be an issue. In this study, almost half of the respondents were only willing to work during office hours, and less than one-third were willing to work in

rural areas or East Malaysia. Due to the greater opportunities and various personal situations, graduates tend to flock to main cities or remain in their own locality. This resulted in the disparity of healthcare access between urban and rural areas, a problem that has been reported in various countries including China (27), Iran (28) and even the United States (29).

It was notable that despite the current interest to work with MOH, only one-third of the participants saw themselves working in MOH facilities after ten years, and almost half of these were Malays (48.1%). However, it was unclear whether the disparity was due to low confidence of being able to be accepted as a permanent staff in MOH or it was due to preference to work in the private sector after gaining experience in the public sector. Respondents were also apprehensive regarding the prospect of obtaining any job offer, likely due to the uncertainty of the economy. Data collection was conducted at the end of 2020, a period in which the country experienced high unemployment rate as a consequence of the national movement control order following the COVID-19 pandemic. The average unemployment rate in 2020 was recorded at 4.5%, reaching the highest level since 1993 (30). However, the pandemic also provided opportunities for contract pharmacists working in this period to extend their contract and remain in service for a longer duration compared to the earlier batches of contract pharmacists (31).

Only eight of the 34 respondents who have looked for job opportunities secured a job offer in this cohort. From this limited number, it was noted that there were disproportionately more successful applicants who were single, Chinese, graduated from private university and worked in health clinics. This study does not generate data to explain the differences observed, but a local study showed that being Chinese or being a Malay with Chinese language proficiency improved call back prospects for job applicants in Malaysian private sector (32). Previous reports have also shown that female job-seekers in fertile age had often been discriminated in hiring due to the potential of pregnancy and being on extended maternity leave (33, 34).

Many respondents raised the issue of fair appraisal and transparency in marking of the PRP assessment, and selection of permanent staff. Over two-thirds of the respondents in this cohort believed that training facilities can affect chances of obtaining an offer to work with MOH after PRP training. Several different individuals hoped for a more transparent and fair marking system, with emphasis on standardisation and merit based on the trainee's performance. This issue had also been reported in another local study (3), and in a local media (35). With hundreds of different training facilities with even larger number of preceptors, variability in marking is unavoidable. However, there should be an effort for standardisation, by providing clear guidelines on marking criteria and ensuring all preceptors were sufficiently trained and adhere to the guidelines provided.

To our knowledge, this was the first study that attempted to explore perception of contract pharmacists regarding their career after the commencement of the new contract system. However, the generalisability of the result is limited by the small sample size, and the localised setting of the study, which primarily focused on pharmacists working in public health care facilities in the urban setting of Kuala Lumpur and Putrajaya. Future studies may want to explore perception of pharmacists who work in the private sector to provide better understanding of the pharmacy workforce as a whole. Very limited data was obtained regarding job application and hiring success rate. The small number of successful job applicants captured in this study may be due to the limitation in the study design, which focused on pharmacists still working in MOH facilities, whereas successful applicants would have likely resigned and moved on to their new job. Due to the limitation of the data collected, the findings need to be interpreted with caution and further study is necessary to understand factors affecting successful job application in pharmacy sector.

Conclusion

Hospital setting was the preferred career option for pre-registration training as well as post-training career placement. Majority of the respondents would like to continue working within public health facilities, but the confidence in attaining the limited positions was fairly low. With the growing number of pharmacy graduates and limited available positions, there seemed to be a very high competition for job vacancies, with less than a quarter of job seekers being able to secure a job offer. There may be a need to review the current training system to improve their career prospect. This also calls for a need to broaden the scope of pharmacy services in Malaysia particularly in the private sector, where the pharmacists' potential is often underutilised.

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Conflict of Interest Statement
The authors declare that they have no competing interests that could influence the work reported in this paper.

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Tolerability of Compulsory Generic Switching from Originator to Generic Levetiracetam in the Outpatient Epilepsy Clinic of a Tertiary Hospital in Kedah

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Abstract

Introduction: Procurement of certain medications in the Ministry of Health Malaysia (MOH) is bound to the central government contracts with designated manufacturers. Thus, generic switching of levetiracetam had occurred in MOH facilities despite mixed evidence on the safety and tolerability of brand switching of anti-seizure medication.

Objective: The objective of this study was to assess the tolerability of generic substitution of Levetiracetam in terms of the occurrence of fit and side effects among epilepsy populations in Hospital Sultanah Bahiyah, Kedah**.**

Methods: This study included patients who were taking originator levetiracetam 500mg tablets (Keppra®) for at least 90 days prior to overnight switch to generic levetiracetam 500mg tablets (Torleva®) and had taken the generic drug for at least 90 days after the switch. The tolerability of levetiracetam and patients' compliance during the 90-day pre-switching period and 90-day post-switching period were compared. Data were collected retrospectively from the clinic visit notes in electronic medical record (e-HIS).

Results: Ninety-seven patients were included in this study. The patients documented with a fit episode increased significantly from 60 (61.9%) to 70 (72.2%) patients post switching to generic Levetiracetam (p=0.031). However, the side effects experienced by patients and patients' compliance pre- and post-switching were not significantly different (p=0.508 and p=0.375 respectively).

Conclusion: This study provided preliminary evidence on the tolerability of brand switching of anti-seizure medication among epilepsy patients.

Key Words: anti-seizure medication, generic substitution, efficacy, tolerability

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Introduction

Epilepsy is one of the most common non-communicable chronic neurological conditions that is characterised by recurrent, unprovoked and epileptic seizures. Epilepsy affects approximately 50 million people worldwide (1). The choice of anti-seizure medication (ASM) must be individualised, taking into consideration the tolerability, long term safety and efficacy of drug. During the past decade, epilepsy guidelines had been emphasising on the issues of generic ASM whereby the use of generic substitutes in epilepsy may not be cost-effective (2). Generic products are equivalent to their originator counterparts in active ingredients, route of administration, strength and dosage form but may differ in some excipients and the specific manufacturing process.

The drug regulatory authorities approve generic drugs based on their bioequivalence to originator counterparts, which requires similar rate and extent of bioavailability of the active ingredient. Such studies generally evaluate the ratio of the generic product's maximum concentration (Cmax) to the originator product's Cmax and the ratio of the generic product's area under the plasma concentration versus time curve (AUC) versus the originator product's AUC in healthy volunteer (3). If the 90% confidence intervals of

the geometric means for these ratios fall within the range of 80% to 125%, the two products compared are deemed bioequivalent (3). Some have argued that this can result in clinically meaningful differences in terms of efficacy and safety between a generic drug and its originator counterpart (3).

The generic ASMs substantially reduces the expenditure of treatment and is therefore encouraged by the health systems (4). Various studies that compared generic and innovator ASMs have been published. Some studies had reported increased seizure events and side effects after ASM generic switching (5,6,7). In addition, most professional societies, including The American Academy of Neurology, Italian League Against Epilepsy, and National Institute for Health and Clinical Excellence had issued statements opposing the generic substitution of ASMs prior to physician's approval (4,8). On the contrary, some organisations such as the US FDA and the American Society of Health System Pharmacists suggested that generic ASM can provide similar efficacy, tolerability and safety to that of the original ASM, thus therapeutically interchangeable (8). Despite conflicting viewpoints regarding generic substitution of ASM, there are also emerging data supporting the use of generic ASMs (8). In recent years, the National Pharmaceutical Regulatory Agency, Ministry of Health Malaysia (MOH) has approved the registration of various generic ASMs which passed the bioequivalence study (2). However, there was a lack of local studies on the real-world response to generic switching of ASMs among our local epileptic population.

Among the ASMs, levetiracetam is one of the common drugs used for the treatment of partial or generalised epilepsy in children and adults due to its broad spectrum of efficacy in different epilepsy syndromes, pharmacokinetic properties, minimal side effects, and safety in pregnancy (8-11). Given the wide use of Levetiracetam in epilepsy, several pharmaceutical companies have manufactured their own generic levetiracetam. In MOH, the procurement of levetiracetam is done via central contract at the national level, in which the contract will be granted to suppliers or manufacturers that offer the most reasonable price. Therefore, when the contract was awarded to a supplier of generic levetiracetam, all MOH facilities will procure the specific brand of generic levetiracetam within the contract period. Thus, generic switching of levetiracetam had occurred. As there were limited studies that explore the efficacy and safety of generic substitution of levetiracetam, and while sometimes the evidence might be conflicting (4,5,6,7,8), this study was conducted to assess the tolerability of generic substitution of levetiracetam in terms of the emergence of fit and occurrence of side effects among the epilepsy patients in a tertiary care hospital.

Method

This was a retrospective cohort study of patients who were treated with levetiracetam in the outpatient Medical Department in Hospital Sultanah Bahiyah, Kedah, Malaysia. The study period was from November 2018 to February 2019. This study was registered with the National Medical Research Register (NMRR) and was approved by the MOH Medical Research and Ethics Committee (MREC) (NMRR-18-1522-42180).

Before March 2018, levetiracetam 500mg tablets used in the MOH was an originator (Keppra®) manufactured by UCB Pharma S.A. Braine-l'Alleud, Belgium. In March 2018, the central contract of levetiracetam 500mg tablets was awarded to a generic brand (Torleva®) manufactured by Torrent Pharmaceuticals, India. MOH patients who were initially taking originator levetiracetam were switched to generic levetiracetam with the new cycle of procurement.

This study included patients from the outpatient epilepsy clinic of the Medical Department in Hospital Sultanah Bahiyah, who were switched from originator levetiracetam 500mg tablets to generic levetiracetam 500mg tablets at the same dose due to the change of procurement contract in March 2018 while the other concomitant anti-seizure medications (ASM) remained unchanged. This study included only patients taking the originator levetiracetam for at least 90 days prior to generic switching, and had taken generic Levetiracetam for at least 90 days after the switch. Paediatric patients taking levetiracetam, patients discharged to other facilities for follow up, patients taking different dosage form of levetiracetam besides tablet and patients having different dose of levetiracetam upon switching were excluded in this study.

The tolerability of generic levetiracetam in the patients were assessed by the absence of fit and levetiracetam-related side effects. Patients were also assessed in terms of emergence of fit, which means presented with new episode of fit after fit free for one year and longer. The data were traced retrospectively from patients' clinic visit notes in the electronic medical record (e-HIS). Data on compliance of treatment was also collected from the e-HIS. Data on compliance of treatment was self-reported by the patients and recorded in patient's case notes in the e-HIS by prescribers. The tolerability of levetiracetam, patients' compliance and emergence of fit during the 90-day pre-switching period (originator levetiracetam 500mg tablets) and 90-day post-switching period (generic levetiracetam 500mg tablets) were compared.

Statistical analysis was performed using SPSS statistical package (version 21.0, SPSS Inc., Chicago, IL, USA). The results were expressed as means and standard deviation (SD) for continuous variables and number (n) with percentage (%) for categorical variables. Comparisons between categorical data were analysed using Pearson chi-square test, whereas continuous variables were analysed using independent t-test. Statistical significance was defined as a p value < 0.05.

Results

A total of 114 patient records were screened for this study. Only 97 patients were eligible after excluding patients who have defaulted, discharged to other hospitals or clinics, and deceased.

Table 1 showed the clinical characteristics of included patients. Patients involved in the study were suffering from generalised seizure (41 patients) and focal seizure (56 patients). Among them, some patients were on levetiracetam tablets as monotherapy (17.5%) while most of the patients (82.5%) were taking as polytherapy in concomitant with one or more other ASMs.

Table 2 compared the tolerability and compliance of patients during the pre- and post-generic switching of levetiracetam. The patients documented with an episode of fit was noted to increase from 60 (61.9%) to 70 (72.2%) patients post switching of generic levetiracetam (p=0.031). Switching of brands neither affect the occurrence of side effects (p=0.508) nor patients' compliance (p=0.375).

Among the 70 patients experiencing fit post-generic switching, 14 patients were categorised as having emergence of new fit, which means they were presented with new episode of fit after being fit free at least one year. In Table 3, we sub-analysed the comparison of factors associated with the emergence of new fit among these 14 patients. The type of seizures, whether generalised or focal, was one of factor significantly associated with the emergence of fit post switching (p=0.017). Gender and age of patients played no role in post switching effect (p=0.536 and p=0.520 respectively).

Table 1: Clinical characteristics of patients who were switched to generic levetiracetam (n=97)

Variables	n (%) / Mean ± SD	
Age, years; mean ± SD; range	36.19 ± 12.67;	range 16-81
Gender		
Female	49	(50.5%)
Male	48	(49.5%)
Type of seizure		
Generalised	41	(42.3%)
Focal	56	(57.7%)
Daily dose of LEV (mg); mean; range	1972;	range 500-3000
Number of AEDs used		
1	17	(17.5%)
2	38	(39.2%)
3	30	(30.9%)
4	9	(9.3%)
5	3	(3.1%)

Table 2: Comparison of outcomes in patients' pre and post switching of generic levetiracetam in terms of tolerability and compliance

Outcome	Pre, n (%)	Post, n (%)	*p*-value [a]
Fit Free (Tolerability)			**0.031**
Yes	37 (38.1%)	27 (27.8%)	
No	60 (61.9%)	70 (72.2%)	
Side Effect* (Tolerability)			0.508
Yes	4 (4.1%)	7 (7.2%)	
No	93 (95.9%)	90 (92.8%)	
Compliance			0.375
Yes	94 (96.9%)	91 (93.8%)	
No	3 (3.1%)	6 (6.2%)	

[a] McNemar Test
* Documented levetiracetam-related side effects reported by patients after change, e.g. mild headache, forgetfulness, etc.

Table 3: Comparison of factors associated with the emergence of new fit episode post generic switching

Outcome	Emergence of new fit episode*		*p*-value
	Yes	No	
Age, years; mean ± SD	38.21 ± 10.47	35.84 ± 13.03	0.520 [a]
Gender, n (%)			0.536 [b]
Female	6 (12.2%)	43 (87.8%)	
Male	8 (16.7%)	40 (83.3%)	
Type of seizure, n (%)			**0.017** [b]
Generalised	10 (24.4%)	31 (75.6%)	
Focal	4 (7.1%)	52 (92.9%)	

* presented with new episode of fit after fit free ≥ 1 year
[a] Independent t-test
[b] Pearson Chi Square test

Discussion

In view of the increasing medical costs in recent years, health care systems have adopted measures to limit expenditures and maximise cost saving by the encouragement for the use of cheaper generic products (9,12). Epilepsy is associated with high treatment cost that affect individuals and society due to the high prevalence of the disease and its long duration of treatment (8). In epileptic patients, reduced efficacy and potential occurrence of side effects after switching from originator name to generic products ASM was reported to be a common phenomenon (4,8). Furthermore, most ASMs have a narrow therapeutic index (12). Thus, generic substitution of ASM raises special concerns regarding their use in the treatment of epilepsy. In recent approved novel chemical analogue of Levetiracetam, Brivaracetam, the average annual cost is higher than other ASM (13,14). This raised the concern in future whether the increase of generic use of levetiracetam or the safety of switching should be prioritised in focal onset seizure.

We reported a retrospective study over a six-month period, which was three months before compulsory switching from originator to generic Levetiracetam and another three months after the switch. Our results showed a significantly higher number of patients experiencing fit post switching. These results are consistent with a few literatures (5,12,16) that demonstrated that generic ASM exhibited reduced efficacy and tolerability compared with their originator counterparts. Also, previous studies showed that patients who showed a high seizure count before switching experienced worsening in clinical response and appearance of side effects when moving from originator to generic ASMs (5,8,12).

Our study result is in contrast with result reported recently in Maria *et al*. (8) and Martina *et al*. (9) where overnight switch from originator levetiracetam to generic levetiracetam was easy and safe in patients with epilepsy. These discordant results may be possibly due to our larger sample size (n= 97) compared to these studies (8,9). Our findings were also at variance with a similar retrospective analysis by Bosak *et al*. that comprised of 90% subjects on epilepsy polytherapy, in which their findings revealed that generic

substitution of Levetiracetam was generally safe (4). Bosak *et al*. refuted the study result by Chaluvadi *et al*. (17) (35.5% of patient on monotherapy) that showed generic substitution of Levetiracetam will lead to loss of seizure control because Bosak *et al*. presumed that patients on monotherapy were more prone to increased seizure frequency as there was only one medication to control seizure (4). However, our current study comprised of 82.5% of patients with polytherapy, yet the findings still showed a significant increase in the occurrence of fit after switching from originator to generic levetiracetam. Thus, polytherapy or monotherapy may not affect the frequency of fit. The American Academy of Neurology advised to avoid switching between originator and generic formulations of ASM (1). The 2017 Consensus Guideline in Management of Epilepsy by Malaysian Society of Neuroscience also suggested that patients with refractory epilepsy and those who are on polytherapy are best maintained on their original ASM to prevent seizure (2). Our study showed that the type of seizures, whether generalised or focal, could be one of the factors affecting the emergence of new fit among stable patients. Based on our findings, the types of seizure may also be used to guide decision on the suitability of brand switching for levetiracetam. Nevertheless, due to observational nature of our study, further confirmatory studies will be needed to verify our findings.

This study was limited by several factors that could have influenced the fit outcome. First of all, this was a retrospective study and therefore the confounding factor affecting seizure threshold was beyond our control. Secondly, the choice of generic levetiracetam was restricted by the government procurement contract and hence we were using a different generic brand of levetiracetam (Torleva®) compared with other similar studies (Epitiram® and Matever®) (9,15). Other factors such as herbal medicines that might trigger fit were not taken into consideration as well. Moreover, the assumptions made in this study was that there were no changes in other ASMs in our patients pre and post brand switching of levetiracetam, except for dose changes in these ASMs. Another limitation of our study was serum levels of levetiracetam were not assessed before and after the generic substitution, limiting the possibility of comparing drug availability (4,15). Finally, the assessment of compliance in our patients were only based on self-reporting as recorded in the e-HIS instead of using any compliance assessment instruments (15).

Conclusion

In summary, our study provided preliminary evidence on the potential influence of levetiracetam brand switching on the tolerability of patients. This warranted more studies to investigate the causal effects of the brand switching on the tolerability. However, given the conflicting evidence on the the safety and effectiveness of generic substitution of ASMs, procurement and brand selection for ASMs in MOH should be more flexible to provide more alternatives for clinicians to optimise the pharmaceutical therapy for seizure patients.

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Conflict of Interest Statement

This study did not receive any funding from public, commercial or non-profit organisations. The authors declared no conflict of interest.

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Cost-effectiveness of Pharmacist-managed Respiratory Medication Therapy Adherence Clinic (RMTAC) on Asthma Patients: A Prospective Multicentre Study

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Abstract

Introduction: Uncontrolled asthma contributes to a higher cost of management. In Malaysia, pharmacist-managed Respiratory Medication Therapy Adherence Clinic (RMTAC) was introduced to aid patient's asthma control through education and continuous monitoring.

Objective: To evaluate the cost-effectiveness of RMTAC service versus standard counselling service in improving asthma control in government health clinics setting.

Methods: A multicentre non-randomised controlled study was conducted in 16 government health clinics in Kuala Lumpur and Putrajaya. Subjects enrolled into RMTAC service were categorised as the intervention group, while subjects from clinics without RMTAC service were categorised as control group. Patients were followed up for six months to assess asthma control according to Global Initiative for Asthma (GINA) symptom control classification, inhalation technique and exacerbation frequency. The direct costs of intervention and control groups were calculated for the study duration. Cost effectiveness analysis was conducted from the perspective of healthcare provider.

Results: A total of 321 patients were recruited, with 158 in RMTAC group and 163 in control group. RMTAC significantly improved asthma control with 51.9% of subjects acquiring well-controlled status after 6-months intervention compared to 20.9% in control group ($p<0.001$). The mean improvement in GINA score was 1.91 and 0.81 in RMTAC and control group respectively ($p<0.001$). The majority of the RMTAC patients also mastered good inhalation technique (75.3%), significantly higher than control group (31.9%) ($p<0.001$). No significant difference was found in exacerbation frequency. The mean 6-month cost per patient for RMTAC and standard care were MYR166.27 and MYR120.22 respectively. The incremental cost-effectiveness ratio (ICER) of RMTAC was MYR41.86 per unit improvement in GINA score.

Conclusion: RMTAC service resulted in significant improvements in patient's asthma control and inhalation technique at a small additional cost. RMTAC service by pharmacists should therefore be expanded to more healthcare facilities in Malaysia to benefit more patients.

Keywords: pharmacists, asthma, cost-effectiveness

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Introduction

The prevalence of asthma has been increasing over the years. The global prevalence of asthma in adults is 4.5% with a large variation ranging from 0.2% in China to 21.0% in Australia (1). Meanwhile, the overall prevalence of asthma in Malaysia had increased by 50% from 4.2% in 1996 to 6.4% in 2011 (2,3). Globally, asthma represents a substantial financial burden that was mainly contributed by the cost of treatment on patients with uncontrolled asthma. For instance, the total estimated cost of asthma for the United States population was found to be $5.8 billion per year which consisted of direct expenditures of $5.1 billion and indirect expenditures of $673 million (4).

Three types of interventions were found to be able to enhance asthma management, namely education, environmental control and self-management (5). The commonest intervention program reported was asthma education, followed by self-management such as a written plan for monitoring peak-flow and symptoms (5). A study on hospital pharmacy-based asthma program in Sudan found that pharmacists interventions significantly reduced the frequency of acute asthma attacks, nocturnal asthma symptoms, the need of inhaled Beta-2 agonists, days of sickness and rate of hospitalisation (6). Another study done by Armour *et al*. on community pharmacy asthma care programme in Australia reported significant improvements in pharmacist intervention group in relation to asthma control, adherence to preventer medication, quality of life, asthma knowledge and inhaler technique (7).

In Malaysia, 60% of asthma patients have uncontrolled or partly controlled asthma (2). This contributed to a higher economic burden with the annual cost of asthma treatment increased from USD108 per patient in 2000 to USD275.65 in 2002 (8,9,10). Despite many strategies have been implemented, asthma control among Malaysians are still suboptimal (11,12). Thus, the Respiratory Medication Therapy Adherence Clinic (RMTAC) was introduced in 2004 in Ministry of Health Malaysia (MOH)'s healthcare facilities as part of pharmacists' efforts to collaborate with other healthcare professionals to effectively control patient's asthma (13). RMTAC is a structured programme in which RMTAC-accredited pharmacists provide more thorough counselling on disease, medication, adherence and inhalation technique as compared to the conventional counselling under standard pharmaceutical care. They review patient's medications, identify and provide solutions to any drug-related problems. RMTAC pharmacists also monitor patients' response more closely to ensure therapeutic goal is achieved, with a minimum of three follow-up appointments. A study by Yong *et al*. found that RMTAC has high probability of being more cost-effective than the standard care management alone (14,15,16).

Several overseas studies were done to evaluate the economic effectiveness of pharmacist intervention programs in asthma management. Studies have supported that pharmacist's intervention in asthma management programs are beneficial in reducing healthcare cost (16,17,18). A study done in the United Kingdom found that pharmacists giving advice to patients via telephone call significantly lower non-adherence and medicine-related problems among studied patients. Moreover, the intervention was less costly, with 90% probability that the intervention is cost effective (17).

Economic evaluation studies in Asian region, however, are still inadequate. In view of the differences in cultural, health care systems and protocol of pharmacist's intervention programs, economic evaluation in Malaysia context is needed. Whilst there was a local economic study done by Yong *et al*. using Markov Model, the economic evaluation using real world input in Malaysia setting is still limited (16). Therefore, this study aimed to evaluate the cost-effectiveness of RMTAC service versus standard pharmaceutical service in improving patient's asthma control in Kuala Lumpur and Putrajaya public primary health care setting, from the health care provider's perspective, which is the Ministry of Health Malaysia. The findings from this study will help policy makers to advocate policy change which expand the role of pharmacists in a comprehensive asthma management program at the national level, across public and private sector.

Methods

This was a multicentre non-randomised controlled study conducted at the pharmacies of 16 government's primary health clinics under the Health Department of the Federal Territory of Kuala Lumpur and Putrajaya to assess the cost effectiveness of RMTAC. The study was done in a duration of 21 months. The study subjects were recruited between January 2017 and March 2018 and each subject was followed up for 6 months (19). This study was approved by the MOH Medical Research and Ethics Committee (MREC) and registered in the National Medical Research Register (NMRR) (NMRR-16-1388-31720).

The inclusion criteria were patients aged 18 years old and above with confirmed diagnosis of asthma by a physician, who completed six months follow-up period and received Step 2 asthma treatment (inhaled corticosteroids) or higher according to Global Initiative for Asthma (GINA) asthma management guideline.

Furthermore, patients must be able to communicate in Malay, English or Mandarin. Patients with cognitive defects or diagnosed with other comorbidities namely chronic obstructive airway disease (COAD) and congestive heart failure (CHF) were excluded. Sample size was calculated from the primary outcome measure, using the true difference in the experimental and control means of 0.57 and standard deviation 1.8, based on an alpha of 0.05 and power of 80%. Assuming 20% of dropout rate, 158 subjects were needed for each arm.

Asthma patients were identified by the doctors using patients' medical record and being recruited into this study by investigating pharmacists after assessing patients' eligibility base on the inclusion and exclusion criteria. Subjects recruited from clinics which provide RMTAC service were categorised into intervention group and received RMTAC care, while subjects from clinics without RMTAC service were in the control group and received standard pharmaceutical care which is conventional counselling. Study protocol was explained and consent was obtained from all study subjects who participated in this study. All enrolled patients were given an asthma diary for them to record the frequency of emergency visits due to asthma exacerbation. Data of intervention group patients were collected from patient's MTAC records and asthma diaries by the site RMTAC pharmacists after assessment by the doctors, while data of the control group patients were collected from patients' medical records and asthma diaries by the site pharmacists. The flow of study subjects from both groups were depicted in Figure 1.

This study used cost-effectiveness analysis to compare the cost over health outcome between RMTAC and standard pharmaceutical care (20). The cost-effectiveness analysis was conducted from the healthcare provider's perspective, which is the Ministry of Health Malaysia. The cost parameters included were direct medical costs such as personnel, medications and materials for both scheduled and unscheduled visits. The cost for laboratory and diagnostic imaging were not included because it was not part of routine investigation for asthma patients in studied clinics. Personnel involved in the asthma treatment care were family medicine specialists, medical officers, medical assistants, pharmacists, pharmacist assistants, nurses and administrative clerks. The personnel cost was calculated based on the time spent by the personnel using time-motion study, multiply by their wages. The wages per minute were determined by their average monthly salary in accordance with the New Remuneration System for The Malaysian Public Service implemented through Service Circular No.2 of 2015 (21). The six-month cost of asthma related medications of each patient was calculated based on the dispensed drug to the study subjects on every visit and follow up. The costs of pamphlets, asthma diaries and peak flow meter mouthpieces that were given to the study subjects during the six-month follow-up period were included. Unscheduled visits in this study included unplanned visits to any private or public healthcare facilities either for in-patient or out-patient utilisation. Data for costs of visits to government and semi-government healthcare facilities were adapted from published literature (10), while the costs of unscheduled visits to private facilities were based on the amount the patients paid. These data were self-reported and documented in the study subjects' asthma diaries.

Three health outcomes were measured in this study. The primary outcome was asthma control, which was assessed based on the GINA symptom scoring tool (22). GINA symptom scores classify a patient's asthma symptom control into 3 categories, in which score 0 is controlled, score 1 to 2 as partly controlled and 3 to 4 as uncontrolled. In the analysis, we grouped the subjects into well-controlled (0-2 score) and uncontrolled asthma (3-4 score). The secondary outcomes were inhalation technique and frequency of unscheduled visit. Inhalation technique was assessed and scored were given based on the six-point checklist in RMTAC protocol (13). The frequency of unscheduled visit was obtained from the subject's diary. Data included were date of visit, type of healthcare facility visited, treatment received and costs.

For economic analysis, the incremental cost-effectiveness ratio (ICER) of RMTAC over standard care were estimated. The primary outcome was used in the cost-effectiveness analysis. The total costs were the sum of direct medical costs and costs of unscheduled visit. The ICER was defined as the additional cost of RMTAC to improve GINA scores by one unit when compared to standard care. ICER was calculated by dividing the differences in costs between RMTAC and standard care with the differences in their mean improvement in GINA scores. One-way sensitivity analysis was conducted to ascertain the robustness of the cost-effectiveness analysis. The base case parameters, namely the costs and outcomes RMTAC and standard care, were varied by 25% in the one-way sensitivity analysis to test the sensitivity of ICER towards the changes in these parameters.

Statistical analysis were completed using IBM SPSS Statistics for Windows, version 25. Statistical significance was set at p value less than 0.05. Means and standard deviations (SD) were calculated for the

continuous variables; whereas frequencies (n) and percentages (%) were calculated for the categorical variables. A comparison of the continuous variables between two groups was accomplished using independent t test; while categorical variables were analysed using Chi-square test or Fisher's exact test.

Results

In this study, 203 study subjects and 178 study subjects were recruited into RMTAC group and standard care group respectively. In the RMTAC group, 158 study subjects completed the study with a completion rate of 77.8%, while 163 study subjects in the standard care group completed the study with a completion rate of 91.6% (Figure 1). The baseline sociodemographic characteristics of the study subjects were summarised in Table 1.

Most of the study subjects were Malay and female with mean age of 45 to 46 years old. At baseline, there were no statistically significant differences between RMTAC group and standard care group except smoking status. In the RMTAC group, only 1.3% of study subjects were smokers and 19% of study subjects were passive smokers. Standard care group had a significantly higher percentage of smokers (6.7%) and passive smokers (38.7%). Majority of study subjects (79.7%) in the RMTAC group were free from smoke whereas only half of the study subjects (50.3%) in the standard care group were free from smoke.

The baseline clinical characteristics of the study subjects were summarised in Table 2. Both study arms had similar baseline clinical characteristics except baseline asthma control. At baseline, standard care group had a significantly higher percentage of study subjects with uncontrolled asthma (95.1%) as compared to RMTAC group (94.3%) (p=0.002).

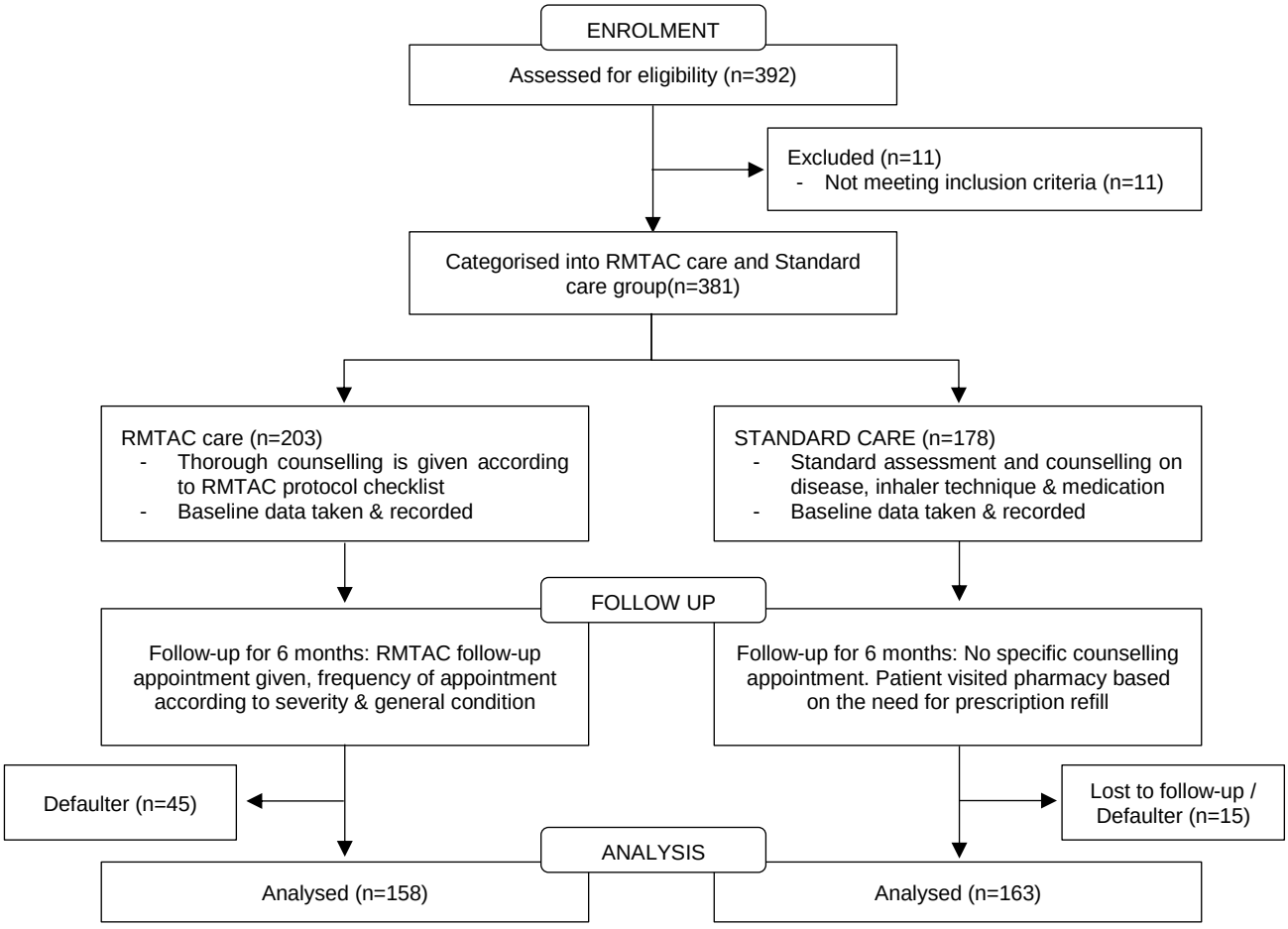

Figure 1: Flow of study subjects in the study

Table 1: Baseline sociodemographic characteristics of the study subjects (n=321)

Characteristics	RMTAC, n=158	Standard Care, n=163	*p*-value
Age at recruitment, year, mean ± SD	45 ± 15.4	46 ± 14.0	0.551 [a]
Gender, n (%)			0.631 [b]
Male	38 (24.1)	43 (26.4)	
Female	120 (75.9)	120 (73.6)	
Race, n (%)			**0.039** [c]
Malay	106 (67.1)	119 (73.0)	
Chinese	22 (13.9)	8 (4.9)	
Indian	26 (16.5)	33 (20.3)	
Others	4 (2.5)	3 (1.8)	
Occupation, n (%)			0.984 [c]
Government employee	34 (21.5)	30 (18.4)	
Private employee	40 (25.3)	45 (27.6)	
Self-employed	13 (8.2)	16 (9.8)	
Unemployed	10 (6.3)	8 (4.9)	
Housewife	45 (28.5)	49 (30.0)	
Student	7 (4.4)	6 (3.7)	
Government pensioner	5 (3.2)	4 (2.5)	
Private retiree	4 (2.6)	5 (3.1)	
Education level, n (%)			0.750 [c]
None	3 (1.9)	1 (0.6)	
Primary	26 (16.5)	27 (16.6)	
Secondary	76 (48.1)	75 (46.0)	
Tertiary	53 (33.5)	60 (36.8)	
Monthly household income category, n (%)			0.623 [c]
< RM 8000	157 (99.4)	160 (98.2)	
≥ RM 8000	1 (0.6)	3 (1.8)	
BMI category, n (%)			0.423 [b]
Not obese (BMI < 30)	115 (72.8)	112 (68.7)	
Obese (BMI ≥ 30)	43 (27.2)	51 (31.3)	
Smoking status, n (%)			**<0.001** [c]
Smoker	2 (1.3)	11 (6.7)	
Smoker and passive smoker	0	7 (4.3)	
Passive smoker	30 (19.0)	63 (38.7)	
Free from smoke	126 (79.7)	82 (50.3)	

Abbreviation: BMI – body mass index; SD – standard deviation
[a] Independent samples t-test
[b] Chi-square test
[c] Fisher's exact test

Table 2: Baseline clinical characteristics of the study subjects (n=321)

Characteristics	RMTAC, n=158	Standard Care, n=163	*p*-value
Medication profile, n (%)			0.646 [a]
Reliever + ICS	140 (88.6)	147 (90.2)	
Reliever + ICS + LABA	18 (11.4)	16 (9.8)	
Asthma control (GINA category), n (%)			**0.002** [a]
Well-controlled	9 (5.7)	8 (4.9)	
Uncontrolled	149 (94.3)	155 (95.1)	
GINA score, mean ± SD	2.91 ± 1.133	2.56 ± 1.134	**0.006** [b]
Duration of asthma, year, mean ± SD	18 ± 14	18 ± 12	0.928 [b]
Inhalation technique, n (%)			0.159 [a]
Good	42 (26.6)	29 (17.8)	
Poor	116 (73.4)	134 (82.2)	

Abbreviation: ICS – inhaled corticosteroids; LABA – long-acting beta agonist; SD – standard deviation
[a] Chi-square test
[b] Independent samples t-test

At the end of six-month follow up, both RMTAC group and standard care group demonstrated improvement in asthma control as evaluated by GINA symptom classification and inhalation technique. The outcome measures after six-month were summarised in Table 3. RMTAC group indicated 46.2% increment in well-controlled study subjects from 5.7% at baseline to 51.9% after six months. Standard care group demonstrated 16% increment in well-controlled study subjects from 4.9% at point of recruitment to 20.9% after six-month interval. In terms of mean GINA score, RMTAC group showed greater improvement compared to standard care group, which is from 2.91 at baseline to 0.99 after 6 months, with a mean improvement in GINA score of 1.91.

As for the measurement of inhalation technique, the RMTAC group showed 48.7% increment in study subjects with good inhalation technique from 26.6% at baseline to 75.3% after 6-month interval. Standard care group showed 14.1% increment of study subjects with good inhalation technique from 17.8% at baseline to 31.9%. Overall, RMTAC group showed significantly better asthma control and inhalation technique as compared to standard care group. However, there was no significant difference between the two groups in terms of frequency of exacerbation which is measured by frequency of unscheduled visit.

The total cost of asthma management per patient for the period of 6 months are presented in Table 4. The mean direct medical cost per patient (including personnel, medications and materials) was MYR 150.18 for RMTAC and MYR 110.37 for standard care. When the costs of unscheduled visits were included, the total cost was MYR 166.27 for RMTAC and MYR 120.22 for standard care. Figure 2 showed the cost for each component in both groups. The highest portion of costs were contributed by medications, followed by personnel, unscheduled visit and materials.

RMTAC demonstrated improved asthma control, but incurred more cost compared to the standard care. The ICER of RMTAC versus standard care was MYR 41.86 per improvement of GINA score by 1 unit (Table 5). The one-way sensitivity analysis was presented in Table 6 and Figure 3.

Table 3: Outcome measures after 6-month interval (n=321)

Characteristics	RMTAC, n=158	Standard Care, n=163	*p*-value
Asthma control (GINA category), n (%)			**<0.001** [a]
Well-controlled	82 (51.9)	34 (20.9)	
Uncontrolled (n, %)	76 (48.1)	129 (79.1)	
GINA score, mean ± SD	0.99 ± 1.254	1.75 ± 1.224	**<0.001** [b]
Improvement in GINA scores, mean ± SD	1.91 ± 1.473	0.81 ± 1.092	**<0.001** [b]
Inhalation technique, n (%)			
Good	119 (75.3)	52 (31.9)	**<0.001** [a]
Poor	39 (24.7)	111 (68.1)	
Frequency of unscheduled visits, mean ± SD	1 ± 1	1 ± 1	0.452 [b]

Abbreviation: ICS – inhaled corticosteroids; LABA – long-acting beta agonist; SD – standard deviation
[a] Chi-square test
[b] Independent samples t-test

Table 4: Health care costs of asthma management per patient for a period of 6 months

Cost Parameters	RMTAC, MYR*	Standard Care, MYR*	*p*-value
A. Direct Medical Costs	150.18 ± 118.02	110.37 ± 79.45	**<0.001**
Personnel	60.00 ± 25.73	46.65 ± 29.66	**<0.001**
Medication	85.33 ± 106.11	62.28 ± 61.23	**0.018**
Materials	4.81 ± 1.23	1.13 ± 0.39	**<0.001**
B. Cost of Unscheduled Visit	16.09 ± 36.76	9.85 ± 29.26	0.094
Total Costs, A+B	166.27 ± 126.50	120.22 ± 83.70	**<0.001**

Abbreviation: MYR – Malaysian Ringgit
* Data presented as mean ± SD

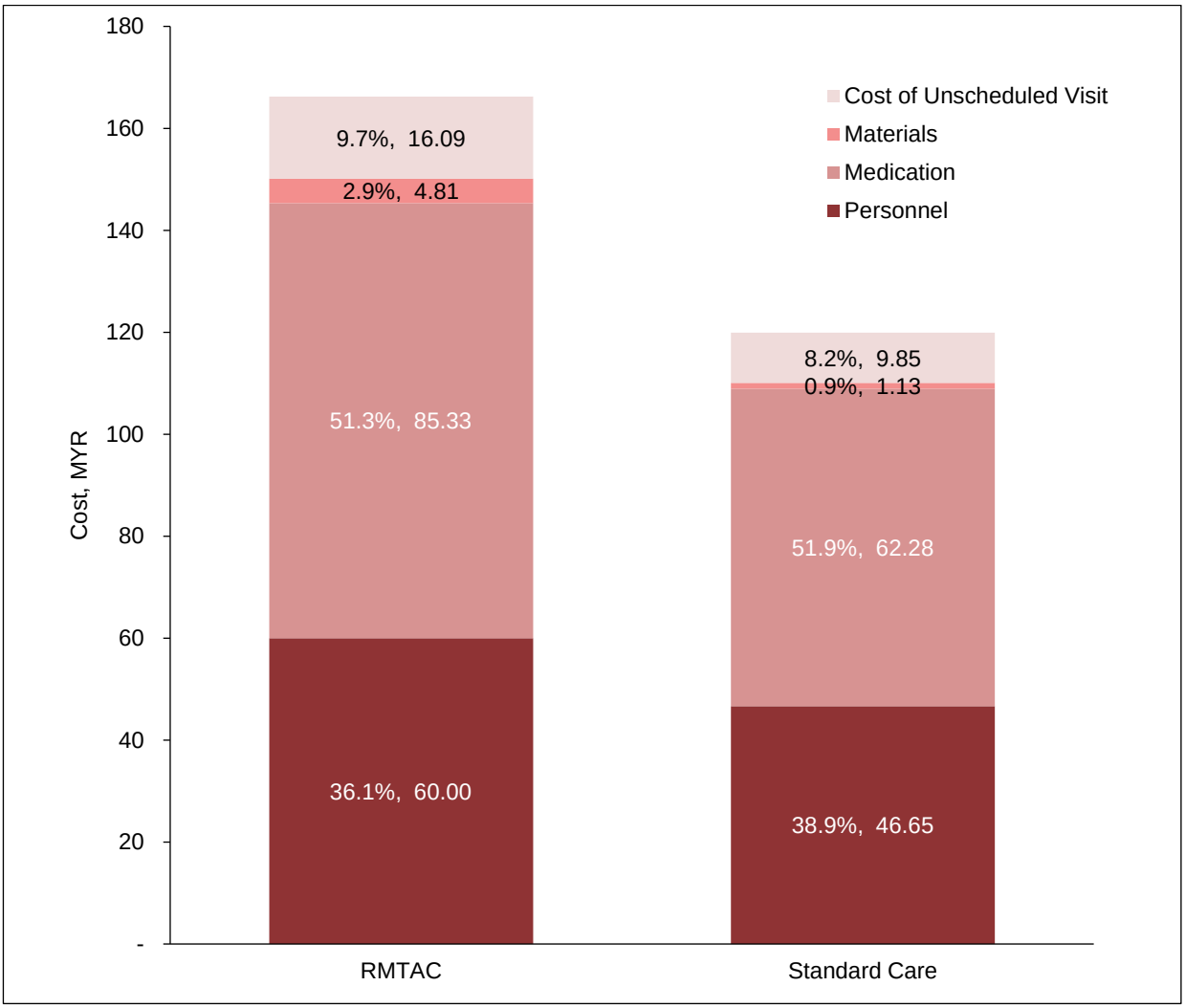

Figure 2: Cost components of asthma management for RMTAC and Standard Care Group

Table 5: Cost-effectiveness analysis of RMTAC versus standard care

	RMTAC	Standard Care	Difference
Cost per patient, MYR	166.27	120.22	46.05
Mean improvement in GINA score	1.91	0.81	1.10
ICER			MYR 41.86 *

Abbreviation: MYR – Malaysian Ringgit; ICER – incremental cost-effectiveness ratio
* ICER for RMTAC versus standard care was MYR41.86 per unit improvement in GINA score

Table 6: One-way sensitivity analysis of cost-effectiveness of RMTAC vs standard care

Varied Parameter	Varied Percentage − 25%	Varied Percentage + 25%
	ICER (MYR per unit improvement in GINA score)	
Cost of Standard care	69.19	14.54
Cost of RMTAC	4.08	79.65
Effectiveness of Standard care	35.36	51.31
Effectiveness of RMTAC	73.98	29.19

Abbreviation: MYR – Malaysian Ringgit; ICER – incremental cost-effectiveness ratio

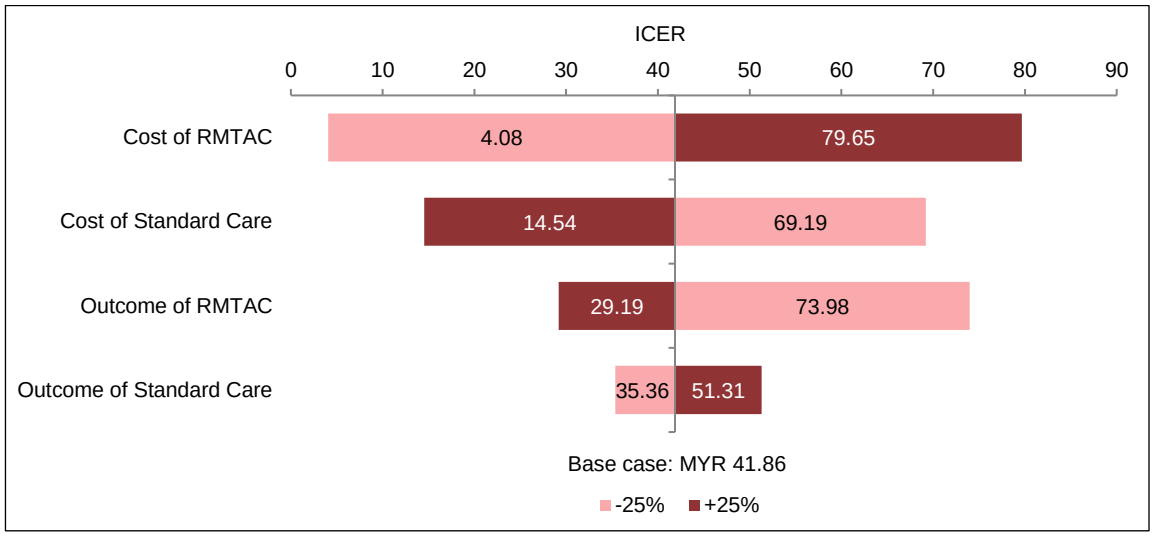

Figure 3: Tornado diagram showing the changes in ICERs (MYR per 1 unit improvement in GINA score) of RMTAC vs standard care in response to variation in input parameters

Discussion

This study was one of the first in Malaysia to assess cost-effectiveness of RMTAC using real world input instead of estimation models. In this study, RMTAC which is a pharmacist-managed asthma clinic was found to improve patients' asthma control and inhalation technique compared to standard pharmaceutical care. The result was similar to a few published studies that showed comprehensive education by pharmacists improved patients' knowledge on disease, inhaler technique skills and adherence; subsequently improve asthma control and quality of life (23,24). A study by Oh *et al*. in Malaysia also found that pharmacists' involvement in RMTAC had shown an overall improvement in asthma clinical outcomes (25).

There were significant differences in baseline clinical characteristics between the intervention and control groups. This is because our study was a non-randomised controlled study and one of the RMTAC referral criteria is patient with poor asthma control. Thus, most of the study subjects from the RMTAC group had higher baseline GINA mean score (2.91) compared to the standard care group (2.56).

Overall, RMTAC incurred a significantly higher cost than standard care. A big component of the costs were contributed by medications in both groups, but the medication cost was significantly higher for RMTAC patients. This could be due to active involvement of RMTAC pharmacists in optimising patients' asthma treatment as according to the asthma guideline. Similar findings were seen in a study by Perez *et al*., where higher cost of care in asthma clinics was due to the cost of medications (26). As RMTAC pharmacists spent more time with patients during RMTAC consultation and counselling, this contributed to significantly higher personnel cost for RMTAC care. However, no significant difference was found in the frequency and cost of unscheduled visits. This may be due to the self-reporting of unscheduled visits and thus subjected to study subjects' recall bias.

Our results showed that RMTAC improved patients' asthma control but was costlier. The incremental cost-effectiveness ratio (ICER) was MYR41.86 to improve GINA score by one unit. Nevertheless, it is common to have a positive cost-effectiveness ratio in healthcare settings as better outcomes may come at higher costs. The willingness-to-pay threshold for health care intervention in Malaysia was estimated by Lim *et al*. to be between MYR19,929 to MYR28,470 per quality-adjusted life year (QALY) (27), but there is no threshold set specifically for asthma control. If compared against this threshold, the ICER of RMTAC was far below the threshold and thus RMTAC could possibly be cost-effective. The one-way sensitivity analysis showed that although the estimated ICER of RMTAC was sensitive to changes in the cost and effectiveness of both RMTAC and standard care, the ICERs were still below the cost-effectiveness threshold suggested by Lim *et al*. (27) even if the cost of RMTAC increased by 25 percent.

Our study only followed up subjects for a period of six months, which is different in real life whereby patients will be under RMTAC follow up for a longer period until they have reached the desired asthma outcome for discharge. Therefore, RMTAC may eventually save cost in the long run if well-controlled asthma

patients have less exacerbation, less need to step up treatment and reduce absenteeism from work. This is supported by a study done by Perez *et al*. and Abdelhamid *et al*. which found a significant reduction in the frequency of acute attacks, use of inhaled beta-agonist and days of sickness after pharmacist's intervention in asthma management (6,26). A systematic review by Yong *et al*. concluded that the most cost-effective enhanced asthma management is a mixture of education and self-management (5). Another study done by Yong *et al*. using Markov cohort model also suggested that the implementation of RMTAC in Malaysia has high probability of being more cost-effective than the usual care management (14). As our study had shown that RMTAC significantly improve patients' asthma control and inhalation technique, it could possibly reduce the economic burden of asthma in long term. This is supported by previous studies which showed that annual medical resources utilisation for poorly controlled asthma is 2.5 to 3.5 folds of well-controlled asthmatic patients (28,29). Therefore, considering the benefits that RMTAC could potentially bring to patients, and the possibility of reducing the economic burden to our healthcare system, it is recommended to invest and expand the current RMTAC service to more health care facilities in Malaysia.

There are some limitations with this study. Firstly, data on unscheduled visits were obtained based on the assumption that study subjects accurately recorded the visits and admission in asthma diaries, thus subjected to recall bias. Secondly, study subjects were recruited into RMTAC and standard care groups from various clinics without randomisation and therefore there may be confounding factors that can interfere with the results. Thirdly, RMTAC group has more patients with higher mean GINA score at baseline compared to standard care, and this could affect the degree of effectiveness observed in RMTAC group. Follow-up period for this study was only 6 months, which may not be able to reflect the true effectiveness, frequency of unscheduled visits and the costs of treatment. Therefore, a randomised controlled study with longer follow-up period is recommended in the future.

Conclusion

Pharmacist-managed RMTAC service helps to improve patients' asthma control and inhalation technique at a small additional cost. Thus, it is recommended that the Ministry of Health should consider these findings and expand RMTAC service to more government facilities to improve the health outcome of asthma patients.

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Conflict of Interest Statement

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The Impact of Pharmacist's Counselling on Knowledge of Epilepsy and Its Treatment among Caregivers of Paediatric Patients with Epilepsy

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Abstract

Introduction: Parent health literacy is a predictor of adherence-related outcome among children with epilepsy.

Objective: The aim of this study was to evaluate the impact of pharmacist's counselling on paediatric patient's caregivers' knowledge on epilepsy and antiepileptic drugs (AED). This study also assessed the caregivers' confidence status before and after pharamcist's counselling and to evaluate their satisfaction on the counselling.

Methods: A pre and post interventional study was carried out from July to December 2017. The intervention was one to one counselling session to caregiver by pharmacist. The first set of questionnaire assessing the knowledge on epilepsy and AED (Part A) and confidence level (Part E) were administered to the caregivers prior to the counselling session. The caregivers had to complete the second set of questionnaire, consisting of Part B, which has the same questions as Part A but in reverse order, and Part G that measure caregivers' satisfaction level on the counselling, immediately after the counselling session. Caregivers were then follow-up a month later during their medication refill with the third set of questionnaire which consisted of Part E that assessed their confidence level.

Results: A total of 18 caregivers received the interventions and completed all three sets of questionnaires. The mean score on knowledge on epilepsy post counselling was significantly higher than pre counselling (16.6 ± 2.8 vs 9.2 ± 4.3, $p<0.001$). There was a marked increment in patients' confidence in managing their children's epilepsy condition (median score 5.0, IQR 0.25, vs 3.0, IQR 0.0, $p<0.001$). Overall, the caregivers rated the pharmacist counselling from very good to excellent.

Conclusion: A comprehensive counselling session tailored to epilepsy disease and its management by pharmacist increased caregivers' knowledge on epilepsy and AED and their confidence in managing children with epilepsy.

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Introduction

Epilepsy is a neurological disorder operationally defined as two or more episodes of unprovoked seizures occurring at least 24 hours apart. It is one of the most common, disabling neurological conditions. It was estimated that around six to seven children per 1,000 population in the United States have epilepsy (1). It increases the morbidity and symptomatic epilepsy reduces life expectancy by 18 years at maximum (2). The commencement of antiepileptic drug (AED) is recommended if there is more than one episode of unprovoked seizure to reduce the recurrence risk.

Parent health literacy has been associated with child health outcomes and medical treatment. Adherence is defined as the extent to which a patient's treatment-related behaviours (e.g., taking medication, following a prescribed diet, modifying health habits, and attending clinic appointments) correspond to a health professional's advice or treatment plan (1). Of those diagnosed with epilepsy, the vast majority are treated with AEDs and approximately 70% can become seizure free once the most effective regime is followed (3-4). Unfortunately, evidence suggested that adherence to medications among patients with

epilepsy was sub-optimal (5-8). Therefore, to address this matter, caregivers' knowledge towards epilepsy and AEDs is crucial to reduce seizures among children apart from increasing patient's adherence.

Nonadherence has been associated with increased seizure risk of 21%, morbidity, mortality and higher health care costs (9,10). Increased frequency of seizure can have serious repercussions on an individual's perceived quality of life (11). Pharmacists play an important role in the care of epileptic patients by educating patients on their condition, appropriate use of medication and advocating importance of adherence (12). It was found that the total first-year medical care cost for epilepsy patient was MYR 1690.13 per patient per year (13). Therefore, it is vital for the pharmacists to highlight the importance of optimising seizure control. Previous research has shown that factors contributing to adherence were patients' knowledge, education, satisfaction with medical care and complexity of treatment regimens (14-18). Knowledge on medication could significantly reduce drug related events such as misinterpretation of directions, side effects and nonadherence (19). Nevertheless, paediatric patients' adherence to treatment is largely dependent on their caregivers. A study suggested that additional counselling helped to improve caregivers' knowledge regarding the condition which may lead to better adherence (17). Counselling services provided by pharmacists to patients with chronic conditions have shown positive impact on patients' outcomes (18). Pharmacists emphasise on rationale drug use and management of patients' medical condition which improves knowledge and subsequently may positively influence adherence to medication. To our knowledge, there was no local published data regarding the impact of pharmacist's counselling on knowledge among caregivers of paediatric patients with epilepsy. Therefore, this study aimed to investigate caregivers' knowledge on epilepsy and AEDs as well as patient's caregiver confidence status and satisfaction upon counselling by pharmacists.

Method

Study Design

A prospective study was performed in Hospital Melaka, Malaysia. Hospital Melaka is a state hospital which covers patients from Melaka state. Ethical approval for this study was obtained from the Medical Research and Ethics Committee (MREC), Ministry of Health Malaysia (NMRR ID: NMRR-17-639-35402). This study adhered to strict information governance and security protocols.

Study Setting and Study Population

This study was conducted from July to December 2017, in Satellite 5 Outpatient Pharmacy of Hospital Melaka. The study population consisted of caregivers who accompanied epileptic paediatric patients aged below eighteen years old that attended the paediatric neurology follow up visits which was scheduled on every Thursday morning. The inclusion criteria were parents or caregivers of children aged below eighteen years old who were diagnosed with any forms of seizure, patients whom AED(s) are administered by their caregivers at home. The exclusion criteria were inadequate data / missing data, patients who just started taking AED(s) or had a new AED regime for less than one month from the recruitment date and parents or caregivers who could not understand Malay and English or illiterate.

Sample size calculation was done based on $N = 2 + C(s/d)^2$ + 20% drop off (20). In which, the constant for significance level of 0.05; power of study of 0.8, C=7.85; standard deviation of knowledge score, s=3.4; difference detected, d = post knowledge score – pre knowledge score = 4.3 (21). Hence, a minimum of eight subjects was required to show a significant result at 95% confidence interval and power of study at 80%.

All epileptic patients' caregivers who went to the Satellite 5 Outpatient Pharmacy after neurology clinic follow up on Thursday morning were screened and recruited via convenient sampling. All caregivers that met the inclusion and exclusion criteria were approached for study details explanation. Caregivers who agreed to join the study were required to sign the informed consent form. Patients and caregiver's demographic data were collected.

Before the pharmacist's counselling, the baseline knowledge on epilepsy and AED and confidence of caregivers in managing epilepsy were assessed using the first set of questionnaires (Part A knowledge and Part E confidence). Then, a counselling session by pharmacist was conducted for approximately 30 minutes. After counselling, the knowledge on epilepsy and AED of caregivers and caregivers' satisfaction towards pharmacist counselling were assessed using the second set of questionnaires consisting of Part B and Part G. Part B had the same questions as Part A but the questions were in reverse order. The caregivers were followed up at one-month interval during their medication refill and their confidence in managing

epilepsy was reassessed using the third set of questionnaires which consisted of Part E. The detailed workflow of the study was shown in Figure 1.

The counselling session was conducted with the aid of presentation slides and leaflets that were prepared by the pharmacists and checked by specialists in charge of paediatric neurology clinic. All counselling materials were prepared in English and Malay. The types of seizures, how to take care of paediatric epilepsy children, what to do during seizure attack, common side effects of AED and importance of compliance were some of the contents included in the counselling tools. The caregivers will receive the counselling leaflets at the end of the counselling session for further reference to improve their knowledge. Throughout the study period, the counselling was carried out by three pharmacists who had been trained by a senior pharmacist and a counselling checklist was used. These approaches were taken to ensure the counselling sessions were consistent, of good quality and effective.

Study Instrument

The questionnaires used were researcher-assisted questionnaires. The questionnaires were developed by Chen *et al*. (21) and permission to use had been obtained. There were four parts of questionnaires used in this study (Part A, B, E and G), as summarised in Table 1.

Questionnaire Part A consisted of 21 questions. Part A was a 10-minute researcher-assisted questionnaire used to assess caregivers' baseline knowledge on epilepsy and AED before counselling. In Part A, the scoring for answers followed a negative grading system. There were three responses for each question: 'true', 'false' and 'not sure'. The correct responses were assigned one point, the incorrect responses were assigned negative one point whereas the 'Not Sure' responses were given zero point. As such, a maximum of 21 points and minimum of negative 21 points were possible for questionnaire Part A. After the counselling session by pharmacist, questionnaire Part B (same questions as Part A but in a reverse order), was used to evaluate caregivers' knowledge on epilepsy. The knowledge scores pre-counselling (Part A) and post-counselling (Part B) was compared.

Caregivers' confidence in managing of epilepsy was evaluated using questionnaire Part E. In this Part of questionnaire, the answers were in five-point Likert scale and scores were assigned to the responses as follow: 'very confident' (five points), 'confident' (four points), 'a little confident' (three points),'a little not confident' (two points), and 'no confidence' (one point). Confidence was assessed pre-counselling and one-month post-counselling to enable caretakers to incorporate their newly acquired knowledge into their daily care for patients. The one-month lapse will give a better insight into caregivers' confidence as compared to if the evaluation of confidence was done immediately post counselling.

Caregivers' satisfaction on pharmacist's counselling was assessed using questionnaire Part G that consisted of seven questions with five-point Likert scale anwers. In Part G, 'excellent' ratings were assigned five points, followed by four points for 'very good', three points for 'good', two points for 'satisfactory', and one point for 'poor'.

Statistical analysis

All data was entered into a Microsoft Excel 2003 spreadsheet. Data was analysed with SPSS (version 18.0.0) software. The mean scores and the mean differences between Part A and B were calculated. Paired sample t test was used to compare the means of sets A and B. The proportion of caregivers giving correct answer for each question was calculated. The proportion of pre- and post-counselling was compared using McNemar test. The median scores of confidence status pre- and post-counselling were compared using Wilcoxon Signed-Ranked test. Statistical significance was defined as $p<0.05$.

Table 1: Summary of questionnaires used

Part	Measurement	Remarks
A	Caregiver's knowledge on epilepsy and AED	-
B	Caregiver's knowledge on epilepsy and AED	Same questions as Part A but in reverse order
E	Caregiver's confidence	-
G	Caregiver's satisfaction on pharmacist counselling	-

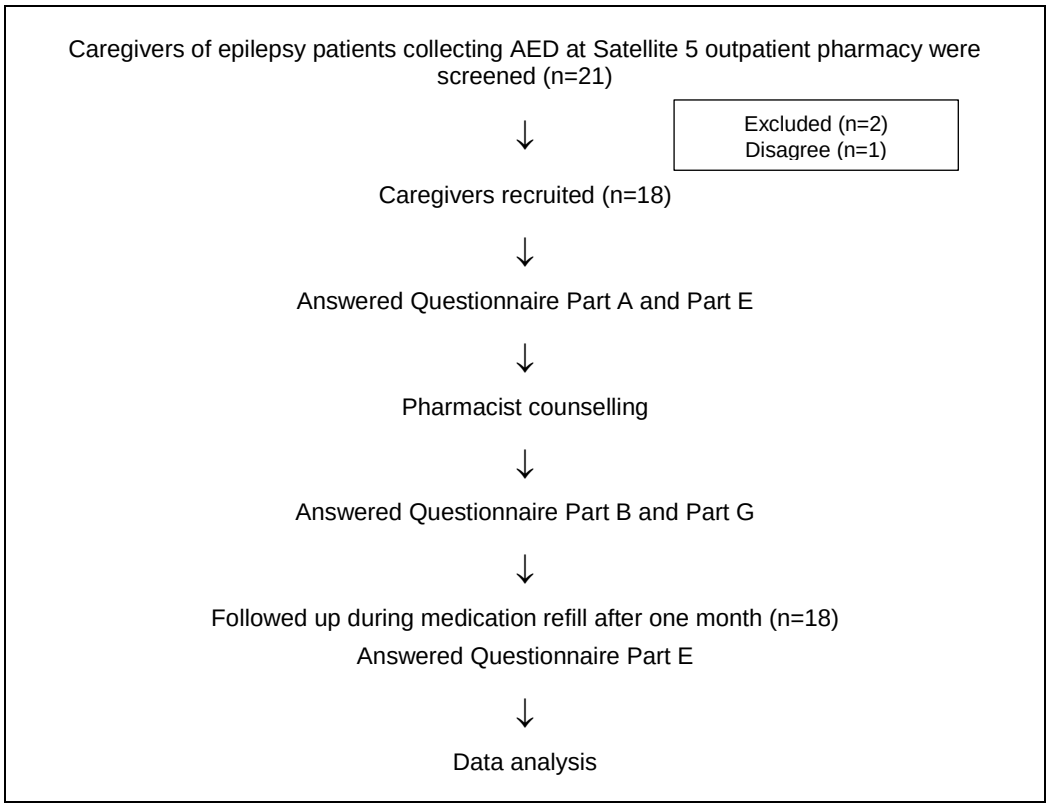

Figure 1: Workflow of study

Results

Twenty-one caregivers were screened. Among these caregivers, one declined participation and two participants were excluded. Among the 18 caregivers included, sixteen (88.9%) of the patients under their care had generalised seizures and two (11.1%) had focal seizure. The characteristics of caregivers and epilepsy patients were presented in Table 2 and Table 3 respectively.

Caregivers' knowledge on epilepsy

After counselling, the mean score of caregivers' knowledge on epilepsy was significantly higher than pre-counselling (16.6 ± 2.8 versus 9.2 ± 4.3, $p < 0.001$) (score range = -21 to 21). After pharmacist counselling, there was an increment of the proportions of caregivers answering correctly for 20 out of the 21 questions. The distribution of proportion of caregivers with correct answer for each question before and after counselling was presented in Table 4. Among the 20 questions, there was significant improvement in proportion of caregivers answering correctly post-counselling for three questions (question 9, 10c and 11b).

Caregivers' confidence and satisfaction towards pharmacist's counselling

The median score of confidence of caregivers improved after counselling (5.0, interquartile range (IQR) 0.25 versus 3.0, IQR 0.0, $p<0.001$). Overall, the caregivers rated the counselling provided by the pharmacist as very good to excellent with median satisfaction score ranging from 4.5 (IQR 1.0) to 5.0 (IQR 0.0) for each component assessed. The details were tabulated in Table 5.

Table 2: Characteristics of caregivers of paediatric epilepsy patients (n=18)

Characteristic	n (%) / mean ± SD
Age of caregivers, mean ± SD	35.8 ± 4.8
Gender of caregivers, n (%)	
Female	14 (77.8%)
Male	4 (22.2%)
Education level, n (%)	
Primary	1 (5.6%)
Secondary	9 (50%)
Pre-university *	3 (16.7%)
Diploma	4 (22.2%)
Degree	1 (5.6%)
No. of children under their care, n (%)	
1	0 (0%)
2	5 (27.8%)
3	8 (44.4%)
≥ 4	5 (27.8%)

Abbreviation: SD – standard deviation
***** Pre-university refers to caregivers with advanced level certificate or underwent matriculation programme

Table 3: Characteristics of paediatric epilepsy patients under the care of respondents (n=18)

Characteristic	n (%) / mean ± SD
Age of epilepsy patients, mean ± SD	5.1 ± 3.0
Types of seizure, n (%)	
Generalised	16 (88.9%)
Focal	2 (11.1%)
No. of AEDs prescribed, n (%)	
1 AED	11 (61.1%)
2 AEDs	5 (27.8%)
3 AEDs	2 (11.1%)
Duration of taking AED, n (%)	
< 1 year	4 (22.2%)
1-5 years	9 (50.0%)
> 5 years	5 (27.8%)
Ever dispensed with rectal diazepam, n (%)	
Yes	5 (27.0%)
No	13 (73.0%)
Keep a seizure diary, n (%)	
Yes	14 (77.8%)
No	4 (22.2%)

Abbreviation: SD – standard deviation; AED – antiepileptic Drug

Table 4: Percentage of caregivers with correct answer for questions regarding epilepsy pre- and post-counselling

No.	Question	Pre (%)	Post (%)	*p-value**
2a	Epilepsy is a disorder caused by abnormal electrical activity in the brain.	66.7	100.0	-
2b	Epilepsy is a curable disease.	38.9	66.7	0.231
3a	My child may have more seizures if he/she does not get enough rest.	55.6	100.0	-
3b	My child may have more seizures if he/she develops a fever or falls sick.	44.4	100.0	-
3c	My child may have more seizures if he/she misses taking their seizure medication(s).	55.6	88.9	0.109
4	If my child stops having seizures while taking the seizure medication(s), I can stop the medication(s).	77.8	100.0	-
5	If my child missed a dose(s) of the medication(s), I should ignore the missed dose and double the next dose.	83.3	100.0	-
6	I can bring the child to see other doctors but I must inform them my child is on seizure medication(s).	94.4	94.4	1.000
7	If my child is drowsy and/or dizzy after taking the seizure medication(s), I should continue with the medication(s), but inform the doctor at the next appointment.	72.2	83.3	0.727
8	If my child has a body rash, fever and mouth ulcers after starting seizure medications, I should bring the child to the Accident and Emergency Department immediately	77.8	100.0	-
9	There is no need to inform the doctor if I want to give herbal supplements or other medicines to my child.	61.1	94.4	**0.031**
10a	If your child is having a convulsive seizure (whole body is stiff and jerking uncontrollably), turn the child's body to recovery position (Body lying on the side, head tilted upwards).	83.3	94.4	0.625
10b	If your child is having a convulsive seizure (whole body is stiff and jerking uncontrollably), put a spoon or finger into the child's mouth to prevent him/her from biting his/her own tongue.	61.1	100.0	-
10c	If your child is having a convulsive seizure (whole body is stiff and jerking uncontrollably), give rectal diazepam if the seizure lasts longer than 5 – 10 minutes.	27.8	77.8	**0.008**
10d	After the seizure, let your child sleep for up to 60 minutes.	16.7	22.2	1.000
11a	I should bring my child to seek medical attention immediately every time a seizure occurs.	44.4	77.8	0.109
11b	I should bring my child to seek medical attention immediately if he/she is remains confused or sleepy 5 minutes after a seizure episode.	33.3	66.7	**0.031**
11c	I should bring my child to seek medical attention immediately if seizure continues for more than 10 minutes after giving rectal diazepam.	61.1	94.4	0.070
12	Children with seizures may swim alone.	72.2	100.0	-
13a	A seizure diary is a diary epilepsy patient or the caregiver use to record their seizure frequency.	72.2	100.0	-
13b	A seizure diary can help the doctor to know if the seizure medication(s) your child is taking helps your child's fits.	72.2	100.0	-

** Mc Nemar test*
Analysis was not done for question 2a, 3a, 3b, 4, 5, 8, 10b, 12, 13a and 13b due to small sample size in the respective categories

Table 5: Scores of caregivers' satisfaction towards pharmacist counselling (n=18)

No.	Question	Score, median (IQR)
1	Pharmacist's knowledge	5.0 (0.3)
2	Pharmacist's explanation of medications	5.0 (0.3)
3	Pharmacist's instructions on administration	5.0 (1.0)
4	Pharmacist's courtesy and respect	5.0 (1.0)
5	Amount of time pharmacist offers to spend	5.0 (0.0)
6	Usefulness of information provided	5.0 (0.3)
7	Overall rating of service	4.5 (1.0)

Score scale 1: poor, 2: satisfactory, 3: good, 4: very good, 5: excellent
Abbreviation: IQR – interquartile range

Discussion

The educational counselling provided by the pharmacist was effective at improving caregiver knowledge on epilepsy and antiepileptic treatment. This result is in accordance with the results from a study done in Singapore by Chen *et al*. (21) and another study in Taiwan by Liu (22).

This study reported that the general knowledge regarding AED among our population was satisfactory for some questions. In our study, more than 80.0% of the caregivers correctly answered missed dose management and not to double dose. Whereas only 59.0% and 70.0% of caregivers in the Thailand and Singapore studies responded that double dosing to replace a missed dose was incorrect (19,21). The higher percentage in our study reflected that our population of study has a better understanding of missed dose management. However, this study highlighted that attention need to be paid to some of the AED knowledge questions. More than one-fifth of the caregivers were not aware of the symptoms of hypersensitivity reaction that need immediate medical attention. In addition, almost one third of the caregivers was not aware of the drug-drug and drug-herb interactions thus would not inform prescribers regarding the initiation of herbal supplements or other medications. After counselling, the knowledge of both aspects improved among caregivers. Therefore, it is crucial to highlight this information in the epilepsy counselling session in the future.

Nonetheless, our findings showed that the less than half of the caregivers was aware that epilepsy is not curable. Even after counselling, around one third of the caregivers was still not aware that epilepsy cannot be cured. Although all caregivers answered that they will not stop the AED if the child stops having seizure, not all of them was aware that missing AED is one of the contributing factors of seizure. Therefore, they still need to be educated that epilepsy cannot be cured but can be controlled well with AED and hence compliance towards AED is important.

There were three questions pertaining to knowledge on acute management during seizure attacks presented with the lowest score before counselling. Only five out of 18 of them were prescribed with rectal diazepam previously and all of them could answer correctly on the use of rectal of diazepam. This result was higher than the population studied in Singapore and Thailand whereby 44.0% and 95.0% of the respective population know how to use rectal diazepam (19,21). Knowledge on the correct use of rectal diazepam is essential to terminate prolonged convulsive seizures and clusters of repeated seizures in children with epilepsy. The management of acute seizures usually demands immediate administration of appropriate antiepileptics for avoiding status epilepticus (23). Therefore, more effort could be focused onto improving patient's knowledge on the correct use of rectal diazepam.

Prior to counselling, only one third of the caregivers were aware that they need to seek immediate medical attention if a child remained confused or sleepy for five minutes after a seizure episode. Similarly, caregivers in Singapore also shared a low level of awareness as only 7.4% of caregivers were able to give a correct response to the similar question prior to counselling (21). In our study, there was significant improvement after counselling, whereby about two third of the caretakers were able to answer the quations correctly. Counselling sessions provided were able to address caregiver's wrong perception on when to seek medical attention after seizure episode and educate caregiver on the correct use of rectal diazepam.

As for seizure diary, approximately 70.0% population of our study kept seizure diaries, which was higher than the respondents in Taiwan (22). This showed that caretakers in this study were aware on the importance of recording frequency of seizure to assist doctors in assessing their children's epilepsy control and thus help to optimise the treatment.

Earlier study done by Galleti recognised the importance of counselling for paediatric patients in order to identify any knowledge deficits but did not explore the effects of counselling on parameters such as knowledge (24). Our study showed that counselling by pharmacist could improve the knowledge of caregivers.

Almost all caregivers were more confident in managing their children's epilepsy conditions after the counselling session. This coincided with the improvement in most of the questions post counselling. This finding was similar to the study done in Singapore (21). The mean score of caregiver satisfaction towards pharmacist's knowledge and pharmacist's explanation of medications was rated between very good to excellent. This implied that the caregivers in our study were generally satisfied with the service provided the pharmacists.

This study gave an insight into the impact of pharmacist's counselling on knowledge of epilepsy and its treatment among caregivers of paediatric patients with epilepsy in local setting. It provided preliminary data on what element to be focused in the counselling to improve the knowledge on epilepsy and its treatment among the caregivers. However, we were unable to explore how improved knowledge on epilepsy

as well as knowledge on AED may affect the compliance in this population of study. Therefore, future studies could further explore the impact of pharmacist's counselling on patient's adherence to antiepileptic treatment.

Conclusion

Pharmacist-based counselling improved caregiver's knowledge on epilepsy, AEDs and confidence in managing epilepsy. Caretakers were highly satisfied with counselling services given by pharmacists. A protocol should be generated with involvement of pharmacists in education service for better care of paediatric epilepsy patients. On the other hand, future study could be conducted to explore the association between caregiver's knowledge and patients' compliance to treatment.

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User Satisfaction Survey on the Implementation of Pharmacy Information System and Clinic Pharmacy System (PhIS & CPS) in Ministry of Health Malaysia Facilities

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Abstract

Introduction: The Ministry of Health (MOH) Malaysia implemented the Pharmacy Hospital Information System and Clinic Pharmacy System (PhIS & CPS) with an aim to strengthen the monitoring of procurement, supply, and use of medicines at MOH facilities. It allows patient drug profile sharing to provide seamless patient care, as well as to serve as a tool in making decisions to ensure the accessibility of medicines by consumers in the MOH facilities. As PhIS is meant to improve the delivery of pharmacy services, it is crucial to evaluate users' perceptions and allow for continuous improvement accordingly.

Objective: This study aimed to identify the level of PhIS & CPS users' satisfaction with the system implementation in the facility.

Method: A cross-sectional study using a self-administered questionnaire was conducted in government healthcare facilities using universal sampling. The HOT-fit framework was employed to analyse the level of users' satisfaction in the human, organisation, and technology domains of system implementation. Descriptive analysis was performed to tabulate the category of users, the system's training received, and their level of satisfaction.

Results: A total of 4,265 responses were analysed indicating a 14.3% valid response rate, more than half of which are pharmacy-related staff. Overall, more than 73% of users had one to five years of experience in using the system, 84% of total users are pharmacy-based system users, and only 55% of users have attended a form of formal system's training. On a scale of 1 to 5, the level of users' satisfaction across all measured factors was generally satisfactory (mean scores were between the range of 3.66 – 4.13), with the human domain having more dissatisfaction and indifferent responses (38%).

Conclusion: The level of satisfaction among the system's users was generally satisfactory, but improvements can be made in targeted areas of concern.

Keywords: pharmacy information system, clinic pharmacy system, user satisfaction

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Introduction

The Pharmacy Hospital Information System and Clinic Pharmacy System (PhIS & CPS) was implemented by the Pharmaceutical Services Programme (PSP), Ministry of Health (MOH) Malaysia to monitor the procurement, supply and use of medicines at MOH facilities (1). This comprehensive system integrated pharmacy-related services and clinical workflows to allow patient-drug profile sharing and provide seamless patient care, as well as a tool in making decisions to ensure rational use and access to medicines (2).

The PhIS & CPS implementation began in 2013, albeit the expansion of usage in all government facilities in the country was gradual and by stages. The PhIS & CPS application has four different integrative modules namely full-based, pharmacy-based, inventory-based and indent-based modules. The types of module implementation heavily depend on the infrastructure and organisational capacity of a facility. Indent- and inventory-based modules focus mainly on the procurement of products and inventory management of stocks, while the pharmacy- and full-based modules comprise of the same functions and applications with differences only in the online drug prescribing workflows (1). The generic functions and components of a hospital information systems (HIS) and PhIS & CPS have been extensively reviewed in several local studies (3-6). As of June 2022, a total of 1,274 facilities has implemented the system. The pharmacy-based module has been implemented in over 65% of MOH facilities while the indent- and inventory-based modules have been implemented in 17% and 11% facilities respectively (7).

HIS are particularly designed to facilitate healthcare providers in managing the medication processes safely (8). As PhIS & CPS was designed to improve the delivery of pharmacy services, it is crucial to evaluate the overall systems performance, users' perception and satisfaction, and the improvements it has contributed to the Malaysian healthcare system. Studies in this area was still lacking and the Pharmacy Research Priorities in Malaysia document highlighted the need for an emphasis in this segment of pharmacy research (9).

Effective and continuous use of HIS provide better access and systematic data management compared to the manual paper-based system (10). The measure of net benefits of HIS implementation involves a multitude of interrelated factors. A HOT-fit framework developed by Yusof *et. al* provided a comprehensive categorisation of evaluation factors and domains that fit and corresponded to specific dimensions within the human (H), organisational (O), and technology (T) domains of HIS implementation success (11,12). This framework can be adapted to assess specific areas of concern that may contribute to a disruption in the whole workflow (12,13,14).

The focus of this study was to quantify the level of users' satisfaction on the PhIS & CPS by adopting the HOT-fit model (12). In the context of this research, user satisfaction was defined as the basic concept of information evaluation as a response to the user's intellectual and emotional judgement (15). The outcome of this research will provide an insight on the types of users and their level of satisfaction. The findings may assist the PhIS & CPS project team to identify the problematic areas and strategise action plans to improve the system.

Method

Study Design

A descriptive cross-sectional study using self-administered questionnaire was conducted in the MOH government healthcare facilities from 2 September to 24 October 2021. Universal sampling method was employed by distributing the online questionnaires to all PhIS & CPS users nationwide that fulfilled the inclusion criteria of this study. The registered e-mail addresses of users were extracted from the system database, including and not limited to doctors, nurses, registration clerks, pharmacists, assistant pharmacists and storekeepers. Exclusion criteria were inactive or dormant users, and registered system users of less than three months. This was to avoid bias that could potentially be introduced by new users due to insufficient system familiarisation. Personal information of respondents was not collected in the study. A statement of consent was prompted in the distributed questionnaire and respondents who selected not to agree with the terms of the study was automatically redirected to the end-page of the questionnaire and excluded from the study. This study was approved by the MOH Medical Research and Ethics Committee (MREC) with the National Medical Research Registry (NMRR) registration number of NMRR-20-2657-57102.

Questionnaire

The questionnaire was developed in Malay language as it was the unified national language in the Malaysian public sector (16). The questionnaire comprised of two parts, where the first part collected demographic information, and the second part contained questions to measure the level of users' satisfaction based on three main domains of the HOT-fit model [human (H), organisation (O), and technology(T)) and the respective sub-domains (H: system development and system use; O: organisational structure; T: system quality, information quality, and service quality) as depicted in Figure 1 (12). The questionnaire was constructed through rigorous expert panel discussions and designed to measure relevant functions that were deemed critical to the system. The detailed domains and questions were illustrated in the Appendix.

A pilot study was conducted among 11 selected users of the system. The internal consistency by Cronbach's alpha (α) for each sub-domain were 0.86 for system development, 0.84 for system use, 0.96 for organisational structure, 0.92 for system quality, 0.96 for information quality, and 0.95 for service quality. Therefore, all Cronbach's alpha scores were acceptable for the developed construct (17). The pilot study results were excluded in the final analysis.

Descriptive Statistical Analysis

Compilation and tabulation of data was performed using Microsoft Excel version 2019 and IBM SPSS version 28. Descriptive analysis was conducted to assess the characteristics of respondents and the types of training attended, expressed in frequencies and percentages. The level of users' satisfaction was measured using a five-point Likert scale. Scores were assigned to the answers, in which 1 = strongly dissatisfied; 2 = dissatisfied; 3 = neither; 4 = satisfied; 5 = strongly satisfied. The mean and standard deviation (SD) of the scores were calculated with the highest possible mean score being 5.00 and lowest possible mean score was 1.00. The scores were classified into low, neutral, and high level of satisfaction by dividing the difference between the highest and lowest possible mean score by 3 to give an interval of 1.33 (low = 1.00-2.33, neutral = 2.34-3.67, high 3.68-5.00) (18).

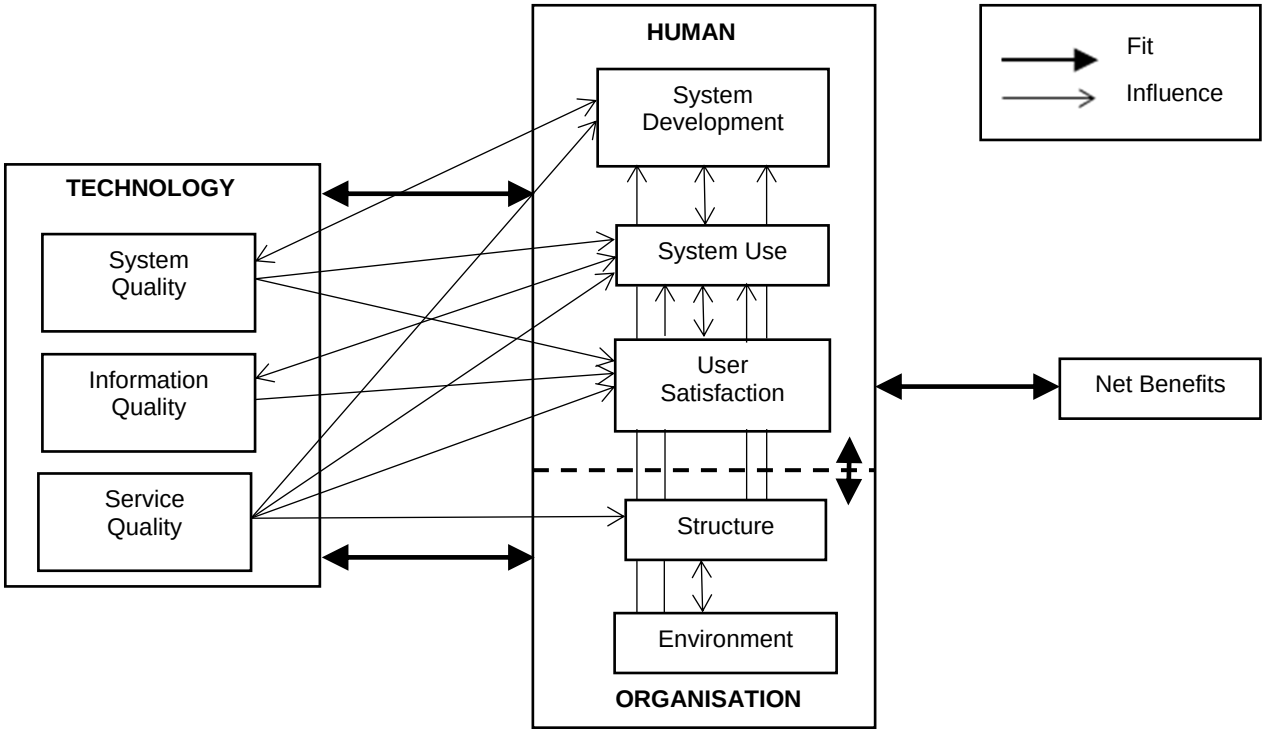


Figure 1: Human-Organisation-Technology Fit (HOT-fit) framework (12)

Results

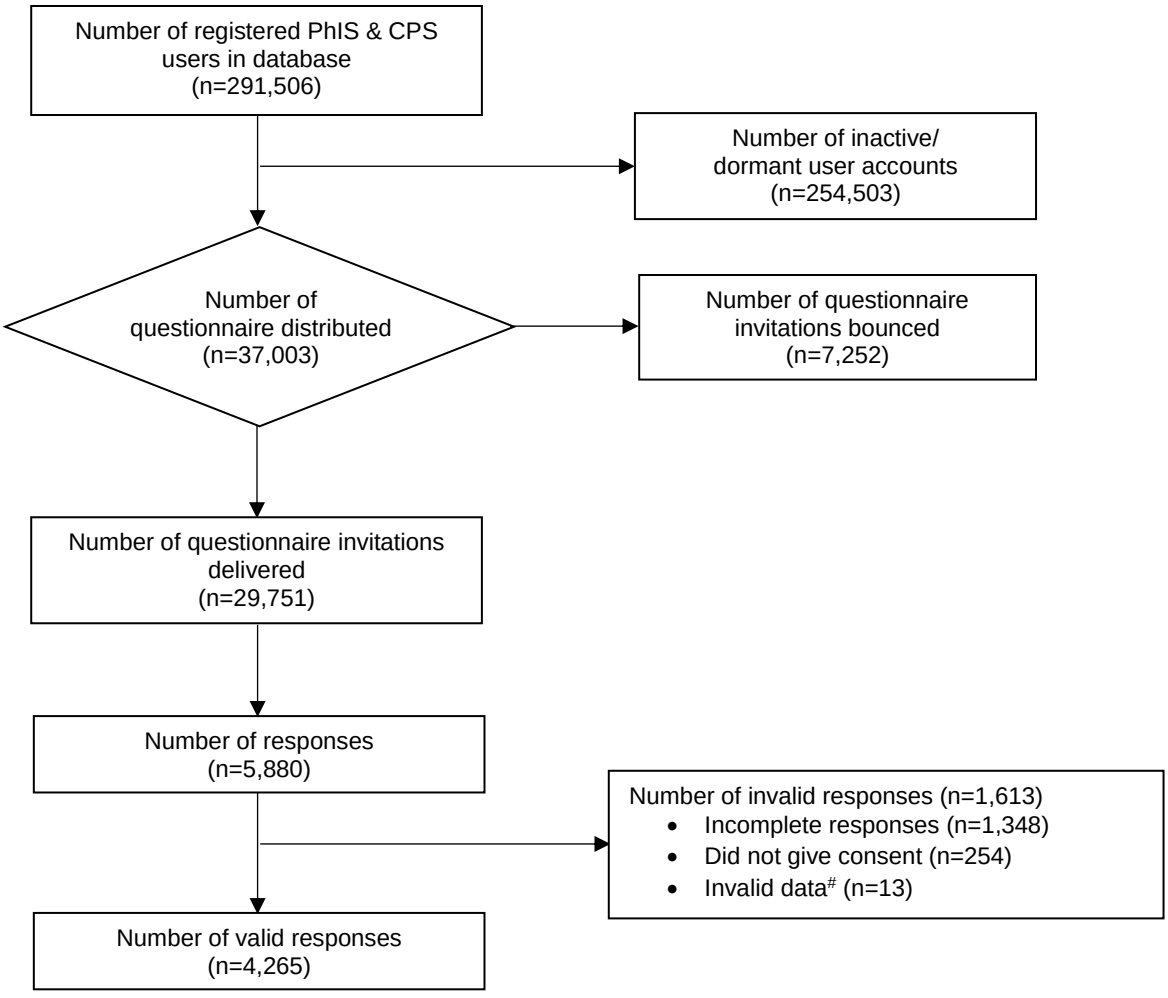
The system database consisted of a total of 291,506 registered PhIS & CPS users, whereby 254,503 of which were inactive and dormant users. The questionnaire invitations were distributed to 37,003 active users but 7,252 invitations were automatically bounced indicating invalid e-mail addresses. The questionnaire invitations delivery acknowledgement notifications received was 29,751. However, the number of responses received was 5,880 (19.8% estimated response rate) with 1,613 invalid responses due to incomplete forms, respondents disagreeing to the terms of the study, and invalid data. The final valid responses included in this study for further analysis was 4,265 (14.3% actual response rate). A breakdown of calculated responses and the final number of valid responses used for the analysis was depicted in Figure 2.

The characteristics of respondents were tabulated in Table 1. The mean age of users was 34.4 years old (SD 7.11 years) and 73.4% of users had about one to five years of experience in using the system. Majority of users (84.1%) were using the pharmacy-based systems, and more than half of the respondents were of pharmacy-related staffs, followed by the nurses (30.2%).

Table 2 summarised the crosstabulation of respondents' professions and their system's training experience. Majority of pharmacists and pharmacist assistants, and about half of the houseman medical officer respondents have attended a PhIS & CPS training and was personally trained by the vendor. More than half of the nurses did not attend any formal training, and 40% claimed to have undergone on the job training or initiated self-learning.

The mean scores on the level of user satisfaction based on the measured sub-domains were summarised in Table 3. The mean score of satisfaction towards the measured sub-domains indicated a high level of satisfaction (mean score of above 3.68) except for the sub-domain of system use (user perception, training, and access) which indicated a neutral level of satisfaction (3.66, SD 0.66). As for user specific functionalities, administrative assistants rated highest for system's quality with a mean score of 4.13 (SD 0.64).

Generally, the overall level of satisfaction across all domains (human, organisation, and technology) were satisfactory (Figure 3). The overview of overall satisfaction based on users' profession (Figure 4) showed that staffs of the medical profession expressed more dissatisfaction towards the system, while administrative assistants were mainly satisfied with the PhIS & CPS.



Invalid data includes errors in respondent's age, position, and place of work

Figure 2: The breakdown of questionnaire responses and the calculated final valid responses

Table 1: Characteristics of respondents (n=4,265)

Characteristics	n (%) / mean ± SD
Age, years, mean ± SD	34.4 ± 7.11
Age group, n (%)	
20 – 29 years	1166 (27.3)
30 – 39 years	2158 (50.6)
40 – 49 years	771 (18.1)
50 – 59 years	170 (4.0)
User experience, years, mean ± SD	4.47 ± 2.05
User experience category, n (%)	
< 1 year	313 (7.3)
1 – 5 years	3132 (73.4)
> 5 years	820 (19.2)
Types of PhIS & CPS system implementation, n (%)	
Full-based	508 (11.9)
Pharmacy-based	3587 (84.1)
Inventory-based	137 (3.2)
Indent-based	33 (0.8)
Position of user, n (%)	
Pharmacist	1847 (43.3)
Pharmacist Assistant	502 (11.8)
Provisionally Registered Pharmacist	97 (2.3)
Medical Officer	171 (4.0)
Assistant Medical Officer	265 (6.2)
Houseman Medical Officer	17 (0.4)
Nurse	1290 (30.2)
Administrative Assistant	76 (1.8)

Table 2: Crosstabulation of respondents' positions and system's training, n (%)

	Has the respondent attended a system's training? (n=4,265)		If Yes (n=2,357), by whom?		
Position	No	Yes	Champion	Vendor	Self-Learning
Pharmacist	658 (36)	1189 (64)	335 (28)	723 (61)	131 (11)
Pharmacist Assistant	90 (18)	412 (82)	81 (20)	279 (68)	52 (13)
Provisionally Registered Pharmacist	77 (79)	20 (21)	3 (15)	4 (20)	13 (65)
Medical Officer	112 (65)	59 (35)	12 (20)	21 (36)	26 (44)
Assistant Medical Officer	168 (63)	97 (37)	24 (25)	34 (35)	39 (40)
Houseman Medical Officer	8 (47)	9 (53)	2 (22)	5 (56)	2 (22)
Nurse	753 (58)	537 (42)	85 (16)	235 (44)	217 (40)
Administrative Assistant	42 (55)	34 (45)	6 (18)	20 (59)	8 (24)

Table 3: Overall satisfaction scores of PhIS & CPS system users based on the sub-domains

Sub-domain	n	mean ± SD
System development	4265	3.69 ± 0.67
System use	4265	3.66 ± 0.66
Organisational Structure	4265	3.75 ± 0.64
Quality of service	4265	3.84 ± 0.61
Information quality (PF, PPF, & PRP)	2446	3.85 ± 0.64
Quality of system (PF, PPF, & PRP)	2446	3.98 ± 0.59
Quality of system (MO & HMO)	188	3.86 ± 0.75
Quality of system (SN & AMO)	1555	3.98 ± 0.65
Quality of system (PT)	76	4.13 ± 0.64
Overall quality of system	4265	3.81 ± 0.63

Abbreviations: PF - Pharmacist; PPF - Pharmacy Assistant, PRP - Provisionally Registered Pharmacist; MO - Medical Officer; HMO - Houseman Medical Officer; AMO - Assistant Medical Officer, SN - Nurse; PT - Administrative Assistant

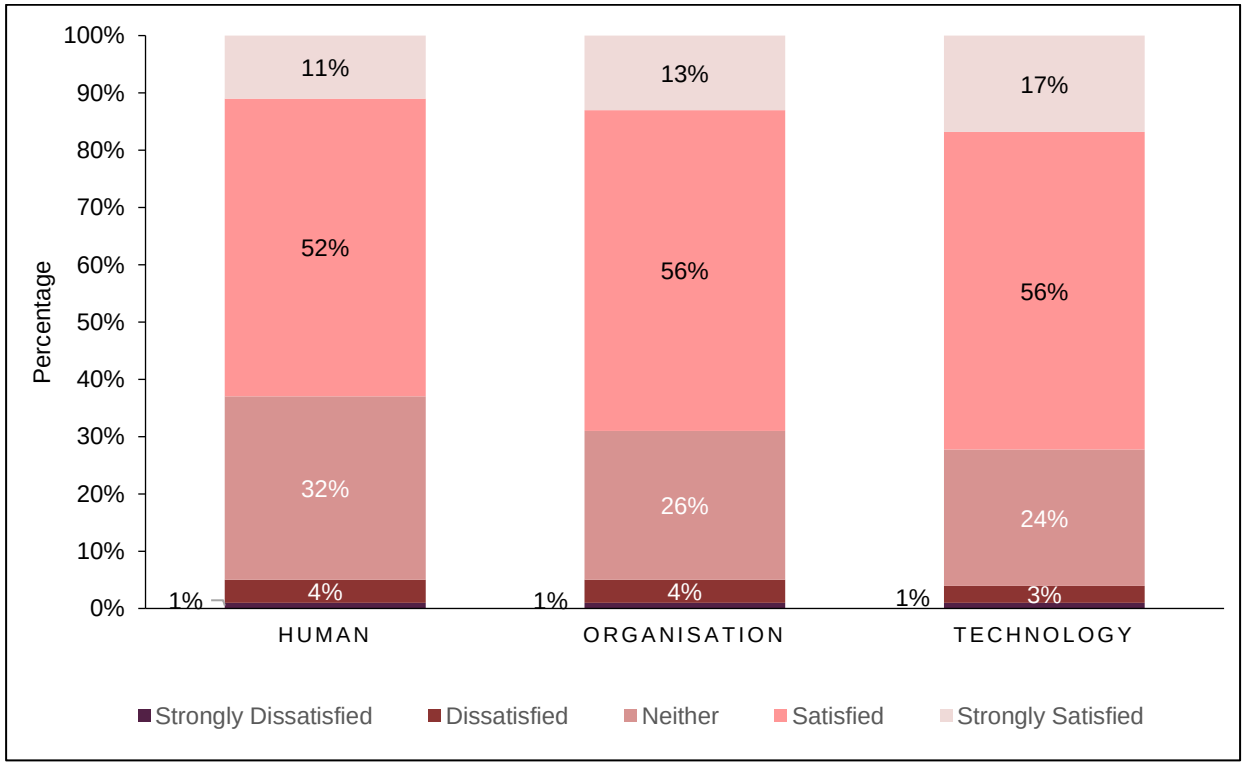
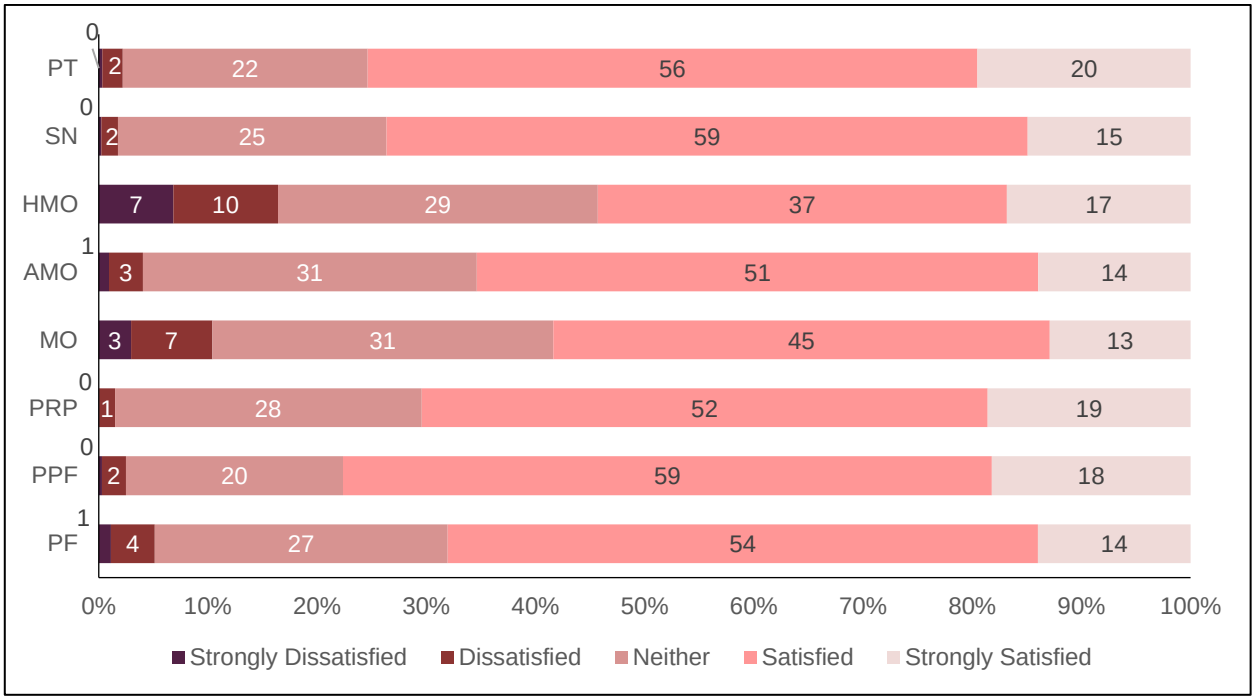


Figure 3: Percentage of overall satisfaction level of PhIS & CPS system users by domain



Abbreviations: PF - Pharmacist; PPF - Pharmacy Assistant, PRP - Provisionally Registered Pharmacist; MO - Medical Officer; HMO - Houseman Medical Officer; AMO - Assistant Medical Officer, SN - Nurse; PT - Administrative Assistant

Figure 4: Percentage of overall satisfaction level of PhIS & CPS system users by position

Discussion

The PhIS & CPS users' perception and satisfaction are the key drivers to an effective and continuous use of the system which could give an indication to the success of system implementation (19,20,21). Since the system was largely designed to cater for the pharmacy-related administrative functions, and management of clinical and pharmaceutical information, the largest group of respondents observed in this study were mainly pharmacists. However, the indentation of medicines and medical supplies from the main store to respective units and departments are commonly performed by nurses or assistant medical officers, hence they are also deemed as frequent users of the PhIS & CPS.

The pharmacy-based module had the highest number of implementations in the country, hence the high number of respondents utilising this module. The modules implemented were particularly dependent on the organisational and infrastructure of the facility, such that indent-based modules were mostly implemented in rural and sub-urban small-sized health clinics that have limited number of staffs in the facility. The inventory-based modules were implemented in facilities to complement their existing HIS applications, while pharmacy-based modules were implemented in facilities that do not have HIS in place and were previously manual, paper-based systems. Full-based module was developed as a full-fledged hospital management information system comprising of the whole clinical management workflow from patient management processes, prescribing of medicines, dispensing, registration, procurement, stock management and reporting (3). The critical function of PhIS & CPS is the component to procure and indent pharmaceutical products and medical supplies. The networking of this component across all facilities enabled monitoring and continuous access to pharmacy services under the governance of PSP.

The realisation of the system's net benefit depends on effective use of the system and the fulfilment of the end-user requirements. Many research had recognised the end-user satisfaction and system usage as the critical determinants of the success of information systems (21,23-25). The utilisation of the HOT-fit framework enabled a seamless categorisation of essential dimensions and measures for evaluating HIS. A qualitative study by Ismail *et al.* utilised the HOT-fit framework in assessing PhIS users' satisfaction in 2016 during the early stages of PhIS & CPS implementation (14). The study noted that the users were aware of the limitations in the system's functions and the unfeasible system upgrades, and that their level of satisfaction could be increased if the quality aspects of the information system, the service provider, system's overall usability, and system's training and communication are improved (14).

Following the study by Ismail *et al.*, this present study provided a quantitative assessment on the level of users' satisfaction based on similar domains and factors, five years after the system was implemented. Generally, the overall satisfaction towards the human, organisational and technological domains were satisfactory. The mean scores of each sub-domain indicated high level of satisfaction with an exception in the system use sub-domain. This sub-domain measured the users' perception, training and access, which reported a neutral score of 3.66 (SD 0.66), indicating room for further improvements. A local study in a tertiary hospital setting analysed PhIS users' acceptance based on perceived usefulness and perceived ease of use among pharmacists and pharmacist assistants by adopting the Davis' Technology Acceptance Model (TAM) (26,27). The study observed a positive attitude towards the system usefulness, but a more neutral attitude towards perceived ease of use. These two measures fall under the human (system use) and technology (system quality) domains respectively, based on the HOT-fit model used in this study. Comparable to that research, our findings observed a more neutral mean score for system use, indicating a lower level of satisfaction compared to other factors being measured. The perceived ease of use, which falls under the measure of overall system quality, reported a mean score of 3.81 (SD 0.63) with administrative assistants having the highest level of satisfaction, and medical officers and houseman medical officers having the lowest. This was in line with another study which found that physicians in Taiwan indicated that perceived ease of use influenced HIS acceptance significantly more that perceived usefulness (28).

A closer look at the level of satisfaction across all domains, the human domain had higher percentage of dissatisfaction and indifferent judgement compared to other domains. Between the two factors measured in the human domain (system development and system use), the latter had a lower mean score. Possible justification to this was over 45% of respondents had not attended any form of formal system's training and of these respondents, more than half were medical officers, assistant medical officers, nurses, and administrative assistants. This could be mitigated by providing system trainings to all new users of the system rather than focusing only on pharmacists and pharmacist assistants. Training was identified as one of the key factors responsible for ensuring successful systems usage in several studies (28,29). Inadequate training causes residual problems and unmet expectations leaving users with a general feeling of dissatisfaction (29). However, due to the user-specific functionalities and applications of the PhIS & CPS, it is difficult to generalise the training modules and courses to accommodate a wider audience. Segmented training courses could be implemented targeting different types of system users, but this requires a thorough and organised planning.

The authors had identified several limitations in this study. The questionnaire was disseminated through work email addresses and reminder notifications were only sent twice throughout the questionnaire distribution period. Hence, users who were on study and maternity or parental leaves, or those who were away from work during this period might not have access to their work emails. The user's response to the questionnaire was on a voluntary basis hence it was difficult to get a high response rate. The small number of respondents for certain professions such as houseman medical officers (0.4%), administrative assistants (1.8%) and provisionally registered pharmacists (2.3%), made it inapt to draw a conclusive representation of the user's profession to their level of satisfaction towards the implementation of PhIS & CPS. Further research is warranted to analyse the level of satisfaction based on profession-specific PhIS & CPS users for targeted system improvements, and to explore the contributing factors that may directly influence the users' satisfaction towards the system.

Conclusion

The aim of implementing the PhIS & CPS was to establish a platform of organised healthcare information and support evidence-based practice to ensure sustainable access to medicines. The system users' satisfaction is the key driver to an effective and continuous use of the system. This study identified that users were generally satisfied with the overall system implementation but indicated that there were room for improvements especially in the human domain. A key concern identified in this study was the inadequacy of system's formal training to a certain segments of users. Further studies should focus on identifying specific areas of concern relating to system's module implementation for a better understanding of challenges faced by individual segments of users.

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Conflict of Interest Statement

The authors declare no conflicts of interest in this work.

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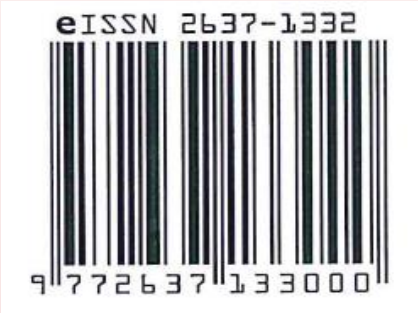
Appendix: Questionnaire design based on selected measures

Domain	Sub-domains	Measures	Target Respondents (Number of questions)
Human	System Development	- System enhancement - System maintenance	All users (3)
	System Use	- User perception - User training - User access	All users (6)
Organisation	Structure	- Guidelines and work processes - Administrative management - IT infrastructure	All users (7)
Technology	System Quality	- Ease of use - System usability - System accessibility - System reliability - System feature usefulness - System integration	All users (8) User-specific questions: - PF, PPF, PRP (6) - MA, HMO (5) - SN, AMO (4) - PT (4)
	Information Quality	- Usefulness - Reliability	User-specific questions: - PF, PPF, PRP (6)
	Service Quality	- Technical support - Responsiveness	All users (14)

Abbreviations: PF - Pharmacist; PPF - Pharmacy Assistant, PRP - Provisionally Registered Pharmacist; MO - Medical Officer; HMO - Houseman Medical Officer; AMO - Assistant Medical Officer, SN - Nurse; PT - Administrative Assistant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