Patient's Perception on the Features of Interest and Barriers of Smartphone Medication Adherence Applications

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Abstract

Introduction: Well-designed smartphone applications (apps) can potentially help in enhancing adherence to medications, but its application was limited due to the lack of studies.

Objective: This study aimed to determine the factors that may lead to medication non-adherence, identify the important features of a smartphone medication adherence app that can improve medication adherence, and to understand the possible predictors and barriers in downloading such app.

Method: A cross-sectional survey was conducted at Outpatient Pharmacy of Hospital Enche' Besar Hajjah Khalsom, Kluang, Johor, where a structured self-administered questionnaire was distributed to the patients. The inclusion criteria were adults with confirmed diagnosis of any chronic illness, on repeated prescriptions of three or more medicines and owned a smartphone.

Result: A total of 154 responses was collected for final analysis. Forgetfulness or carelessness were reported as the most common factors causing non-adherence. About half of the respondents rated side effect management tool (52.2%), disease information (47.8%) and reminder system (41.3%) as the most important features in an app whereas offline internet access and the ability to create reports to be send to doctors were found to be the least important to them (15.2% and 19.6% respectively). Patients who lived in urban areas, had more than five medicines intakes daily and used smartphones for more than five times daily were significant predictors of interest to adopt an adherence app. The lack of knowledge about the usefulness of medication adherence app were the main reasons given by the participants for their disinterest in adopting an adherence app (43.8%).

Conclusion: Patients showed great interest to be more actively involved in the therapy. Thus, app developers should consider toinclude database of information about disease, medicine and self-management tools and wide range of reminder system to develop a functional and relevant medication adherence smartphone apps.

Keywords: compliance, adherence, smartphone, application

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Introduction

Adherence is defined as the extent of an individual, particularly a patient, to follow or stick to the healthcare professionals' recommendation, advices or instructions regarding his or her individualized therapeutic regimen (1). In 2016, The Ministry of Health Malaysia (MOH) reported that they disposed about RM 2 million worth of expired medicines returned by the patients (2). On top of that, a study conducted among hypertensive patients in 2007 at Hospital Tuanku Jaafar Seremban found that each patient had wasted around RM 42 of taxpayer's money due to unused medicine. A total loss of unused medicine amounting to RM 59,566.50 with monthly average of RM 9,927.75 was reported at the end of the study (3).

Adherence to medicines is commonly thought to be a patient's full responsibility. However, it is now known that medicine-taking behaviour is more complicated than it was thought to be and relies closely to the relationships between physicians, patients, and the healthcare system itself (4).

In a US-based report by Express Script, it was found that 69% of non-adherence was due to patients' behaviour (5). It can be divided into two major categories which were unintentional and intentional non-adherence. The latter is described as patient own decision to deviate from the therapeutic plans agreed

with the prescribers. According to the National Survey on the Use of Medicines (NSUM) by Malaysian Consumers 2015, almost half of the correspondents had admitted to consciously chosen not to take prescribed medicines (6). The fear of possible side effects and not feeling ill or any better upon taking the medicines were commonly seen among patients taking symptom-control medication regimens like antihypertensives and hyperlipidaemias. Shockingly, the lack of adherence could also be due to the patients' self-denial of current unwell conditions, i.e. patients refuse to take medicine as it reminds them of being ill or unhealthy (7).

Unintentional nonadherence is the passive type of nonadherence in which the patients are unable to take medications as indicated or instructed due to limited resource or capacity. According to the NSUM 2015, almost two-third of the surveyed subjects claimed that they had forgotten to take their daily medications (6). Physical impairments such as blindness or limited limb dexterity can also affect patients' efforts in adhering to the treatment (8). In the large-scale Aston Medication Adherence Study (AMAS) conducted in Birmingham, England, the researchers concluded that some demographic factors like ethnicity, religion practice and poor socioeconomic patients might also be associated with weak adherence to treatments (9). Prescribers are being considered as the gatekeeper for the healthcare sector but them being the front line of healthcare sector might indirectly lead to nonadherence among the patients. It was found that most general practitioners (GP) failed to identify adherence issue among the patients, probably due to time constraints (10). This could be due to overcrowding patients and limited resources in the healthcare (11).

In general, the common methods used to motivate patients to increase adherence are traditional reminder systems, education on medicine taking behaviour, counselling by healthcare professionals, simplifying the complex dose regimen, or a combination of these approaches (12). Smartphones could be a new platform for the healthcare system to reduce the barriers between the healthcare providers and patients. With the growing number of worldwide smartphone users, which was estimated to escalate up to 22.38 million in 2018 in Malaysia alone (13), it is a major indicator of heavy reliance on the gadget nowadays. Hence, it seems promising to introduce mobile downloadable medication adherence applications (apps) for smartphones.

As the market for medication adherence apps is relatively new, there is very little extensive research focusing on smartphone apps as a potential intervention to improve medication adherence. Only 1.5% out of 400 participants in a previous small-scale study realised the existence of such apps on their smartphones (14). As there are increasing reliance on smartphones among the Malaysians, a novel approach of improving medication adherence using mobile apps may be introduced. Therefore, this study aimed to determine the factors that may lead to medication non-adherence and to identify the important features of the app that can improve medication adherence from the patients' perspectives. In addition, we also aimed to understand the association between the patients' demographic factors and their interest in downloading a smartphone medication adherence app, and to identify any possible barriers hindering them from downloading any smartphone medication adherence applications.

Method

Questionnaire design and development

A draft questionnaire was devised based on validated questionnaire from previous studies (12,14,15,20). It was reviewed for content validity and the final questionnaire was approved after several amendments over four weeks.

In overview, the questionnaire constituted four sections which were personal details and smartphone usage information, medication regimen, features of interest in the medication adherence app and the perceived barriers in using the app. As this study was targeting respondents from the general public with different background of life, the questions were devised in the absence of technological terms or medical jargon. The questions were mostly designed in the form of multiple-choice questions (MCQs) and several questions were presented in Likert-scale statements. Most of the questions were closed questions which will help respondents to narrow down their choices and complete the questionnaire faster, in approximately five to ten minutes.

Questionnaire distribution and participant recruitment

This cross-sectional study was conducted at the Outpatient Pharmacy of Hospital Enche' Besar Hajjah Khalsom, Kluang, Johor from August 2018 to September 2018. Using a sample size calculator, 195 participants were needed for the study with 95% confidence interval and marginal of error of 5%.

We performed convenience samplings with recruitment of respondents conducted at the outpatient pharmacy during prescription screening in order to identify suitable participants who fulfilled the inclusion criteria. The inclusion criteria of the study were adult from the age of 18 and above, diagnosed with any chronic disease (for example, cardiovascular diseases, diabetes mellitus, etc.), prescribed with at least three medicines and being an active smartphone user. Exclusion criteria were patients who were unable to understand Malay or English language and those who were already using such apps upon recruitment.

Consents to participate in the survey were obtained from the respondents. Upon agreement, respondents were given short briefing about the objective of the study and overview of different section of the questionnaire before completing the questionnaire.

Data analysis

Minitab Express Software was used to process and analyse the data. Microsoft Excel was mainly used to count the frequency of each demographic factors and factors of non-adherence. To identify any association between two observations, cross tabulations and Chi-square tests were conducted. P-values were calculated with statistical significance only if the P-value was less than or equal to 0.05 which implied that there was a 95% confidence in the analysis.

Ethical issue

The survey was approved by the Medical Research & Ethics Committee (MREC), Ministry of Health Malaysia. No findings, which could identify any individual participant, was published. Participation in this research was entirely voluntary.

Results

I total, 154 responses were included in the final analysis. According to Table 1, the cohort was dominated by males (n=94, 61%) and the mean age of the respondents was 52.86 (standard deviation (SD) 12.12) years. Malay participants consisted of 69.6% (n=107) of the whole respondents. In terms of education level, only 17.4% (n=26) of the respondents received tertiary education. Most of the respondents were pensioner which made up to 34.8% (n=54) of the participants and 67.4% of the respondents belonged to the urban locality. About 44% (n=67) of the respondents had monthly income of RM 1001-2000.

From Table 2, it was found that about two-third of the respondents used Android phones (71.7%), with more than half of them were considered as heavy smartphone users by using it more than five times daily (52.2%). Almost 80% of the respondents said that they used mobile data for smartphone internet connection while the rest only relied on WIFI connection (21.7%).

It was reported in Table 3 that almost 60% of the total respondents were taking more than three types of frequent medicines daily, while only 13% took more than eight medicines daily. Most of these respondents admitted already getting accustomed to the daily routine of medicines intake (80.4%). However, about 11% used written reminder to remind them to take the medicines on time.

From Figure 1, it was found that more than one third of the respondents (36.6%) admitted that they were careless or simply forgot with no specific reason which they did not take the medicines. This was followed by the fear of medicine side effects and the perception of being healthy (17.8% and 11.1% respectively) which hindered them to adhere to the therapy. It was found that most of the respondents did understand how their prescribed medicines help to control the disease and the health staffs did a satisfactory job in assisting patients to obtain the information throughout the therapy.

All participant had not used any medication adherence app previously. Despite the low number of app awareness, the interest in using an app was high in which more than half of the respondents (57.1%) showed their interest in downloading a medication adherence app in their smartphone.

Chi-square test was performed to identify any association between the demographic factors and respondents' interest in downloading the app. As shown in Table 5, there was significant associations between living area, smartphone usage and total medicine intake ($p=0.0491$, $p=0.0431$ and $p=0.0448$, respectively) and the respondents' interest in downloading the app. In other words, patients who lived in urban areas, have more than five medicines intake and those who used smartphone for more than five times

daily were significant predictors of interest to adopt an adherence app. The other demographic factors had not shown any significant association.

Figure 2 demonstrated that the respondents thought that side effect management tool was the most important feature in a medication adherence app (52.2%), followed by the access on disease information (47.8%) and reminder system (41.3%). Offline app access and the ability to create reports to be send to the doctors were found to be the least important feature for them (15.2% and 19.6% respectively).

Most of the respondents reported that they do not have enough information about the usefulness of medication adherence app, and this could prevent them from using such app in the smartphone (43.8%) (Figure 3). This was followed by the issue of technical difficulties when using the app (10.1%). The security of the app was not a considered as a big concern by the respondents (2.2%).

Table 1: The demographic background of the respondents (n=154)

Demographic factors		Frequency (n)	Percentage (%)
Gender			
	Male	94	61.0
	Female	60	39.0
Age			
	18 - 54 year	74	48.1
	55 - 64 year	50	32.5
	≥65 year	30	19.5
Ethnicity			
	Malay	107	69.6
	Chinese	20	13.0
	Indian	20	13.0
	Others	7	4.3
Education			
	Primary school	27	17.4
	Secondary school	97	63.0
	Pre-university / Diploma	13	8.7
	Degree	10	6.5
	Master	3	2.2
	No formal education	3	2.2
Occupation			
	Government	23	15.2
	Private	40	26.1
	Student	0	0.0
	Retired	54	34.8
	Self-employed	13	8.7
	Unemployed	23	15.2
Living area			
	City	104	67.4
	Rural	50	32.6
Income			
	Less than RM 1000	37	23.9
	RM 1001 - RM 2000	67	43.5
	RM 2001 - RM 3000	20	13.0
	RM 3001 - RM 4000	13	8.7
	RM 4001 - RM 5000	7	4.3
	More than RM 5000	10	6.5

Table 2: Smartphone usage among the respondents (n=154)

Smartphone Usage	Frequency (n)	Percentage (%)
Type of smartphone		
Android	110	71.7
Apple	7	4.3
Others	37	23.9
Usage per day		
1 - 3 times	54	34.8
3 - 5 times	20	13.0
More than 5 times	80	52.2
Internet connection		
Mobile data / WIFI	121	78.3
WIFI only	33	21.7

Table 3: Medication regimen information of the respondents

Medication Regimen Info	Frequency (n)	Percentage (%)
Total medicine intake		
3-5 types of medicine	90	58.7
5-8 types of medicines	44	28.3
More than 8 medicines	20	13.0
Approaches used to remember to take medicine		
Daily routine	124	80.4
Family / carer aids	10	6.5
Alarm	3	2.2
Written reminder	17	10.9

Table 4: Awareness and interest in downloading a smartphone medication adherence app (n=154)

Aware of the application existence, n (%)	Interest in downloading the apps, n (%)	
	Yes	No
Yes	13 (8.4)	10 (6.5)
No	87 (56.5)	44 (28.6)

Table 5: Association between demographic factors and interest in downloading smartphone medication adherence application

Demographic factors	Interest in downloading the apps, n (%)		P-value
	Yes	No	
Gender			0.0186
Male	60 (39.1)	33 (21.7)	
Female	40 (26.1)	20 (13)	
Age			0.0903
18 – 54 year	54 (34.8)	20 (13)	
55 - 64 year	27 (17.4)	23 (15.2)	
≥ 65 year	20 (13)	10 (6.5)	
Ethnicity			**0.0187**
Malay	64 (41.3)	44 (28.3)	
Chinese	17 (10.9)	3 (2.2)	
Indian	17 (10.9)	3 (2.2)	
Others	3 (2.2)	3 (2.2)	
Education			0.0756
Primary school	10 (6.5)	17 (10.9)	
Secondary school	64 (41.3)	33 (21.7)	
Pre-university / Diploma	3 (2.2)	0 (0)	
Degree	10 (6.5)	3 (2.2)	
Master	10 (6.5)	0 (0)	
No formal education	3 (2.2)	0 (0)	
Occupation			0.0912
Government	17 (10.9)	7 (4.3)	
Private	23 (15.2)	17 (10.9)	
Student	0 (0)	0 (0)	
Retired	37 (23.9)	17 (10.9)	
Self-employed	7 (4.3)	7 (4.3)	
Unemployed	17 (10.9)	7 (4.3)	
Living area			**0.0491**
City	74 (47.8)	30 (19.6)	
Rural	27 (17.4)	23 (15.2)	
Income			0.0814
Less than RM 1000	23 (15.2)	13 (8.7)	
RM 1001 - RM 2000	44 (28.3)	23 (15.2)	
RM 2001 - RM 3000	13 (8.7)	7 (4.3)	
RM 3001 - RM 4000	7 (4.3)	7 (4.3)	
RM 4001 - RM 5000	3 (2.2)	3 (2.2)	
More than RM 5000	10 (6.5)	0 (0)	
Frequency of smartphone usage			**0.0431**
1 - 3 times daily	37 (23.9)	17 (10.9)	
3 - 5 times daily	7 (4.3)	13 (8.7)	
More than 5 times daily	57 (37)	23 (15.2)	
Internet connection			0.1129
Mobile data or WIFI	74 (47.8)	47 (30.4)	
WIFI only	27 (17.4)	7 (4.3)	
Total medicine intake			**0.0448**
3 - 5 types of medicine	57 (37)	33 (21.7)	
5 - 8 types of medicines	27 (17.4)	17 (10.9)	
More than 8 medicines	17 (10.9)	3 (2.2)	

Figure 1: Factors that led to medicine non-adherence among the respondents

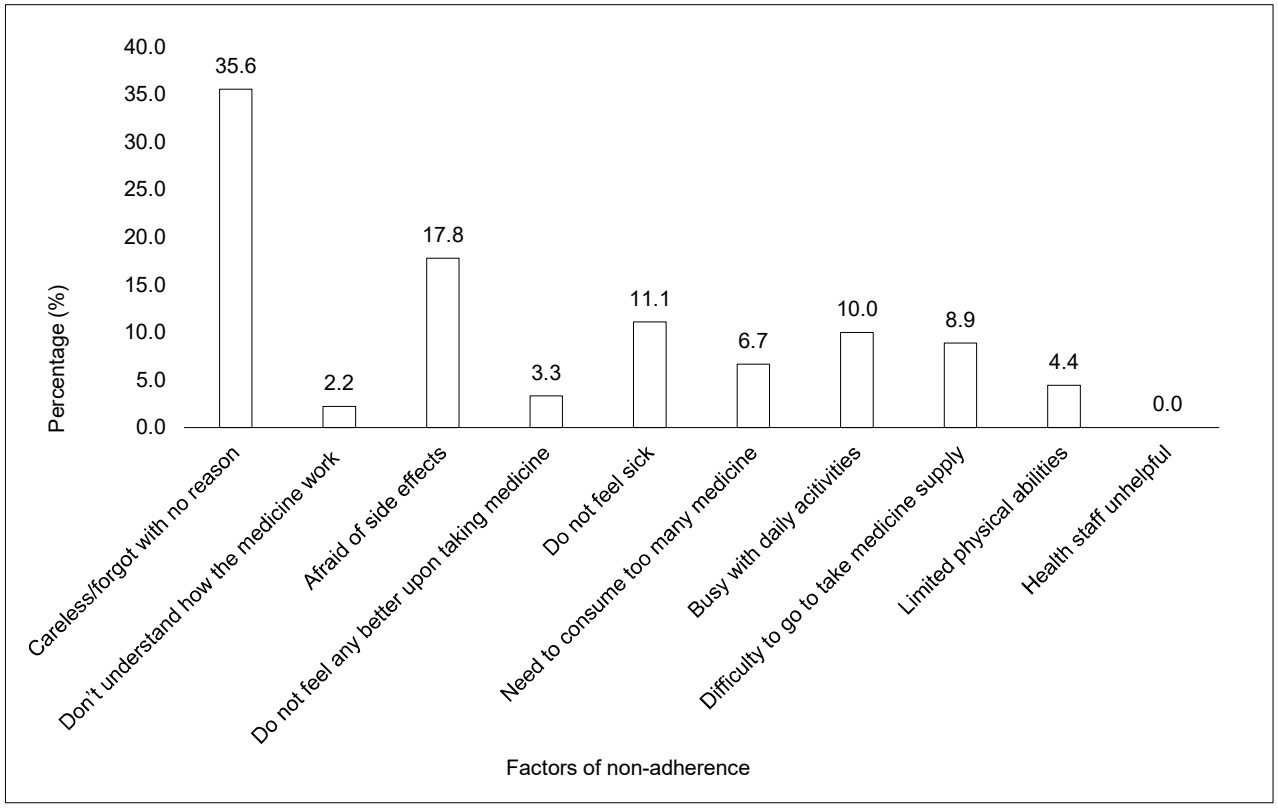


Figure 2: Level of perceived importance on different features in the app

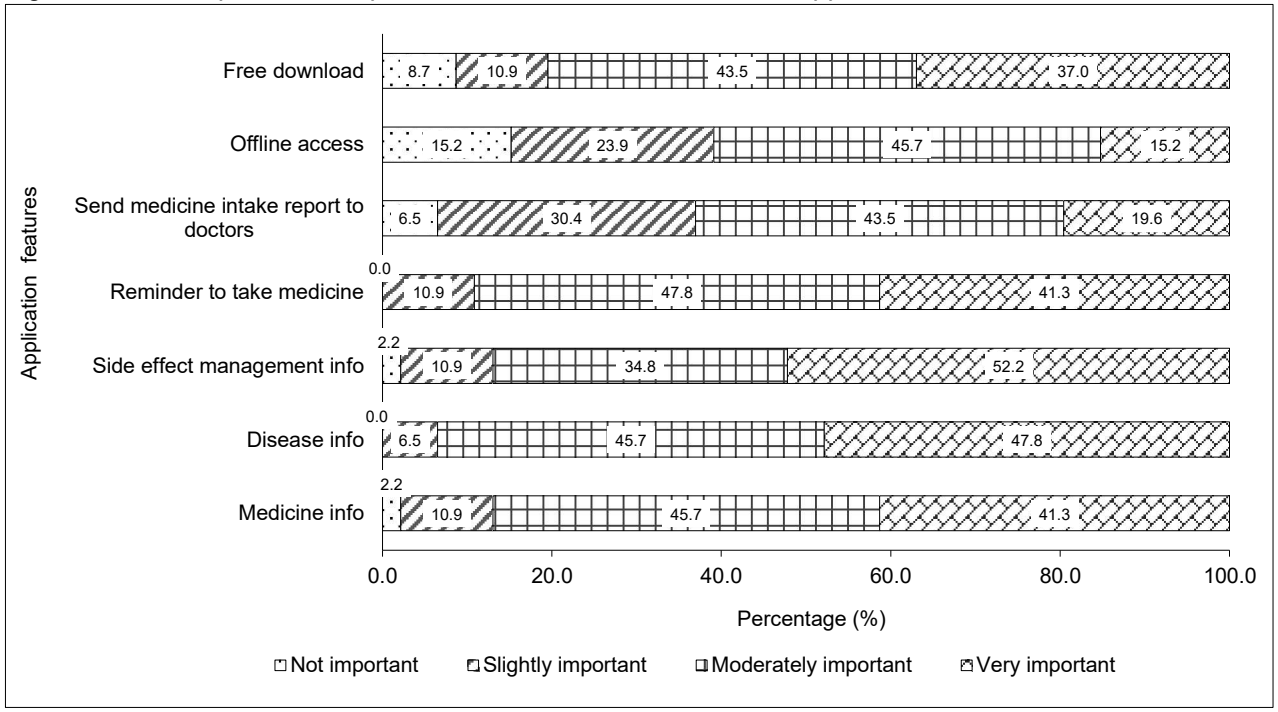
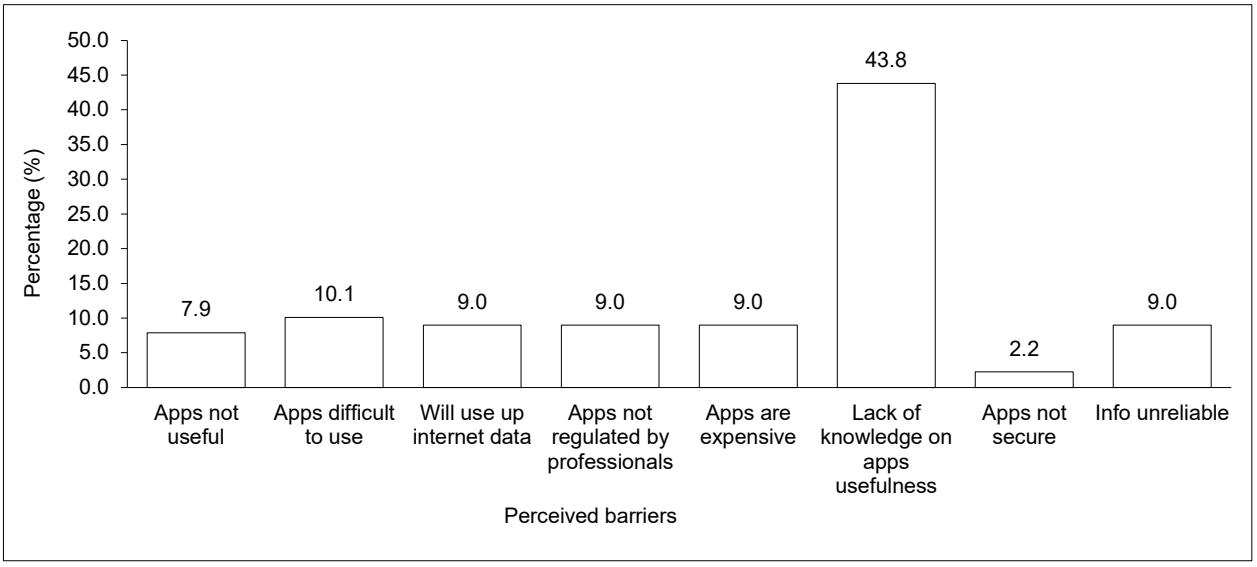


Figure 3: Perceived barriers among the respondents in using the app



Discussion

In this study, it was found that forgetfulness or carelessness were the most common factors causing non-adherence and this was consistent with the reviews by Jin (15). Hence, the reminder and side effect monitoring features were found to be among the most important features of interest among the respondents. It was also found that patients who lived in the cities who needed to take at least five medicines daily and heavy smartphone users are more likely to download the app to help to improve their compliance. However, the lack of exposure to the usefulness of the app were perceived as a barrier to use the app in real life by most of the respondents.

Smartphone intervention is the new, cutting-edge method in assisting adherence and to date, was proven to show promising results in some small-scale studies (17). However, this study found that only approximately 15% of the respondents knew about the existence of medication adherence apps. This might be due to most of the patients were satisfied or comfortable with the conventional adherence strategies which made them less interested in trying any new approach.

Nevertheless, this study also found good level of interest among the respondents especially in those from urban areas and considered as heavy phone users with many medicine intakes. One of the previous studies also showed that increasing number of prescribed medicines was associated with the higher intensity of using medication apps (18). This was probably because they need a more practical way to keep track with their therapy plan and smartphone seem to provide the best platform to improve medicine adherence in their hectic life (19). Hence, patients with these demographic backgrounds were good predictors for medication adherence application intervention.

The level of importance of application features in our questionnaire were adopted from a study conducted in Singapore (20). The findings from this study showed an urge to design a viable medication adherence application that includes information on disease, medicines and self-management of side effects. This can be classified as educational interventions (20). Therefore, a database of different diseases categorized in different classes of discipline like cardiovascular, neurological and oncology should be created to provide the end users with sufficient amount of information regarding each disease. Therefore, a database of medicine details like dosages, indication, common side effects and ways to manage should be included in the application to promote better understandings on how different medicines help patients to control their diseases as well as self-management of different side effects.

The findings from this study also indicated that the reminder feature was also considered to be a necessity in the app. Several previous studies also showed higher demand from users for this feature (20-23). This indicated the heavy reliance of people to reminder-based system in medication adherence apps which could relate closely to better adherence. A review was conducted to identify high quality adherence application and it was found that the application equipped with various effective reminder systems like

missed dose reminder or “snooze” feature, next medicine collection reminder and doctor appointment reminder were more clinically relevant for adherence intervention (24).

However, it was alarming to discover that most people do not want to send their medication intake history to healthcare professionals. The same result was also reflected in another smartphone app intervention study in Singapore (20). One possible explanation is that they want to prevent from being nagged by the doctors or pharmacists on the procrastination habits in taking their medicine. Others might feel demotivated upon seeing unsatisfactory adherence rate in the records which may lead to the loss of interest in taking their medicines. Some people could be over protective with their personal information which made them to decide not to share with anybody. Moreover, patients might have overlooked the usefulness of enabling health professionals’ monitoring, in terms of improving their adherence levels (25). Despite the low perceived importance of this feature, the ability to produce reports on monthly medicine intake is very important as this greatly provides healthcare staffs on the adherence level of patient that usually correlates to disease management. Therefore, app developers should include this feature if they want to create a more clinically relevant app.

The offline access feature is deemed to be least important which might indicate that most people nowadays have stable internet connection every day. Hence, this feature could be considered as redundant. This might be advantageous as app developer might not need to prepare offline database of all the information. Besides, it is possible to link the additional info to established health-based websites like WebMD. Hence, possible partnership with existing health websites might reduce the burden of app developer in fulfilling demands on information database of the app.

The perceived difficulty in using and the lack of knowledge about the usefulness of apps for medication adherence were the main reasons given by the participants for their disinterest in adopting an adherence app. This was consistent with theories of technology adoption. According to the technology acceptance model, perceived usefulness and ease of use greatly influence the acceptance and adoption of technology (26). These findings implied that app developers should consider user-centred approaches in designing adherence apps that are more age sensitive and user friendly.

It was surprising that most of our respondents did not find the security of the app important. This might be due to the underestimation on the need of data security as they were not fully aware about the possibility of privacy breach and misuse of health data from non-secured electronic data keeping and sharing (27). Some possible explanation was the thought that the revelation of their personal data to third party is insignificant as there were no perceived detriments to them, i.e. no harm to them if anyone knows about their health status (28). Nevertheless, the risk of unauthorized access to these information remains as potential violation towards one’s privacy. Therefore, it is advisable that app developer include a trustable security system in the app to make the app reliable and more trustable.

Data in this study were gathered from a convenience sample at a single institution, which could limit generalizability of the results. A small number of participants was obtained for the study, hence it could not represent the true population in the country. Furthermore, limited statistical test can be conducted using these limited data, thus reducing the impact of the study. As the target group of the study including elderly people, high rejection rate of questionnaire was observed from 50 years old and above respondents. This could be due to the lack of interest of the senior citizens towards technology mediated adherence aids which led them to leave some of the major sections in the questionnaire completely blank.

Conclusion

Smartphone intervention should be introduced as the new mainstay of adherence improvement among the patients due to its cheaper cost, portability and unlimited seamless access. Regardless of the limitation, this study provided an insight of what people desire in a medication adherence app. As the common non-adherence reason was forgetfulness, app providers should design an app that can overcome forgetfulness using a wide range of reminder system. Besides, to promote more active involvement in the disease management, database of information about disease, medicine and self-management tools should be included in the app. Massive efforts in promoting the potential benefits of medication adherence app is very much needed to provide better knowledge on the practicality of this new adherence tool.

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Conflict of Interest Statement
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