Original Article

Patients' attitudes towards mobile health in Singapore: a cross-sectional study

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Background: Smartphone-mediated mobile health (mHealth) has the potential to assist patients with medication adherence and disease monitoring. This study aimed to describe the awareness and usage of, and attitudes towards, mHealth among smartphone-owning patients in a tertiary hospital in Singapore.

Methods: A self-administered cross-sectional survey was systematically offered to patients at the Singapore General Hospital from August to September 2018. Participants were included if they were at least 18 years old, owned a smartphone, and could speak and read simple English. No identifiable data was collected. Responses were summarized using descriptive statistics. Multiple logistic regression analysis was used to identify factors associated with awareness and usage of, and attitudes towards, mHealth.

Results: Four-hundred and two eligible responses were received, with most participants reporting having completed tertiary education (63.7%) and having chronic medical conditions (71.1%), with a mean age of about 43 years. On average, participants were aware of 3.7 out of 7 mHealth functions and used 1.9 functions. Most patients were aware that smartphones could be used for general health/fitness tracking, obtaining health information, and appointment management. Most (76.3%) participants were keen to learn to use mHealth in future, and 63.2% agreed that mHealth could help them better manage their health.

Conclusions: Although mHealth usage among patients was low, most patients held positive attitudes towards mHealth. For mHealth to fulfill its potential, strategies to improve the awareness and usage among patients need to be explored.

Keywords: Mobile health; Singapore; smartphone; health knowledge, attitudes, practice

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Introduction

Mobile health (mHealth) refers to medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants, and other wireless devices (1). Although a relatively new concept, some studies have demonstrated that mHealth helps to improve the management of chronic diseases such as diabetes, hypertension and asthma through lifestyle management, medication adherence and engagement in self-care (2-7). Mobile health solutions, which could be as simple as automated text message reminders, are potentially low cost and scalable (8-10). Although improvements in long-term clinical outcomes have yet to be clearly demonstrated, the evidence supports that mHealth can empower patients and potentially improve health outcomes (11).

Singapore is a multicultural city state in South East

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Asia (population: 5.6 million) with an efficient and technology-driven public healthcare system (12-14). It has one of the highest mobile phone penetrations (147.3% in August 2018) in the world, with an estimated 76% of the population using smartphones (15,16). According to the World Health Organization's 3rd Global Survey on eHealth, most mHealth program types were already established in Singapore (17). Furthermore, Singapore, like many developed countries, is facing the impending challenges of an ageing population with an increasing prevalence of chronic diseases (18). Therefore, effective implementation of mHealth programs could assist in tackling some of these challenges proactively through active prevention and care integration.

Apart from the technical prerequisites, cultural practices and attitudes influence the successful adoption and implementation of new technologies and innovations. In Singapore, previous studies have been done regarding specific app-based interventions or among defined patient groups, for example type 2 diabetes mellitus patients, coronary heart disease patients, and patients on oral anticancer medications (19-22). Little is known about the usage patterns and attitudes towards smartphone-mediated mHealth among patients in general. For example, it is difficult to find reliable estimates for the proportion of patients who are aware of mHealth interventions and use them.

A previous study by our research team identified generally positive attitudes towards mHealth amongst the general population, albeit with relatively low mHealth usage (as might be expected of generally young and healthy participants) (23). Managing appointments, and fitness and diet tracking were the most popular mHealth functions in terms of both awareness and usage. That said, the awareness and usage patterns among patients are expected to be different. Furthermore, as patients are the users who might benefit the most from mHealth, it is important to understand their attitudes towards mHealth.

This study aims to describe current knowledge, practices and attitudes towards mHealth among patients at a tertiary hospital in Singapore who own a smartphone. It also attempts to identify factors that influence the above in the study population. Acknowledging and understanding these attitudes and behaviors will allow future mHealth solutions to be optimized to realize the benefits of mHealth in Singapore and similar societies.

Methods

Study design

The study was a cross-sectional survey of patients who visited the outpatient and discharge pharmacies in Singapore General Hospital (SGH), across a 3-week period in August and September 2018. Patients who were 18 years and above, owned a smartphone and able to speak and read English were eligible for the study. Patients were systematically offered participation in this study, according to their queue number.

After obtaining verbal informed consent, a self-administered questionnaire was handed to the participant. Recruitment continued until a target of 400 eligible responses were received. As participation in the study was voluntary and no identifiable information was collected, exemption from full Institutional Review Board review was granted.

Survey development & pretesting

The survey instrument was modified from the one used in a prior study assessing public attitudes towards mHealth (23). The survey instrument included multiple choices, modified Likert scales, and yes/no questions. The survey was originally developed based on tools used in similar cross-sectional studies pertaining to mHealth, though discretion was exercised to ensure relevance to a Singapore context. mHealth functions were grouped broadly into 7 categories, which were adapted from categories used in the WHO's 3rd Global Survey on eHealth: managing appointments, accessing health records, health information/education, general health and fitness tracking, disease monitoring, medication management, and contacting healthcare professionals.

Survey questions were organized into 4 sections: (I) participant demographics, and background information; (II) baseline general smartphone usage; (III) awareness and usage of mHealth functions; and (IV) attitudes towards mHealth in general, and factors influencing receptivity towards mHealth apps. Simplicity was a guiding principle, to ensure that participants with a basic understanding of written English (equivalent to an elementary level) would be able to understand and complete the survey in 10 minutes with minimal assistance.

The proposed survey instrument was pretested with

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fifty participants (including middle-aged and elderly participants). Modifications were made based on feedback to improve ease of understanding. The final survey took the form of a 6-page printed questionnaire.

Participants & survey administration

Patients presenting to both inpatient (discharge) and outpatient pharmacies (i.e., collecting medications for themselves) were systematically sampled based on their queue numbers. The study objectives and risks were explained to potential participants by a study team member. Participants who agreed were then handed a printed questionnaire and were encouraged to submit the completed questionnaire into a drop-box before leaving the pharmacy. The target recruitment was set at 400 completed questionnaires, with about 10% from the discharge pharmacy (proportionate to the number of patients discharged relative to number of specialist outpatient attendances to the hospital).

Statistical analysis

Descriptive statistics for categorical data were reported using frequencies and percentages. Subgroup analyses were conducted based on responses to section (I) of the survey (demographics and background smartphone usage), to assess whether they had an influence on responses on sections (II) to (IV) of the survey (awareness and usage of, and attitudes towards, mHealth). Responses for sections (II), (III), and (IV) were converted to numerical scores for each participant, and their means were compared between subgroups. For example, mHealth awareness was scored based on the number of "yes" responses across the 7 categories to derive a score out of 7.

Univariate dichotomous subgroup analyses were conducted using the Mann-Whitney U test to compare mean scores across responses, and Pearson's chi-squared test to compare proportions. Factors identified as statistically significant were then compared using a multiple logistic regression to identify the factors that were independently associated with the outcomes after adjustment. All tests were two-sided and a P value of <0.05 was considered statistically significant. As subgroup analyses were considered hypothesis-generating, no adjustments were made for multiple comparisons. Data analyses were performed with SPSS Statistics Version 25.0 for Mac OS (SPSS Inc., Chicago, IL, USA).

Results

Participant characteristics

Six-hundred and ninety-two patients were approached, of whom 402 participants met the inclusion criteria and agreed to participate. The mean age of patients was 42.6 years old. Majority of them were Chinese, completed tertiary education, employed and lived in public housing. Most patients reported having at least 1 chronic medical condition (71.1%) and were taking regular medications (74.1%). Only a minority (3.2%) reported having at least 4 chronic conditions, and about a third of the patients reported having been hospitalized in the past year. About a third of the patients reported taking health supplements regularly, and only a minority reported taking traditional medicines (in this context, referring to forms of alternative or complementary medicine such as traditional Chinese herbal medicine, and acupuncture) regularly (*Table 1*).

Only patients who owned smartphones were recruited to participate in the study. Of the participants, all reported being able to independently make calls or use short message service (SMS). On average, each participant reported using 6.7 out of 8 smartphone functions listed in the survey (i.e., smartphone usage score) (*Table 2*). More than half of the patients (62.4%) used ≥7 of the 8 smartphone functions listed in the questionnaire.

The most popular sources from which patients reported obtaining health information were 'website/internet/online sources' (72.9%), 'Newspaper, magazines and other printed materials' (51.0%) and 'Healthcare providers' (49.5%).

General mHealth awareness, usage, and attitudes

General health and fitness tracking (83.1%), health information and education (78.4%), and managing appointments (75.1%) were the mHealth functions with the highest awareness among participants. A minority of patients were aware of disease monitoring (34.6%) and medication management (23.4%) as mHealth functions. The mean (SD) mHealth awareness score (out of 7) was 3.7 (1.9) (*Table 3*).

Likewise, with mHealth usage, health information and education, general health and fitness tracking, and managing appointments (41.0%), were the most used functions. Only a minority of participants reported using smartphones for disease monitoring and medication management. The mean (SD) mHealth usage score (out of 7) was 1.9 (1.6) (*Table 3*).

All of the participants were asked whether they felt

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Table 1 Baseline demographic & medical characteristics of participants

Characteristics	Respondents (%)[†] (n=402)
Demographic	
Survey location	
Outpatient pharmacies	362 (90.0)
Discharge pharmacy	40 (10.0)
Sex	
Male	193 (48.0)
Female	209 (52.0)
Age (years), mean ± SD	42.6±13.0
Ethnicity	
Chinese	255 (63.4)
Malay	72 (17.9)
Indian	51 (12.7)
Others, or not reported	24 (6.0)
Languages (spoken)	
English	402 (100.0)
Mandarin	252 (62.7)
Malay	51 (12.7)
Tamil	31 (7.7)
Marital status	
Single	138 (34.3)
Married	246 (61.2)
Divorced	9 (2.2)
Widowed	9 (2.2)
Employment status	
Employed (full-time)	315 (78.4)
Employed (part-time)	21 (5.2)
Unemployed/retired	66 (16.4)
Educational level	
Degree/diploma	256 (63.7)
Secondary or pre-university	123 (30.6)
Primary or below	23 (5.7)
Residential status	
Public housing	338 (84.1)
Private housing	64 (15.9)
Medical	
Chronic conditions	
None	116 (28.9)
1 to 3	273 (67.9)
4 or more	13 (3.2)
Hospitalizations (in the past year)	
None	265 (65.9)
1 to 2	115 (28.6)
3 or more	22 (5.5)
Chronic disease visits (per year), n=286[‡]	
Up to 2	118 (41.3)
3 to 4	128 (44.8)
5 or more	40 (14.0)
Regular medications (daily)	
None	104 (25.9)
1 to 3	222 (55.2)
4 or more	76 (18.9)
Compliance, n=298[§]	
Always/usually	281 (94.3)
Sometimes/rarely	17 (5.7)
Others (regular)	
Traditional medicines use	41 (10.2)
Health supplements use	143 (35.6)

[†], unless otherwise specified; [‡], only including participants reporting chronic conditions; [§], only among participants who reported taking regular medications.

each of the seven functions were useful, and these were then converted to 'usefulness' scores (out of 1) to allow for comparison (very useful: 1 point; somewhat useful: 0.5 point; not useful at all: 0 points). Managing appointments had the highest overall usefulness score (0.81), followed by health information and education (0.75), and general health and fitness tracking (0.73). Medication management had the lowest usefulness score (0.63), with only 35.1% of respondents considering it to be very useful. On average, the mean mHealth usefulness score across all seven

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functions was 0.70 (*Table 4*).

Participants were asked to rate how much they agreed or disagreed with a series of five statements to assess some of their attitudes towards mHealth. Most of the patients were keen to learn and try mHealth in the future (73.6%). In addition, over half of patients agreed that mHealth could help them manage their health better (63.2%) and improve communication with healthcare providers (62.4%). Similarly, 56.5% of patients were keen to share their health data with their family members and 60.7% were keen to do so with their healthcare providers (*Table 5*).

Table 2 Baseline smartphone usage characteristics of participants

Baseline smartphone usage	Respondents (%) (n=402)
Smartphone use	
Sending & receiving E-mails	359 (89.3)
Alarms & time management	378 (94.0)
Entertainment	369 (91.8)
Social media/communication apps	389 (96.8)
Reading news	300 (74.6)
Online shopping/ordering	248 (61.7)
Transport & navigation	350 (87.1)
Banking & electronic payments	278 (69.2)
Use score (out of 8), mean ± SD	6.7±1.6

The "smartphone use score" is a count of the number of functions (out of the 8 surveyed) a respondent regularly (and independently) uses his or her smartphone for. Also, all participants surveyed reported being able to make calls or send text messages independently.

Participants were also asked to rate how important they felt six features were in influencing their receptivity to using mHealth. Majority of patients felt that data security and privacy (89.6%), reliability (60.9%), and being easy to learn (83.1%) were very important. Only a minority of participants felt that way about automatic login (36.3%), which referred to the absence of further authentication at the point of starting an application (such as reentry of passwords, pins, or fingerprint recognition), excluding the initial set-up (*Table 6*).

Factors influencing mHealth awareness, usage, and attitudes

Univariate analyses suggested that higher mHealth awareness scores (out of 7) were associated with age below 50 years (3.92 *vs.* 3.20, P<0.001), having completed tertiary education (3.88 *vs.* 3.32, P=0.006), and having a smartphone use score ≥7 (4.05 *vs.* 3.59, P<0.001). After adjustment using binary logistic regression, only a higher smartphone use score was significantly associated with an awareness score of at least 4 (OR: 1.43, P<0.001). Age and education were no longer statistically significant (*Table* 7).

Univariate analyses suggested that higher mHealth usage scores (out of 7) were associated with age below 50 years (2.13 *vs.* 1.38, P<0.001), being employed (1.93 *vs.* 1.56, P=0.018), having completed tertiary education (2.20 *vs.* 1.29, P<0.001), and having a smartphone use score ≥7 (2.26 *vs.* 1.21, P<0.001). After adjustment using binary logistic regression, only a higher smartphone use score (OR: 1.73, P<0.001), was significantly associated with a mHealth usage score of at least 2 (*Table* 7).

Table 3 Mobile health awareness and usage among participants (n=402)

Mobile health functions	Awareness, n (%)[†]	Usage, n (%[‡])[†]
Managing appointments	302 (75.1)	165 (54.6)
Accessing health records	166 (41.3)	57 (34.3)
Health information or education	315 (78.4)	243 (77.1)
General health and fitness tracking	334 (83.1)	169 (50.6)
Disease monitoring	139 (34.6)	47 (33.8)
Medication management	94 (23.4)	22 (23.4)
Contacting or consulting healthcare providers	127 (31.6)	48 (37.8)
Average score (out of 7), mean ± SD	3.7±1.9	1.9±1.6

[†], unless otherwise specified; [‡], usage percentage reported as proportion of participants who were aware of that specific mHealth function. Respondents who declared being unaware of a specific function were defaulted to 'non-users'.

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Table 4 Participants' perceived usefulness of mobile health

Mobile health attitudes	Not useful at all†	Somewhat useful†	Very useful†	Usefulness score‡
Managing appointments	17 (4.2)	119 (29.6)	266 (66.2)	0.81
Accessing health records	42 (10.4)	161 (40.0)	199 (49.5)	0.70
Health information and education	15 (3.7)	168 (41.8)	219 (54.5)	0.75
General health and fitness tracking	14 (3.5)	188 (46.8)	200 (49.7)	0.73
Disease monitoring	24 (6.0)	209 (52.0)	169 (42.0)	0.68
Medication management	33 (8.2)	228 (56.7)	141 (35.1)	0.63
Contacting healthcare providers	33 (8.2)	185 (46.0)	184 (45.8)	0.69
Mean ± SD‡				0.71±0.06

†, reported as n (%); ‡, the 'usefulness score' is a weighted average computed by assigning scores of 0, 0.5, or 1 to the possible responses ("not useful at all", "somewhat useful", and "very useful" respectively). A higher score implies a more favourable attitude towards the usefulness of the specific mHealth function. The mean usefulness score of all the functions is a measure for participants' attitude towards usefulness of mHealth in general.

Table 5 Participants' attitudes towards mobile health

Statements	Disagree†	Neither†	Agree†	Score‡
Mobile health can help me better manage my health	8 (2.0)	140 (34.8)	254 (63.2)	0.81
I am keen to learn about and try new mobile health solutions in future	7 (1.7)	99 (24.6)	296 (73.6)	0.86
Mobile health can help me communicate better with my healthcare providers	9 (2.2)	142 (35.3)	251 (62.4)	0.80
I would be keen to share my health data with my immediate family members	41 (10.2)	134 (33.3)	227 (56.5)	0.73
I would be keen to share my health data with healthcare providers	26 (6.5)	132 (32.8)	244 (60.7)	0.77

†, reported as n (%); ‡, this score is a weighted average computed by assigning scores of 0, 0.5, or 1 to the possible responses ("disagree", "neither agree nor disagree", and "agree" respectively). A higher score implies a higher level of agreement with the statement.

Table 6 Factors influencing participants' receptiveness to using mobile health solutions

Factors	Not important at all†	Somewhat important†	Very important†	Importance score‡
Free to download and use	14 (3.5)	85 (21.1)	303 (75.4)	0.86
Simple interface	6 (1.5)	75 (18.7)	321 (79.9)	0.89
Easy to learn	3 (0.7)	65 (16.2)	334 (83.1)	0.91
Multiple language support	26 (6.5)	130 (32.3)	246 (61.2)	0.77
Data security & privacy	3 (0.7)	39 (9.7)	360 (89.6)	0.94
Rewards for using	108 (26.9)	178 (44.3)	116 (28.9)	0.51
Automatic login	86 (21.4)	170 (42.3)	146 (36.3)	0.57
Reliability	4 (1.0)	53 (13.2)	245 (60.9)	0.92

†, reported as n (%); ‡, the 'importance score' is a weighted average computed by assigning scores of 0, 0.5, or 1 to the possible responses ("not important at all", "somewhat important", and "very important" respectively). A higher score implies more importance ascribed to that factor by respondents collectively.

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Table 7 Logistic regression analysis of factors influencing awareness, usage, and attitudes towards mHealth

Outcome	Factors[†]	OR	P value
mHealth awareness score ≥4 (out of 7) (n=200)	Age (years)[‡]	1.00	0.961
	Education (diploma/degree)	0.95	0.817
	Smartphone use score[‡]	1.43	<0.001
mHealth usage score ≥2 (out of 7) (n=132)	Age (years)[‡]	1.00	0.781
	Employment	1.16	0.674
	Education (diploma/degree)	1.61	0.091
	Housing (private)	1.46	0.208
	Smartphone use score[‡]	1.73	<0.001
mHealth usefulness score >0.75 (out of 1) (n=182)	Education (diploma/degree)	1.63	0.021
Agree that mHealth can help better manage health (n=254)	Sex (male)	1.63	0.024
	Education (diploma/degree)	1.27	0.330
	Chronic medical conditions	0.85	0.537
	Chronic medications (4 or more)	0.55	0.034
	Smartphone use score[‡]	1.15	0.054
Keen to learn about and try new mHealth solutions in future (n=296)	Education (diploma/degree)	1.29	0.321
	Smartphone use score[‡]	1.20	0.016
Agree that mHealth can help communicate better with healthcare providers (n=251)	Education (diploma/degree)	1.62	0.043
	Smartphone use score[‡]	1.16	0.043
	Traditional medicines use	3.18	0.008
Would be keen to share health data with immediate family members (n=227)	Age	1.01	0.130
	Education (diploma/degree)	0.61	0.030
	Health supplements use	1.98	0.002
Would be keen to share health data with healthcare providers (n=244)	Education (diploma/degree)	0.65	0.047

[†], only factors identified as statistically significant in univariate analysis were included in the multiple logistic regression models. Subsequently, P values <0.05 were considered statistically significant (factors in bold). Odds-ratio (OR) >1 implies a positive relationship with the outcome, OR <1 implies a negative relationship with the outcome; [‡], for age and smartphone use score, the ORs are in relation to a one unit increase in the factor (i.e., a 1 year increase in age, or a 1 unit increase in smartphone use score).

After adjustment, male participants were more likely to agree that mHealth could help them better manage their health (OR: 1.63, P=0.024), but participants with 4 or more chronic medications per day were less likely to agree (OR: 0.55, P=0.034). Participants with higher smartphone use scores (OR: 1.20, P=0.016), were more likely to be receptive to learning or trying mHealth in future. Users of traditional medicines, participants with tertiary education, and those with higher smartphone use scores were all more likely to agree that mHealth could help them communicate better with healthcare providers. Participants with tertiary education were more likely to assign higher usefulness scores to mHealth, but less likely to be keen to share their health data with family members and healthcare providers. Users of health supplement were more likely to be keen to share their health data with their family members (*Table* 7).

Discussion

The systematic sampling process obtained a diverse sample of smartphone-owning patients at a tertiary hospital in Singapore. The sample included roughly equal proportions

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of male and female patients (with median & mean age of about 42 years), and a representative proportion of ethnic minorities in Singapore. The participants used a mean of 6.7 out of 8 smartphone functions (median 7), suggesting a generally high baseline familiarity with smartphones.

The participants reported relatively low awareness (mean 3.7 of 7 functions) and usage (mean 1.9 of 7 functions) of mHealth. In our earlier study among the public, these figures were 4.4 and 2.2, respectively. Most patients were aware of appointment management, general health and fitness tracking, and health information/education functions. Using smartphones to access health information was the most used function (about 60 % of all patients reported doing so). This suggests patients are generally comfortable seeking health information online today – although previous studies have highlighted some barriers to this (24,25).

On the other hand, the use of smartphones for disease monitoring, contacting or consulting healthcare providers (e.g., telemedicine, tele-pharmacy etc.), and especially medication management had very low usage. Among those who were aware of those mHealth functions, only between a quarter to a third of them reported using them. This suggests a disconnect between the intentions of tool creators, and actual usage by patients for whom such tools are ostensibly designed. This observation could also reflect the lack of integration of mHealth into routine care by healthcare professionals. A recent study among elderly patients with cardiovascular diseases (CVD) in Singapore identified usability concerns and perceived lack of need as barriers to acceptance of mHealth medication adherence tools (22). Similar barriers were reported among patients on oral chemotherapy (21).

On top of barriers to usage, our results identify a clear awareness gap among patients (regardless of age) about such apps. Only about a third of the patients were aware of disease monitoring, and less than a quarter were aware of medication management. Given that poor adherence or disease management is a common problem among patients with chronic diseases, we believe that there is a need to increase awareness of mHealth among these patients through various channels. Healthcare professionals especially have an important role to play in understanding the landscape and advising their patients on which mHealth solutions might be suitable for them.

Of note, patients with a least 4 chronic medications were less likely to agree that mHealth had the potential to help them better manage their health. Although well-designed studies have demonstrated some benefits of mHealth in short-term outcomes, improvements in long-term clinically important outcomes are still lacking (11,26,27). It is imperative for the digital health industry to find ways to add and demonstrate real value to patients. Further research on patients with relatively complex medical issues may be necessary in this regard.

We attempted to identify factors that influenced awareness and usage of mHealth. However, we did not find any demographic factors that influenced either per se. Only their baseline smartphone use behaviors were independently associated with both – other demographic factors (education and age, in particular) were presumably covariates. Our findings agree with a study conducted among patients with CVD in China, which concluded that information technology skill was the only factor independently influencing willingness to use mHealth (28).

Participants with tertiary education were more likely to perceive mHealth as useful. An exploratory analysis of our results suggests that participants who rated mHealth as more useful were associated with higher mHealth awareness and usage. According to the technology acceptance model, perceived usefulness contributes to intention to use, and thus influences actual use (29). As such, our cross-sectional study design does not allow for exploring this relationship beyond a superficial level. A study specifically looking at mHealth users and how their attitudes have changed before and after using mHealth could shed more light on this.

In this current climate where technology corporations have access to vast amounts of personal information, and recent high-profile cases of health data security breaches (including in Singapore), it is perhaps unsurprising that data privacy and security was rated as very important in influencing receptiveness towards mHealth by most patients (about 90%). This concern is a widely acknowledged one and requires collaborative solutions between healthcare providers, regulatory authorities, and the industry (30). The Singapore Ministry of Health Licensing Experimentation and Adaptation Programme, a regulatory sandbox, is one such example of a collaborative approach that aims to ensure the risks of mHealth (starting with telemedicine) are mitigated while still allowing for innovative care models to evolve (31).

Despite the low awareness and usage (coupled with low perceived usefulness of some mHealth functions), we identified some positive attitudes towards mHealth. About 63% of patients believed mHealth could help them manage their health better and improve communication

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with their healthcare providers. Furthermore, almost three quarters of the patients reported being keen to learn about and try mHealth solutions in future. We are hopeful that despite the barriers, with collaborative evidence-based mHealth development, innovative marketing, and effective regulation, the potential benefits of mHealth can be realized.

This study has several key limitations. Firstly, as the questionnaire was self-administered, the responses would be affected by differences in patients' interpretations, and there was no means to verify whether their answers were accurate. Secondly, the survey instrument used has not been independently validated. Finally, the results may not be generalizable to patients in the primary care setting, or to non-English speaking patients.

Conclusions

In conclusion, this cross-sectional survey reported on the awareness and usage of mHealth among smartphone-owning patients in a tertiary hospital in Singapore. Patients had relatively low awareness and usage of mHealth, particularly regarding disease monitoring and medication management. However, patients held some positive attitudes towards the potential of mHealth, suggesting an opportunity exists to improve usage by increasing awareness and demonstrating the usefulness of mHealth in Singapore.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

Ethical Statement: As participation in the study was voluntary and no identifiable information was collected, exemption from full Institutional Review Board review was granted (CIRB Ref: 2017/2906). Informed consent was obtained by the study investigators for all participants. The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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