

Acceptance of Information and Communication Technologies for Healthcare Delivery: A SingHealth Polyclinics Study

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Abstract

Objective: This study aimed to determine the prevalence of short message system (SMS) and internet usage in patients visiting the SingHealth Polyclinics and to measure patients' acceptance of using these technologies in healthcare delivery. **Materials and Methods:** A representative sample of patients visiting the 9 SingHealth Polyclinics were interviewed in-person by trained medical students. Collected information included demographic characteristics, access to and usage of mobile phone/SMS and internet, as well as acceptance and concerns on using these technologies in primary healthcare delivery. **Results:** Among 705 patients surveyed (mean age: 54.6 years, female: 50.6%, response rate: 92%), 407 (57.7%) were SMS users and 158 (22.4%) were internet users. Two hundred and eighty-four of 412 SMS and/or internet users (40.3% of the entire sample) were comfortable with the use of these technologies in healthcare delivery. Malay or Indian ethnicity, better education, and visiting the clinic for acute symptoms or screening were factors positively associated with willingness to use such technologies. The main concerns associated with the use of SMS and internet in healthcare delivery were preference for in-person consultation with a doctor (23.5%), reduced patient-doctor interaction (23.0%), and increased healthcare cost (20.8%). **Conclusion:** The present prevalence of SMS and internet usage among patients visiting the SingHealth Polyclinics and their concerns towards use of these technologies in healthcare delivery do not support current widespread implementation of services entailing SMS and internet in the study sites.

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Key words: Information and communication technology, Internet, SMS, Singapore

Introduction

Information and communication technologies, such as internet portal and short message system (SMS), are increasingly used in healthcare delivery worldwide.^{1,2} Typically, these technologies are used to facilitate or enhance communication and exchange of information between patients and doctors or other health professionals. Both healthcare consumers and providers can benefit from these new technologies. For patients and their caregivers, these technologies have the potential to save time and money, increase convenience and choices, obtain timely information, and reduce stigma associated with certain diseases.³ For health providers, a great attraction of these new technologies is reduction in health services costs. By

delivering health services through internet or SMS, costs for conducting population-based health programmes can be lowered, unnecessary encounters between patients and their doctors can be reduced, and management of patients in isolated or remote areas would be less expensive.¹ Moreover, appropriate use of these technologies can also improve the quality and efficiency of health services. For example, there were studies showing that SMS reminders increased outpatient attendance^{4,5} and patient satisfaction.⁴

In Singapore, internet and SMS technologies are also beginning to play a role in the way healthcare is delivered. Internet has been used as a means to disseminate health services information. The Ministry of Health website periodically publicises the sizes of hospital bills. In

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Singapore Health Services (SingHealth), 2 medical education websites (i.e. Interactive Patient Guide and Health-4-U) have been developed,^{6,7} MyTelecare.com.sg has been set up for monitoring outpatients with chronic diseases,⁸ and the Singhealth Polyclinic Queue Watch provides patients with an online monitor of the waiting areas in all of the SingHealth Polyclinics.⁹ SMS has also been used in healthcare delivery. Examples are communication with caregivers of patients admitted to ICU of the National University Hospital (NUH) and management of patients with hypertension in the SingHealth Polyclinics.¹⁰

In spite of these developments, there are concerns and uncertainties in implementing new information and communication technologies in the healthcare setting in Singapore. The concerns include Singapore's ability to design and implement such technologies in healthcare delivery, and more importantly, the acceptance of the service users.¹⁰ Since such technologies will change the traditional way healthcare is being delivered, issues such as quality and continuity of care, the validity, consistency and privacy of information, as well as physician-patient relationship may surface as major areas of concern.¹¹

More fundamentally, the access to and knowledge of such technologies among users of health services is crucial for successful implementation of these new technologies. The essential infrastructure for new information and communication technologies in Singapore is well established and new information and communication play an important role in our daily living and commercial services. The use of mobile phone and internet services is highly prevalent among Singaporeans.¹² To the best of our knowledge, however, no information is available on the prevalence of internet and SMS usage among local healthcare services users and their willingness to use such technologies in the healthcare setting. Such information would be useful to assess the feasibility and acceptability of future healthcare services in which providers hope to use new technologies to either lower cost or improve efficiency.

The purpose of the present study was to survey the routine use of internet and SMS among patients who visited the SingHealth Polyclinics and measure their willingness and concerns for the use of these technologies in healthcare delivery. Results from our study would be useful in the planning and implementation of information and communication technologies in primary healthcare delivery in Singapore.

Materials and Methods

Study Population

This study was a cross-sectional survey of patients who visited SingHealth Polyclinics in Singapore. Among all

adult patients who went to any of the 9 SingHealth Polyclinics for consultation during the period from 11 to 17 January 2008, 1 in every 30 consecutive patients was systematically sampled and invited to participate in this study. Patients who were below 21 years of age or had disability that precluded participation (e.g. cognitive impairment) were excluded.

The interviews were conducted by 38 medical students who worked in small groups covering all the 9 clinics. Training sessions were conducted to standardise the administration of the questionnaire and minimise interviewer-bias. After providing informed consent, each participant was interviewed in the waiting area of the clinics using a standardised questionnaire administered by a trained interviewer who followed a standardised protocol to explain the questions. In each polyclinic, interviewers were available to conduct the interview in local languages including English, Mandarin, Hokkien, Malay, and Tamil. This study was approved by the Institutional Review Boards of SingHealth Polyclinics and the National University of Singapore.

Questionnaire

The survey questionnaire included 5 sections: (i) demographics, (ii) usage of SMS and internet in daily life, (iii) hypothetical scenarios of using SMS and internet in primary healthcare delivery, (iv) willingness to use SMS and internet in healthcare delivery and associated concerns, and (v) concerns about using SMS and internet in healthcare delivery among non-users of these 2 technologies. In section 3, a total of 5 hypothetical health services that involved using either SMS or internet were described to assess acceptance of these technologies among respondents. Two scenarios involved sending self-measurement at home to and receiving test results from polyclinics by SMS; the other 3 scenarios described services allowing patients to change appointments, search for health information, and send self-measurement to doctors through internet. In section 4, the overall willingness to use SMS and internet in health services was assessed by the following question: "Are you comfortable with the use of technology (i.e. internet and SMS) in healthcare delivery?" There were 5 response options: "very comfortable", "quite comfortable", "neutral", "not quite comfortable", and "not comfortable at all". In sections 4 and 5, statements describing possible concerns about using SMS and internet in health services were read to the participants for them to consider if the concerns applied to them. The questionnaire was designed to skip irrelevant questions for each respondent. For example, only those who owned a mobile phone and knew how to send and receive SMS were asked about the 2 SMS scenarios questions in section 3.

Prior to use in the formal study, the study questionnaire

was tested in 2 pilot studies in the study sites to improve clarity and flow. The final questionnaire was also translated into Chinese and Malay (available from the correspondence author upon request).

Statistical Analysis

Users of SMS were defined as those who had access to mobile phone and knew how to send and receive SMS; internet users were those who had access to internet and know how to surf websites and use emails. Willingness to use these technologies in healthcare delivery was defined as “very comfortable” or “quite comfortable” with the use of SMS and internet in healthcare delivery. Each factor was re-categorised into 2 groups for inferential analysis. For age, patients were divided into those below 65 years and those 65 years or older. For race, non-Chinese included Malays, Indians and others. For working status, the working group included those who were working (96%) and students (4%), and the non-working group included unemployed or retired participants as well as homemakers or others.

The relationship between individual demographic/study factor and access to technologies (yes/no) was first examined using chi-square tests. The statistically significant demographic/study factors were then examined simultaneously in a logistic regression model to adjust for confounding between the factors. Likewise, the associations between demographic/study factors and willingness to use these technologies in healthcare delivery (yes/no) were also examined by following these steps in statistical analysis.

All data analyses were performed with SAS for Windows (Version 9.1). All *P* values quoted are 2-sided and <0.05 to be considered statistically significant.

Results

Seven hundred and five patients were successfully surveyed, with a response rate of 92%. The mean (standard deviation) age of the sample was 54.6 (16.8) years, with 50.6% being females. The majority of the patients were Chinese (75.0%), completed secondary education or higher (61.8%), currently working (51.1%), and lived in 4-bedroom apartments or better residence (67.2%). Most patients visited the clinics for chronic conditions (53.6%) at a frequency of 2 to 5 times a year (69.1%). Detailed socio-demographic characteristics are displayed in Table 1.

Access to Mobile Phone and Usage of SMS

Five hundred and two patients (71.2%) had access to mobile phone and 407 of them (57.7%) knew how to send and receive SMS. Access to mobile phone was most prevalent in those who were working or studying (90.6%), completed secondary education or higher (89.2%), or those who visited the clinic for acute symptoms or health screening

Table 1. Demographic Characteristics of Patients (N = 705)

	N (%)
Mean (SD) Age, years	54.6 (16.8)
Gender	
Male	348 (49.4)
Female	356 (50.6)
Race	
Chinese	529 (75.0)
Malay	84 (11.9)
Indian	73 (10.4)
Other	19 (2.7)
Marital status	
Never married	141 (20.0)
Married	486 (68.9)
Separated/divorced	25 (3.6)
Widowed	51 (7.2)
Refused to disclose	2 (0.3)
Education	
No formal education	100 (14.2)
Primary	169 (24.0)
Secondary, junior college, pre-university, ITE	323 (45.9)
University, polytechnic, postgraduate	112 (15.9)
Housing type	
1 or 2 room HDB	58 (8.2)
3 room HDB	173 (24.6)
4 room HDB	213 (30.3)
5 room or executive HDB	172 (24.4)
Condominium or private flat	38 (5.4)
Landed properties	36 (5.1)
Others	14 (2.0)
Working status	
Working	360 (51.1)
Unemployed	41 (5.8)
Homemaker	104 (14.8)
Student	14 (2.0)
Retired	176 (25.0)
Others	9 (1.3)
Monthly household income	
< \$1000	143 (20.3)
\$1000 – \$2999	249 (35.3)
\$3000 – \$4999	131 (18.6)
\$5000 +	82 (11.6)
Refuse to disclose/not sure	100 (14.2)

Table 1. Contd.

Purpose of visit to clinic on the day of survey	
Acute symptoms	288 (40.9)
Follow up of chronic symptoms	378 (53.6)
Health screening	
Frequency of visit to polyclinic	
First visit	83 (11.8)
Twice to five times a year	487 (69.1)
Once in two months	96 (13.6)
Once a month	33 (4.7)
More than twice a month	6 (0.9)

(87.7%). Conversely, the access was low in patients 65 years or older (38.8%), with primary or no formal education (42.5%), or who were not working or studying (48.6%). In the logistic regression model, the access to mobile phone was positively associated with younger age, male gender, higher educational level, more expensive housing type, working or studying, and visiting the clinic for acute symptoms or health screening, with the most significant characteristics being educational level and working status (Table 2).

The association between SMS usage and socio-demographics was similar to that observed for the access to mobile phone but only the positive associations with younger age, higher educational level, working status, and visiting the clinic for acute symptoms or health screening reached statistical significance in multivariate analysis (Table 2). Educational level and working status had the strongest associations with SMS usage.

Access to and Usage of Internet

Three hundred and forty-eight patients (49.4%) had access to internet and 158 (22.4% of the 705 participants) said they knew how to surf the web and use emails. The access to internet was high in patients with secondary education or higher (67.6%), working or studying (65.5%), or those who visited for acute symptoms or health screening (65.8%). Conversely, low access was observed in those with primary or no formal education (19.7%), 65 years or older (20.9%), or who were neither working nor studying (29.9%). In multivariate analysis, younger age, higher education, more expensive housing type, either working or studying, and visiting for acute symptoms or health screening were factors positively and significantly associated with access to internet, with educational level and housing type being the 2 strongest predictors.

Similarly, internet usage was most prevalent in patients who were working or studying (35.4%), better educated (34.7%), or visiting the clinic for acute symptoms (34.6%).

Internet usage was less common in those with primary or no formal education (2.6%), aged 65 years or older (5.0%), or who were neither working nor studying (6.9%). The 2 strongest predictors of internet usage were educational level and working status (Table 3).

Willingness to Use SMS and Internet in Healthcare Delivery

In our study, 284 participants were comfortable with the use of the SMS and internet technologies in healthcare delivery, and this was 40.3% among all participants (n = 705) and 68.9% among those who were SMS and/or internet users (n = 412). In the logistic regression model, race, educational level, and purpose of visit were significant predictors of willingness to use SMS and internet in healthcare delivery. Among users of SMS and internet, patients who were better educated, Malay or Indian, or visiting for acute symptoms or health screening were more willing to use these technologies in healthcare delivery than those with less or no formal education, Chinese, or who visited the clinics for chronic symptoms, respectively (Table 4).

In the hypothetical scenarios of implementing technologies into healthcare delivery, 60.3% and 81.1% of SMS users would like to send self-measurement to and receive test results from clinics, respectively. Similarly, among internet users, the majority was willing to use internet to change appointments (87.9%), search for health information (84.1%), and send self-measurement to clinics (66.9%).

Concerns About Use of SMS and Internet in Health Services

The top 3 concerns among users of SMS and/or internet were: preference for in-person consultation with the doctor (23.5%); reduced patient-doctor interaction (23.0%); and increased healthcare cost by using the technologies (20.8%). Among patients who did not use SMS and internet, 55.8% were concerned about paying more for health services, 31.6% worried that non-users may lose out, and 22.2% felt that the quality of care they received might be compromised.

Discussion

In our study, the overall acceptance rate of SMS and/or internet usage in healthcare delivery was 40.3% among patients attending the SingHealth Polyclinics. This relatively low acceptance rate was expected since the rates of access to mobile phone (71.2%) and internet (49.4%) among these patients were much lower than the national levels. Polyclinics are set up primarily to provide subsidised care to the economically less well off in Singapore. The patient population at polyclinics also has a greater proportion of elderly who use such technology less frequently than the younger population. Our analysis showed that older patients

Table 2. Characteristics of Patients Associated with Access to Mobile Phone and Usage of SMS

	Access to SMS		Usage of SMS	
	%	Adjusted OR (95% CI) [†]	%	Adjusted OR (95% CI) [†]
Overall (n = 705)	71.2		57.7	
Age				
<65 years	86.2	1.00	75.0	1.00
65+ years	38.8	0.32 (0.20 – 0.52)***	20.1	0.29 (0.18-0.49)***
Gender				
Female	65.5	1.00	52.5	1.00
Male	77.5	1.65 (1.05-2.60)*	63.3	1.26 (0.81-1.96)
Race				
Chinese	69.4	1.00	53.5	1.00
Non-Chinese	77.6	0.77 (0.44-1.34)	71.3	1.35 (0.80-2.30)
Education				
Primacy or no formal education	42.5	1.00	20.5	1.00
Secondary school or above	89.2	4.34 (2.75-6.87)***	80.9	7.70 (4.94-12.02)***
Housing type				
1-3 room HDB	56.3	1.00	42.4	1.00
4-5 room HDB or private properties	78.8	1.93 (1.23-3.05)**	65.0	1.58 (0.99-2.53)
Working status				
Non-working	48.6	1.00	30.2	1.00
Working/students	90.6	3.86 (2.33-6.40)***	80.9	3.71 (2.32-5.92)***
Purpose of visit				
Chronic symptoms	57.4	1.00	40.5	1.00
Acute symptoms or health screening	87.7	1.98 (1.21-3.24)**	78.2	1.99 (1.27-3.10)**
Frequency of visit				
<1 visit per month	71.5	1.00	58.8	1.00
1+ visit per month	71.1	1.14 (0.66-1.96)	54.1	0.96 (0.57-1.62)

P* <0.05; *P* <0.01; ****P* <0.001

OR: odds ratio; 95% CI: 95% confidence interval

† Adjusted for all factors in the table

as well as those with lower socio-economic status were less likely to have access to mobile phone and internet. Hence, our findings suggest that SMS and internet may only be used as additional modes to enhance the current healthcare delivery in SingHealth Polyclinics at the current stage, and it may be too premature to actively implement technology-assisted healthcare delivery on a big scale until the patient population is more ready to embrace such technologies.

Educational level, purpose of visit, and race were 3 predictors of willingness to accept SMS and internet in healthcare delivery among users of these technologies. Patients with higher educational level may be using these technologies more frequently in their daily lives and hence less resistant to using them in healthcare services. Patients

who visited the polyclinics for management of chronic illnesses had lower acceptance of SMS and internet in healthcare delivery compared to those who visited the polyclinics for acute illnesses or screening. This may be because patients with chronic conditions tend to prefer direct contact with their physicians for in-person communication in place of SMS or internet contact.¹³ In contrast, patients with acute health problems such as flu or diarrhoea may be more concerned about the time spent waiting for medical consultation and therefore more willing to use technologies to expedite the process of healthcare delivery.

Interestingly, Malays and Indians users of SMS and internet accepted these technologies in healthcare delivery

Table 3. Characteristics of Patients Associated with Access to and Usage of Internet

	Access to internet		Usage of internet	
	%	Adjusted OR (95% CI) [†]	%	Adjusted OR (95% CI) [†]
Overall (N = 705)	49.4		22.4	
Age				
<65 years	62.3	1.00	30.4	1.00
65+ years	20.9	0.43 (0.27 – 0.70)**	5.0	0.42 (0.19-0.91)*
Gender				
Female	45.5	1.00	16.0	1.00
Male	53.2	1.17 (0.80-1.70)	28.8	1.89 (1.23-2.90)**
Race				
Chinese	47.3	1.00	21.0	1.00
Non-Chinese	55.7	0.98 (0.63-1.51)	26.7	0.87 (0.54-1.41)
Education				
Primacy or no formal education	19.7	1.00	2.6	1.00
Secondary school or above	67.6	4.25 (2.83-6.39)***	34.7	9.73 (4.31-21.96)***
Housing type				
1-3 room HDB	31.6	1.00	16.0	1.00
4-5 room HDB or private properties	59.0	2.32 (1.55-3.49)***	26.0	1.13 (0.69-1.87)
Working status				
Non-working	29.9	1.00	6.9	1.00
Working/students	65.5	1.83 (1.20-2.81)**	35.4	2.77 (1.56-4.93)**
Purpose of visit				
Chronic symptoms	35.2	1.00	11.9	1.00
Acute symptoms or health screening	65.8	1.74 (1.18-2.56)**	34.6	1.91 (1.21-3.00)**
Frequency of visit				
< 1 visit per month	50.0	1.00	22.9	1.00
1+ visit per month	46.7	0.92 (0.58-1.46)	20.7	1.20 (0.70-2.07)

P* <0.05; *P* <0.01; ****P* <0.001

OR: odds ratio; 95% CI: 95% confidence interval

† Adjusted for all factors in the table

more readily than their Chinese counterparts. This is probably due to the different proficiency in English between Chinese and non-Chinese patients. In Singapore, consumer and commercial services delivered through SMS and internet are mainly in English and greater proportion of Chinese than Malay and Indians are less proficient in English.¹⁴ Furthermore, Chinese words are more difficult to write than English words, and Chinese characters can only be keyed into electronic devices using pinyin which is not easy to learn. This inconvenience may also contribute to the relatively lower willingness to use these technologies among Chinese patients. On the other hand, another study which examined the use of internet for health-related information has also shown that Indians are more likely than Chinese to

use the internet to search for medical information.¹⁵

Naturally, patients in our study had concerns about the use of new technologies in healthcare delivery. The most frequently quoted concern was the perceived reduction in direct patient-doctor interaction. This concern also surfaced in similar studies conducted in New Zealand¹⁶ and the United States.¹⁷ These findings support the notion that the center of healthcare is still the human touch, which should not be compromised as technology is increasingly introduced into patient care and services. Thus, the use of new information and communication technologies should not lower the current standard of medical care; but should enhance patient-doctor relationship. Cost was another major concern for both users and non-users of SMS and internet

Table 4. Characteristics of Patients Associated with Willingness to Use SMS and Internet in Healthcare Delivery

	Willing to use technologies among all patients	Willing to use technologies among users of SMS and/or internet	
	%	%	Adjusted OR (95% CI) [†]
Overall (N = 705)	40.3	68.9	
Age			
<65 years	57.5	70.4	1.00
65+ years	19.1	60.0	0.90 (0.43-1.89)
Gender			
Female	40.5	65.8	1.00
Male	50.6	72.1	1.33 (0.84-2.12)
Race			
Chinese	40.1	64.1	1.00
Non-Chinese	61.9	81.3	2.36 (1.34-4.16)**
Education			
Primacy or no formal education	16.7	48.2	1.00
Secondary school or above	63.2	72.5	2.39 (1.28-4.47)**
Housing type			
1-3 room HDB	33.8	67.3	1.00
4-5 room HDB or private properties	51.0	69.7	1.21 (0.70-2.09)
Working status			
Not working or studying	25.9	59.6	1.00
Working/students	61.8	72.2	1.39 (0.81-2.40)
Purpose of visit			
Chronic symptoms	31.0	58.7	1.00
Acute symptoms or health screening	62.4	75.7	1.73 (1.07-2.79)*
Frequency of visit			
< 1 visit per month	46.7	69.9	1.00
1+ visit per month	40.7	66.7	1.05 (0.58-1.89)

* $P < 0.05$; ** $P < 0.01$

OR: odds ratio; 95% CI: 95% confidence interval

† Adjusted for all factors in the table

in the present study. The rise in healthcare cost is a growing concern among Singaporeans.¹⁸ The implication of this finding for healthcare providers is that cost for implementing new technologies should not be transferred to patients. Privacy related to use of SMS and internet was not a concern among our patients; although it was a concern in some overseas studies.¹⁹⁻²¹ This may reflect the high level of trust our patients have in the ethical conduct of health professionals in preserving the confidentiality of healthcare information in Singapore.

Our study has 2 limitations. First, the scenarios used for describing implementation of health services were completely hypothetical, thus making it difficult for some respondents to imagine how these services may be

implemented in reality. Second, the questions used to assess concerns related to the use of SMS and internet in this study questionnaire are all close-ended, thus we might have missed some concerns that were not included. However, our list of concerns came from earlier pilot studies and literature review, and we listed at least 11 concerns for patients to consider and choose from. Hence, it should be comprehensive enough to cover the vast majority of our patients. It should also be noted that our findings may or may not be generalised to patients visiting private clinics or hospitals. Our study population is of lower socioeconomic or educational status compared to the population using private healthcare in Singapore.

In conclusion, the current SMS and internet usage among

Table 5. Concerns Regarding Use of SMS and Internet in Healthcare Delivery

	N (%)
Users of SMS and/or internet (N = 412)	
Decrease in patient-doctor interaction	92 (23.0)
Quality treatment compromised	24 (6.0)
Preference of seeing a doctor	94 (23.5)
Overall healthcare cost will rising	83 (20.8)
Having to pay for such service	24 (6.0)
Responsibility of monitoring own health	15 (3.8)
Privacy compromised	6 (1.5)
Info accessible by others	18 (4.5)
Current system will not be improved	5 (1.3)
Preference of the present system	26 (6.5)
Non-users of SMS and internet (N = 172)	
Having to pay more for visits	96 (55.8)
Non-users may lose out	54 (31.6)
Quality of care compromised	38 (22.2)

patients visiting the SingHealth Polyclinics and their acceptance towards the use of these technologies in healthcare delivery do not support aggressive implementation of services entailing SMS and internet in the study sites. These technologies should only be used to enhance or complement current services with minimal cost to patients. However, as the population becomes more educated and such technologies further diffuse into the general population, Singaporeans will be more ready to accept the wide use of technology in healthcare delivery in the near future.

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