Preprint – *the manuscript has not been peer-reviewed yet.*

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Summary

The growth and development of smartphone and e-health technologies has enabled the employment of extended care hospitals such as e-hospitals in China in order to facilitate the success of a primary healthcare center (PHC) based integrated delivery model. Although the adoption of this innovation in healthcare delivery is essential, few studies have directed their research towards understanding the perspectives of healthcare providers. This study aims to identify the current readiness of healthcare providers to adopt e-hospital technologies, determine factors influencing their adoption, and describe perceived facilitators and barriers in regards to e-hospital use. A cross-sectional study was conducted from July to September of 2019 in Western China. This study included a self-administered questionnaire that was used to assess participants socio-demographic characteristics, online medical practice, willingness to use e-hospitals, and perceived facilitators/barriers to using e-hospitals. Multivariate regression analysis was performed in order to

evaluate independent factors associated with e-hospital use. The survey population consisted of 2,298 medical professionals from a tertiary hospital, secondary hospital, PHC, and private hospital. Overall, 86.3% had a positive response toward the usage of e-hospitals. Age ($P<0.05$), familiarity with e-hospitals ($P<0.001$), and prior work experience in online healthcare settings ($P<0.001$) were associated with participants' readiness to use e-hospitals. Gender, education level, professional level, the tier of the affiliated hospital, and workload were not statistically associated. Healthcare providers who had positive attitudes towards e-hospitals considered improved efficiency, patient satisfaction, communication among physicians, increased reputation, and alleviated workload to be advantages of adoption. The participants who were unwilling to use e-hospitals perceived lack of time, insufficient authenticity/reliability, and underdeveloped policies as potential challenges. Improving operative proficiency in electronic devices, accommodating to work schedules, increasing familiarity, and regulating practices will improve the readiness of healthcare providers to use e-hospitals.

Introduction

Since 2014, the Chinese government has suggested that the most cost-effective approach for healthcare delivery should focus on primary healthcare, with coordination between secondary and tertiary health institutions.[1] In principle, individuals should start treatment at primary healthcare centers (PHCs), which focus on population-based prevention, case detection, and disease management. Individuals should only proceed to secondary hospitals if the PHC is unable to cure and/or resolve the health issue.[2] It has been proposed that tertiary hospitals should focus primarily on solving complicated diseases, and exclusively treat patients unable to be cured by other institutions.[3] The primary care integrated delivery model would allow people to receive convenient care from nearby health providers. It would also help the Chinese healthcare system meet emerging health needs and rising patient expectations that are caused by the rapidly aging population and the increase in incidence of non-communicable diseases.

However, the inequitable distribution of healthcare providers has proven to be a major barrier to the adoption of this delivery approach.[4] The vast majority of highly educated physicians and nurses are drawn to work at tertiary public hospitals due to their high salaries and prestigious reputations, while others medical professionals with fewer qualifications tend to fill positions at secondary hospitals and PHCs.[5] Compounded with healthcare providers' unwillingness to relocate to PHCs and secondary hospitals, these tendencies have led to dominant patient preference for tertiary hospitals.[6]

E-hospitals, also known as extended care hospitals, are defined as internet related online technologies used to facilitate the exchange of health information, usually in the form of an application.[7,8] E-hospitals have the potential to improve access to high quality health services as well as effectively reducing professional isolation and improving providers' performance in resource constrained environments. E-hospital services can be delivered simultaneously in real-time by

videoconference, or through a messaging platform. By providing opportunities for online health education, medical services, follow-ups, and disease management, e-hospitals allow the delivery of high-quality services regardless of geographic, temporal, social, cultural, and/or political barriers.[9,10]

The predicted benefits of e-hospitals carry great promise for the implementation of a primary care-centered healthcare system in China. This technology empowers users to find solutions to issues related to the shortage of qualified doctors, especially in rural regions. It improves access to healthcare professionals, reducing referrals, and minimizing travel costs for patients.[11] E-hospitals also provide essential assistance in the management of communicable diseases. For example, during crises such as the COVID-19 pandemic where demand for healthcare services grossly exceeds the capacity of hospital systems, e-hospitals could lessen the burden on physicians/hospitals as well as maximize the number of individuals given care and overall improve health outcomes.[12] This could allow physicians to virtually instruct assessment and care for patients with milder cases who would have otherwise further crowded hospitals or suffered at home, due to inadequate information about self-care. Furthermore, e-hospitals would allow patients with pre-existing non-related conditions to continue their care and/or rehabilitation from home with physician assistance while decreasing person-to-person contact. Visiting a physical hospital would further strain the resources/capacity and risk contracting infection from persons receiving treatment. E-hospitals would not only benefit those directly receiving online services, but also greatly improve the quality of care for patients in hospitals with critical conditions. These patients would be afforded more resources and physician attention due to the lesser crowding of facilities.[13]

However, the success of this healthcare innovation is dependent on the full adoption of e-hospitals by both providers and patients.[14-16] Unfortunately, despite China's political commitment and significant financial investment in the technology, e-hospitals have not been fully adopted into the Chinese healthcare system. This is partly due to the poor acceptance of end-users. E-health

readiness, which has been positively associated with acceptance, is defined as the degree to which both healthcare providers and patients, are prepared to engage with e-health projects.[17] While previous studies have assessed patient attitudes towards e-hospitals and theorized appropriate policy responses, few provide information about the concerns of healthcare providers. Studies have confirmed that e-health readiness among doctors, nurses, and allied healthcare professionals vary depending on their degree of exposure to online healthcare delivery methods.[18] Unlike the private sector-dominated healthcare system in the United States, private hospitals in China are only intended to be supplements to public hospitals.[19,20] Therefore, public hospitals are able to hire more highly skilled physicians and provide quality services. In 2001, China's central government began to encourage the proliferation of private hospitals in an attempt to decentralize the role of tertiary public hospitals, which became increasingly possible as e-health innovations continued to emerge.[21] As a result, private hospitals now exist in addition to the three-tiered e-hospital system (PHCs, secondary and tertiary public hospitals). Thus, the readiness of healthcare providers from different medical institutions must be considered in the design of e-hospitals, and the factors that facilitate or hinder their adoption should be closely analyzed.

The main objective of this study is to assess the factors influencing the providers' preparation to successfully take on e-hospitals. It also describes the factors that contribute to their acceptance or rejection of the technology in order to inform the integration of e-hospitals into the primary healthcare-centered delivery model.

Methods

Setting and ethical consent

A cross-sectional, questionnaire-based study of the medical staff in Sichuan Province was conducted between June and September 2019. Medical staff were from one of four medical institutions: West

China Hospital of Sichuan University (tertiary hospital), First People's Hospital of Longquan District (secondary hospital), Community Health Centers of Chenghua District (PHCs), and Aidi Hospital (private hospital). Ethical approval to conduct the study was obtained from the Research Ethic Committee of the West China Hospital of Sichuan University.

Study tool

A panel consisting of five experts from the fields of hospital administration and healthcare policy, designed the questionnaire (Multimedia Appendix I). The questionnaire touched on a number of factors impacting the use of e-health applications by providers as identified in the previous literature. A pilot survey was then performed with 25 healthcare providers to evaluate the questionnaire. Context-specific adjustments were made according to the feedback acquired from the pilot survey.

The self-administered questionnaire consisted of five sections—see Multimedia Appendix I. The first section included questions related to the participants' socio-demographic characteristics such as gender, age, education level, employment department, years of practice, professional level, hospital type, and length of time working. The second part of the questionnaire measured their experience and satisfaction with working with online medical services, based on a 5-point Likert scale. Part three measured the participants' familiarity with e-hospitals, using a 5-point Likert scale, and part four assessed willingness to use e-hospitals with binary answer choices. In the final section, respondents who chose "*yes*" reported their "*perceived facilitators*," while the others reported "*perceived barriers.*"

Participant selection and data collection

Directors of the participating institutions were notified about the study via a memorandum drafted and signed by one of the authors. Once approval was obtained, the questionnaire was distributed using the Web-based survey tool Sojump (Changsha ran Xing InfoTechLtd, China), which included the

written consent forms. Both physicians and nurses at the selected centers were eligible to participate in this study, regardless of occupation, employment status, and years of experience. The link to the survey was published and shared through the hospitals' WeChat contacts network. Prior to participation, the purpose of the survey was introduced, the concept of e-hospitals was explained, and the consent of participants was obtained through the WeChat network. Questionnaires were individually completed by the healthcare providers and each individual could fill out the questionnaire only once. All centers received one reminder a week after the questionnaires were distributed. No compensation was provided for participation in the study.

Data analysis

Descriptive statistics were calculated for all survey items. Percentages and frequencies were evaluated for categorical variables, and mean values with standard deviations were calculated for continuous variables. For univariate analyses, a Chi-squared test was used for categorical variables, a t-test was used for continuous variables, and a Kruskal-Wallis test was conducted to analyze ordinal variables. Multiple significance tests were also used to examine whether there were existing differences among hospital tiers. However, years of experience were excluded from these analyses due to its multicollinearity with age.

A Chi-squared test was performed to examine the association between willingness to use e-hospitals and other variables. Variables in the descriptive analysis were included in the multivariate regression model. Degree of knowledge about e-hospitals was enrolled as a continuous variable because it resulted in findings that did not significantly differ from those found when categorizing the variable as ordinal (χ^2=4.1, P>0.05). Additionally, a Chi-squared test was employed to analyze hospital-related variations in perceived facilitators and barriers. SPSS (IBM SPSS, version 25, IBM Corporation) was used to perform the analysis. Two-tailed P-values of less than 0.05 were considered statistically significant.

Results

Baseline characteristics of study participants

Table 1 presents baseline characteristics across the four hospitals. Overall, this study included 2,298 participants with 379 being from the primary care center, 552 from the secondary public hospital, 834 from the tertiary public hospital, and 533 from the private hospital.

Several differences in the surveyed characteristics existed across the four hospitals. Participants in the secondary public hospital appeared to be older than those in the other three hospitals. Specifically, 20.8% of participants in the secondary public hospital were over the age of 40. This was only true for 16.1% of participants in the private hospital, 15.4% in the tertiary hospital, and 16.6% in the primary care center (P<0.001). The primary care center (90.8%) and the tertiary public hospital (86.9%), had a higher proportion of female participants relative to the private hospital (82.6%) and the secondary public hospital (78.6%) (P<0.001). While the vast majority of our participants had bachelor-level education or above (96.2%), the primary care center (8.4%) and private hospital (5.8%) had higher proportions of providers who did not have a bachelor degree (P<0.001). The hierarchy in these organizations includes juniors, intermediates, and seniors, where senior providers have more experience, skill, and academic achievement and certifications. The primary care center had a lower percentage of senior providers (3.4%) compared to the tertiary hospital (10.0%), private hospital (10.1%), and secondary hospital (12.9%) (P<0.001).

Interestingly, we found that the percentage of nurses in the tertiary public hospital (84.3%) was significantly higher than that of the other three hospitals (P<0.001), where the proportion ranged from 38.3% to 52.9%. We also found that 64.7% of participants at the private hospital had been practicing for less than 10 years, which was significantly higher than those at the secondary public hospital (50.2%), tertiary hospital (47.3%), and primary care centers (48.3%). Lastly, 47.1% of our

participants worked over 40 hours per week, with this being highest for the private hospital (73.4%), and lower for the primary care center (19.5%), tertiary hospital (32.0%), and secondary public hospital (63.3%) (P<0.001).

< Table 1 near here >

Variations in knowledge, usage, and satisfaction of e-hospitals

Table 2 presents results regarding participants' knowledge, usage, and satisfaction with e-hospital technologies. Among the 2,298 participants, only 2.5% respondents stated that they had never heard of e-hospitals. Participants in the tertiary public hospitals appeared to have a better understanding of e-hospitals, given that the highest proportion of participants reported being very familiar with e-hospitals (13.7%, P<0.001).

Overall, 59.6% of healthcare providers stated that they have a history of online medical service usage, including: consultations (50.6%), e-prescriptions (47.5%), remote rounds/teaching (44.0%), follow-ups and rehabilitation guidance (40.8%), interpretation of test reports (38.7%), and chronic disease management (39.5%). Healthcare providers in tertiary hospitals were more likely to offer online medical services (P<0.001), online consultation, and e-prescriptions. Moreover, 74.9% of current users reported that they were satisfied with their online medical experiences.

< Table 2 near here >

Variations in willingness to work at e-hospitals

Table 3 shows the results from the descriptive analyses. Among the 2,298 participants, 314 individuals (13.7%) reported that they were not willing to work for an e-hospital. Younger participants were found to be more willing to work for e-hospitals relative to older participants

(P<0.001). More specifically, 89.4% of participants between the ages of 18 and 29, reported that they would like to work for an e-hospital, while only 73.6% of participants over the age of 50 reported the same. Female participants (87.5%) were more willing to work for an e-hospital when compared to male participants (80.0%) (P<0.001). Junior participants (87.7%) were most willing to work for an e-hospital, followed by intermediate (85.1%), and then senior participants (81.9%) (P<0.001).

Compared to physicians (76.0%), nurses (92.8%) were more willing to work for an e-hospital (P<0.001). Participants with 10 to 19 years of experience (88.7%) appeared to be most willing to work for an e-hospital (P<0.001) when compared with those who had less than 9 years or more than 20 years of experience. The proportion of providers currently working over 40 hours per week who were willing to work at an e-hospital (83.6%) was lower than those who worked less than 40 hours per week (88.7%) (P<0.001). Participants with a better understanding of e-hospitals were more likely to report that they were willing to work for one (P<0.001). Results also indicated that individuals with online medical experience were more willing to conduct their work in e-hospital platforms (P<0.001).

< Table 3 near here >

Table 4 presents the results of multivariate analysis, showing that the level of affiliated hospitals, education, professional level, and working hours per week were not statistically associated with the willingness to work for an e-hospital after adjusting for other covariates in the model. Results further suggested that compared with those 18 to 29 years of age, individuals aged 30 to 39.9 (OR=0.663, P=0.043) and 40 to 49.9 (OR=0.409, P=0.014), and over 50 (OR=0.197, P<0.001) were less willing to work for e-hospitals. Nurses were found to be more willing to work for e-hospitals relative to physicians (nurses vs. physicians, OR=0.421, P<0.001). Also, participants with a better understanding of e-hospitals were more willing to work for e-hospitals (OR=2.247, P<0.001). In addition, clinicians

with online working experience had a higher likelihood of being willing to use e-hospitals compared to those without an online working background (OR=3.205, P<0.001).

< Table 4 near here >

Variations in perceived facilitators and barriers

Among the 1,984 participants that were willing to work for e-hospitals, over 90% perceived that it could improve the convenience and efficiency of healthcare. Participants from tertiary public hospitals (94.6%) appeared to be more concerned with improving convenience and efficiency relative to those from other hospitals (P<0.001). A statistically higher proportion of participants from the tertiary public hospital considered e-hospitals to be a potential tool for alleviating workload (66.8%, P<0.001) and improving patient satisfaction (72.8%, P<0.001). Similarly, a significantly higher proportion of participants from private hospitals perceived it as a way for physicians to communicate with and learn from one another (41.9%, P<0.001). 19.6% of participants in the secondary public hospital considered working for an e-hospital to be a way to increase their income and reputation (P<0.001).

Several barriers were identified from the 314 participants who were unwilling to use e-hospitals. Among them, 18.5% reported that they were not willing to work at an e-hospital because they were unable to operate smart devices (this figure did not differ across the four hospitals). In addition, 48.4% reported that they did not have extra time to work at an e-hospital. The proportion of participants from secondary hospitals that reported this (67.5%) was statistically higher than those from tertiary public hospitals (51.0%), primary care centers (36.5%), and private hospitals (42.6%) (P<0.001). Furthermore, 43.6% of participants were not willing to work for an e-hospital because they believed that the current licenses for multi-sited and medical disputes for e-hospitals are not fully developed. 53.5% of participants reported that they believed e-hospitals were not reliable and

18.2% said that they were concerned that e-hospitals had not been well-received by patients. No variations in the last three barriers existed among participants across the four hospitals.

Figures 1 and 2 present the perceived facilitators for users of e-hospitals and barriers for non-users, respectively.

< Figures 1 and 2 near here >

Discussion

Many contend that e-health technologies hold promises for enhanced efficiency and quality of healthcare.[22,23] Our previous study found that poor information technology skills among seniors and the familiarity with face-to-face consultation among young people, were the primary barriers for patients unwilling to use e-hospitals in China.[24] To the best of our knowledge, no studies have been conducted to assess the attitudes of healthcare providers towards e-hospitals or their respective facilitators/barriers towards its adoption. This research attempts to address this informational gap and provide insight for decision makers in China.

Principal Findings 1

The popularity of smartphones is increasing exponentially, particularly in metropolises. In 2016, the penetration rate of smartphones surpassed 2 billion, and it is expected to increase to 2.86 billion in 2020.[25] However, our study that was conducted in Western China, found that only half of the participants had experience with online medical services in this region. Such a trend may be explained by the lesser prevalence of information technology in the healthcare field in Western China.

Research has shown that computer proficiency is positively associated with the acceptability of e-health technologies.[26,27] However, our study found that it was the physicians' age, not their IT skills, that could negatively affect their readiness for the adoption of e-hospitals. One possibility is the fact

that the younger physicians are generally equipped with higher IT proficiency, enabling them to be more open to e-health. While seniors with limited telehealth training were more likely to guide the treatment and verbally issue orders.[28] Given that patients often favor treatment from senior physicians when visiting e-hospitals, it is essential to prioritize the readiness of senior providers to meet this demand. Therefore, it is imperative to set up guided operational skills training, including e-hospital training in curricula and to mandate post-graduate e-hospital accreditation. Designing a user-friendly app and providing technical assistants, especially for the older cohort, may be also critical for facilitating the engagement of e-hospitals in China.[29]

Considering that nurses are usually more focused on direct patient care, while physicians are more involved in handling patients' diagnoses and treatments, the priority of nurses in facilitating e-hospital initiatives was presumed to be lower in comparison to physicians. Although physicians are deemed the most important for the adoption and implementation of e-health services.[30] We found that nurses were significantly more willing to work in e-hospitals than physicians. The positive association between nurses and willingness to work in e-hospitals may be attributed to the ability of e-hospitals to significantly decrease physical labor for nurses, while the workload for doctors will remain equal or greater. In order to increase the use of e-hospitals, physician perspectives should be carefully taken into account. It may be necessary for policymakers to prioritize the needs of physicians to optimize their participation, given the essential role physicians will play in the operation of e-hospitals.[31] For example, to address concerns regarding workload, government and hospital administrators can designate specific times during the workday to attend virtual visits and provide additional incentives for professionals who work for e-hospitals.[32]

Our participants who had previous online medical service experience and better familiarity with e-hospitals reported being more willing to use e-hospitals, which is consistent with prior research.[33] As the technology acceptance model suggests,[34] perceived usefulness is statistically significant in

determining the use of technology. There was no significant association between respondents' respective hospital tier and their willingness to use e-hospitals in our study. One possible explanation is that the variations among hospitals could result from the physicians' differences in terms of online working experience. Clinicians may not realize and recognize the advantages of e-hospitals when they have limited online experience. It should be noted that access to e-hospital hardware infrastructures and internet access may not be affordable for smaller institutions such as PHCs, and therefore policy-makers should take corresponding strategic approaches to address this concern.[35,36]

Principal Findings 2

In this study, improved efficiency, patient satisfaction, communication among physicians, provider reputation, and alleviated workload were perceived by users as key facilitators for e-hospital usage. The top perceived barriers for non-users included: difficulty of use, lack of extra time, dubious authenticity and reliability, negative patient attitudes, and underdeveloped policy. Specifically, our findings revealed that the most expected facilitator for e-hospitals among willing providers at tertiary hospitals was the alleviation of workload. However, workload was also the highest reported concern among unwilling providers. In light of this, e-hospital and physical hospital administrators should ensure that healthcare providers continue to have reasonable working hours.

For decades, the private sector in China has received minimal attention from policy-makers. However, recent years have brought an interest in its potential. We believe that the integration of private hospitals into the e-hospital delivery cycle is necessary for the success of the primary-care centered integrated model and the promotion of communication between public and private hospitals. To some extent, this interest can be attributed to the emergence of e-health, which aims to break through the barriers between various medical institutions in order to improve outcomes for the patient.

This study found that physicians from PHCs and secondary hospitals were highly willing to work for e-hospitals and consider them to be effective in daily practices. It is apparent that concerns regarding the authenticity/reliability of e-hospitals still need to be addressed so that they can be successful staples of the primary care-centered integrated delivery model.[3,37] E-hospitals should be implemented according to criteria that will guarantee quality and continuity of clinical care. Though there are currently many e-hospitals within the Chinese healthcare market, none fulfills the legal requirements for patient safety, nor are there any scientific entities responsible for evaluating e-hospitals. Establishing a reliable treatment protocol and evaluation mechanism for e-hospitals is imperative for policy-makers to ensure that the quality of healthcare is protected.[38,39] Other researchers have also highlighted the lack of regulation and data security surrounding e-hospital technologies.[40-42] The government should play an essential role in improving this aspect of e-hospitals.

Strengths, Limitations, and Future Research

This study has several limitations. Its participant sample was only drawn from hospitals in the Sichuan province, and thus the results may not be generalized to other regions with different healthcare providers and characteristics. Although the present study contained various healthcare providers from different departments, we could not precisely estimate the differences among subgroups due to the limited sample size across specialists. Due to the constraint of time of respondents, our survey lacked open-ended response options and qualitative interviews, which would have allowed for the collection of more specific information from respondents. Also, since this is a cross-sectional study, changes over time in attitudes towards e-hospitals due to rapid social development and population aging were not captured.

Nevertheless, this study is the first to investigate factors impacting the adoption of e-hospitals at this scale with respondents from various hospital levels. It provides useful implications for recognizing

healthcare providers' perceived facilitators and barriers to the use of e-hospitals and can lay the groundwork for the future conceptualizations of digital health in China.

The Chinese healthcare system must enhance its responsiveness and capacity to meet the imperative needs of the aging population, especially given the burden of communicable and non-communicable diseases. Although e-hospitals have evidence-based value in the delivery of healthcare services, it is important to note that these advantages cannot be accessed without patient demand for e-hospitals and cooperation from healthcare providers.[43] Despite efforts that have been made, the e-hospital technology is imperfect, and therefore further studies are needed to support policies and expand available resources for this critical infrastructure. In addition, cost-benefit analysis and outcome evaluations are encouraged.[44] Future research can also focus on the specific attitudes and perceptions of specialists, such as psychiatrists, geriatricians, and general practitioners. Issues of quality and accessibility must also be taken into consideration for future research.

Authors' contributions

PL conducted literature search, conceived study design and questionnaire, carried out the survey, and drafted the manuscript. YL led the design of the questionnaire, data collection, analysis, and interpretation. XY was involved in the statistical analysis and interpretation of data. ZZ provided comments and suggestions in revisions of the paper, and WJ helped with the designing of the questionnaire and provided scientific input. EM and MSJ consulted the analysis, contributed to further development of the analysis and content, and revised the manuscript for important intellectual content. WL was responsible for all the results of the study, as well as the review and approval of the manuscript. All authors read and approved the final manuscript.

Declaration of Interest

The authors declare no competing interests.

Acknowledgments

This work was supported by the National Natural Science Foundation of China (Grant No. 71874115); and the Science and Technology Department of Sichuan Province, China (Grant No. 2018KZ0046 and 2017FZ0104). The funder had no role in the design of the study, or collection, analysis, and interpretation of data, or in writing the manuscript. We sincerely thank the four medical institutions and all participating physicians who shared their perspectives throughout this study. The authors would like to acknowledge Yan Jiang, Zi Liu, Li Ma, Qiqiang Xiao, and Wenqi Zeng for their clinical assistance, and Guanhua Qing for his assistance in making this a better article.

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Table 1. Socio-demographic data of the healthcare providers included in the study

Characteristics	Total	Level of hospital				*P*-value
		Primary healthcare center	Secondary public hospital	Tertiary public hospital	Private hospital	
Sample size, n	2298	379	552	834	533	
Age, n (%)						<0.001 [b]
18-29	852 (37.1)	114 (30.1)	182 (33.0)	292 (35.1)	264 (49.5)	
30-39	1053 (45.8)	202 (53.3)	255 (46.2)	413 (49.5)	183 (34.4)	
40-49	264 (11.5)	41 (10.8)	79 (14.3)	87 (10.4)	57 (10.7)	
≥50	129 (5.6)	22 (5.8)	36 (6.5)	42 (5.0)	29 (5.4)	
Gender, n (%)						<0.001 [a]
Male	355 (15.4)	35 (9.2)	118 (21.4)	109 (13.1)	93 (17.4)	
Female	1943 (84.6)	344 (90.8)	434 (78.6)	725 (86.9)	440 (82.6)	
Education level, n (%)						<0.001 [b]
Junior college	88 (3.8)	32 (8.4)	7 (1.3)	18 (2.1)	31 (5.8)	
College/Bachelor degree	2057 (89.5)	343 (90.5)	485 (87.8)	752 (90.2)	477 (89.5)	
Master degree or above	153 (6.7)	4 (1.1)	60 (10.9)	64 (7.7)	25 (4.7)	
Professional level, n (%)						<0.001 [b]
Junior	1366 (59.5)	275 (72.6)	296 (53.6)	478 (57.3)	317 (59.5)	
Intermediate	711 (30.9)	91 (24.0)	185 (33.5)	273 (32.7)	162 (30.4)	
Senior	221 (9.6)	13 (3.4)	71 (12.9)	83 (10.0)	54 (10.1)	
Specialty, n (%)						<0.001 [a]
Nurse	1409 (61.3)	145 (38.3)	292 (52.9)	703 (84.3)	269 (50.5)	
Doctor	889 (38.7)	234 (61.7)	260 (47.1)	131 (15.7)	264 (49.5)	
Years in practice, n (%)						<0.001 [b]
0-9	1200 (52.2)	183 (48.3)	277 (50.2)	395 (47.3)	345 (64.7)	
10-19	773 (33.7)	141 (37.2)	183 (33.2)	327 (39.3)	122 (22.9)	
≥20	325 (14.1)	55 (14.5)	92 (16.6)	112 (13.4)	66 (12.4)	
Hours worked per week, n (%)						<0.001 [a]
≤40	1216 (52.9)	305 (80.5)	203 (36.7)	565 (67.7)	143 (26.8)	
>40	1082 (47.1)	74 (19.5)	349 (63.3)	269 (32.3)	390 (73.2)	

[a] Chi-square test; [b] Kruskal-Wallis Test

Table 2. Present usage and satisfaction of online medical services among healthcare providers

Characteristics	Total	Level of working hospital				*P*-value
		Primary healthcare center	Secondary public hospital	Tertiary public hospital	Private hospital	
Sample size, n	2298	379	552	834	533	
Degree of knowledge towards e-hospitals						<0.001 [b]
Very familiar with	212 (9.2)	25 (6.6)	54 (9.8)	114 (13.7)	19 (3.6)	
Know a better bit	499 (21.7)	76 (20.1)	116 (21.0)	242 (29.0)	65 (12.2)	
Know a good bit	962(41.9)	149 (39.3)	248 (44.9)	349 (41.8)	216 (40.5)	
Only heard of	568 (24.7)	115 (30.3)	129 (23.4)	123 (14.7)	201 (37.7)	
Never heard of	57 (2.5)	14 (3.7)	5 (0.9)	6 (0.8)	32 (6.0)	
Sample size-online medical users	1369	195	338	617	219	<0.001 [a]
Category of the online medical services, n (%) [c]						
Online consultation	693 (50.6)	71 (36.4)	135 (40.0)	363 (58.8)	127 (58.0)	<0.001 [a]
E-prescription	650 (47.5)	77 (39.4)	163 (48.2)	318 (51.5)	92 (44.3)	0.008 [a]
Remote round/teaching	603 (44.0)	13 (6.7)	242 (7.16)	307 (49.8)	41 (18.7)	<0.001 [a]
Interpreting test reports	530 (38.7)	30 (15.4)	156 (46.2)	273 (44.2)	71 (32.4)	<0.001 [a]
Online follow-up and rehabilitation guidance	558 (40.8)	43 (22.1)	131 (38.8)	296 (48.0)	88 (40.2)	<0.001 [a]
Managing chronic diseases	541 (39.5)	129 (66.2)	114 (33.7)	249 (40.4)	49 (22.4)	<0.001 [a]
Satisfaction of the online Medical experience, n (%)						<0.001 [b]
Extremely satisfied	399 (29.2)	44 (22.6)	80 (23.7)	228 (37.0)	47 (21.4)	
Satisfied	627 (45.8)	85 (43.6)	173 (51.2)	277 (44.8)	92 (42.1)	
Neutral	321 (23.4)	60 (30.8)	78 (23.1)	104 (16.9)	79 (36.1)	
Dissatisfied	16 (1.2)	5 (2.5)	5 (1.5)	5 (0.8)	1 (0.4)	
Extremely dissatisfied	6 (0.4)	1 (0.5)	2 (0.5)	3 (0.5)	0 (0.0)	

[a] Chi-square test; [b] Kruskal-Wallis Test; [c] there are overlaps among the responses to these categories.

Table 3. Willingness of work at e-hospitals

Characteristics	Total	Willingness to work at e-hospitals		Chi-square test *P*-value
		No	Yes	
Sample size – all, n (%)	2298	314	1984	
Age, n (%)				<0.001 [a]
18-29	852 (37.1)	90 (10.6)	762 (89.4)	
30-39	1053 (45.8)	139 (13.2)	914 (86.8)	
40-49	264 (11.5)	51 (19.3)	213 (80.7)	
≥50	129 (5.6)	34 (26.4)	95 (73.6)	
Gender, n (%)				<0.001
Male	355 (15.4)	71 (20.0)	284 (80.0)	
Female	1943 (84.6)	243 (12.5)	1700 (87.5)	
Education level, n (%)				0.091 [a]
Junior college	88 (3.8)	18 (20.5)	70 (79.5)	
College/Bachelor degree	2057 (89.5)	271(13.2)	1786 (86.8)	
Master degree or above	153 (6.7)	25(16.3)	128 (83.7)	
Professional level, n (%)				0.034 [a]
Junior	1366 (59.4)	168 (12.3)	1198 (87.7)	
Intermediate	711 (31.0)	106 (14.9)	605 (85.1)	
Senior	221 (9.6)	40 (18.1)	181 (81.9)	
Specialty, n (%)				<0.001
Nurse	1409 (61.3)	101 (7.2)	1308 (92.8)	
Doctor	889 (38.7)	213 (24.0)	676 (76.0)	
Years in practice, n (%)				<0.001 [a]
0-9	1199 (52.2)	160 (13.3)	1039 (86.7)	
10-19	774 (33.7)	87 (11.3)	687 (88.7)	
≥20	325 (14.1)	67 (20.6)	258 (79.4)	
Hours worked per week, n (%)				<0.001
≤40	1219 (53.0)	137 (11.2)	1082 (88.8)	
>40	1079 (47.0)	177 (16.4)	902 (83.6)	
Level of hospitals				<0.001 [a]
Primary healthcare center	379 (16.5)	85 (22.4)	294 (77.6)	
Secondary public hospital	552 (24.0)	77 (13.9)	475 (86.1)	
Tertiary public hospital	834 (36.3)	51 (6.1)	783 (93.9)	
Private hospital	533 (23.2)	101 (18.9)	432 (81.1)	
Degree of knowledge towards e-hospitals				<0.001 [a]
Very familiar with	212 (9.2)	5 (2.4)	207 (97.6)	
Know a better bit	499 (21.7)	20 (4.0)	479 (96.0)	
Know a good bit	962 (41.9)	97 (10.1)	865 (89.9)	
Only heard of	568 (24.7)	167 (29.4)	401 (70.6)	
Never heard of	57 (2.5)	25 (43.9)	32 (56.1)	
Experience of online medical services, n (%)				<0.001
Yes	1369 (59.6)	70 (5.1)	1299 (94.9)	
No	929 (40.4)	244 (26.3)	685 (73.7)	

[a] Kruskal-Wallis Test

Table 4. Multivariate logistic regression of the willingness to work in e-hospitals

Independent variables	Coefficient	Odds ratio (95% CI)	Standard Error	Degree of freedom	*P*-value
Level of working hospital				3	0.057
Secondary public hospital	Ref.	Ref.			
Primary healthcare center	-0.385	0.680 (0.438-1.056)	0.225	1	0.086
Tertiary public hospital	0.248	1.282 (0.841-1.954)	0.215	1	0.248
Private hospital	0.052	1.054 (0.729-1.523)	0.188	1	0.780
Age				3	0.006
18-29	Ref.	Ref.			
30-39	-0.411	0.663 (0.445-0.988)	0.204	1	0.043
40-49	-0.895	0.409 (0.201-0.832)	0.363	1	0.014
≥50	-1.626	0.197 (0.078-0.498)	0.474	1	<0.001
Gender					
Female	Ref.	Ref.			
Male	-0.105	0.900 (0.627-1.292)	0.184	1	0.568
Education level				2	0.791
Junior college	Ref.	Ref.			
College/Bachelor degree	-0.232	0.793 (0.393-1.598)	0.358	1	0.516
Master degree or above	-0.297	0.743 (0.304-1.815)	0.456	1	0.515
Professional level				2	0.704
Junior	Ref.	Ref.			
Intermediate	0.105	1.111 (0.765-1.613)	0.190	1	0.579
Senior	0.249	1.283 (0.709-2.323)	0.303	1	0.411
Specialty					
Nurse	Ref.	Ref.			
Doctor	-0.864	0.421 (0.304-0.584)	0.167	1	<0.001
Years in practice				2	0.153
0-9	Ref.	Ref.			
10-19	0.393	1.481 (0.993-2.209)	0.204	1	0.054
≥20	0.270	1.310 (0.639-2.685)	0.366	1	0.461
Hours worked per week					
≤ 40	Ref.	Ref.			
>40	-0.151	0.860 (0.629-1.176)	0.160	1	0.344
Degree of knowledge towards e-hospitals	0.810	2.247 (1.861-2.712)	0.096	1	<0.001
Experience of online medical services, n (%)					
No	Ref.	Ref.			
Yes	1.165	3.205 (2.336-4.397)	0.161	1	<0.001

-2lnL=1425.986; Hosmer and Lemeshow test: χ^2=5.043, P=0.753

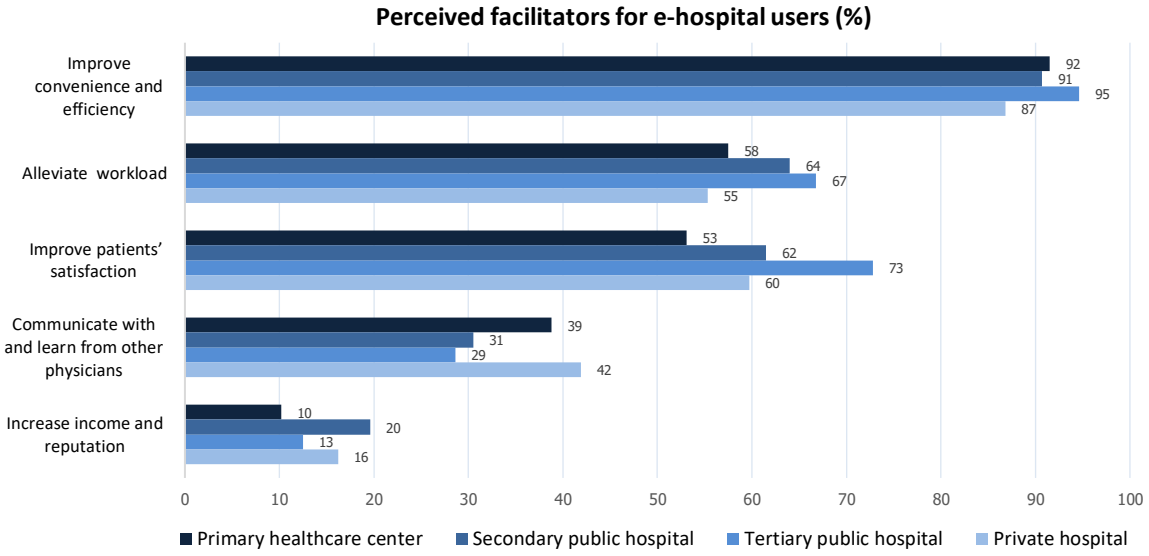

Figure 1. Perceived facilitators for users of e-hospitals

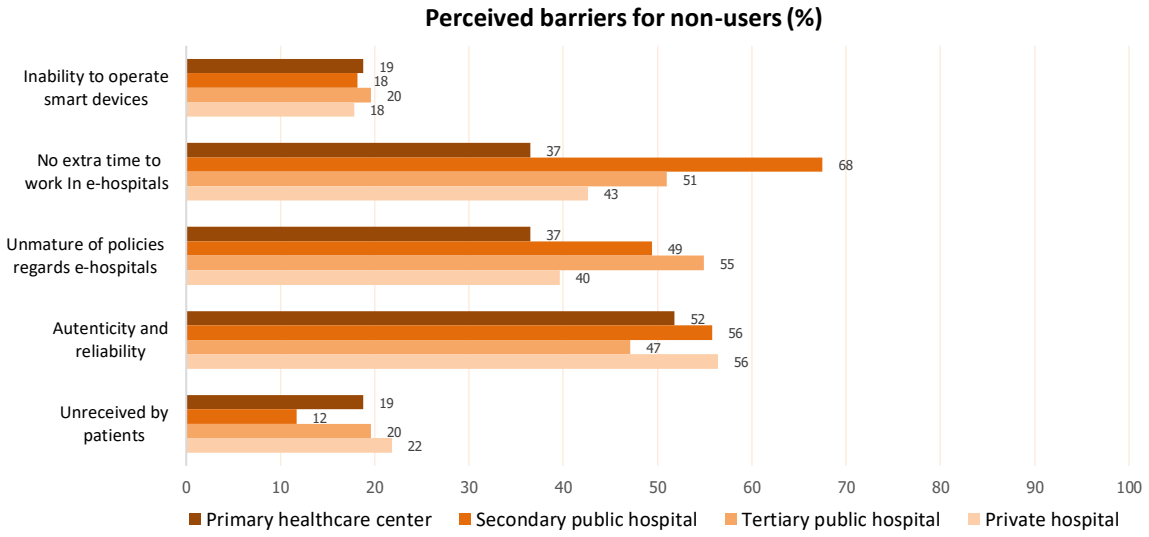

Figure 2. Perceived barriers for non-users