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Review

Mobile health in China: Current status and future development

Huijun Li [a,*], Tianhong Zhang [b], Hongmei Chi [a], Yingmei Chen [c], Yue Li [d], Jijun Wang [b]

[a] Florida A & M University, United States
[b] Shanghai Mental Health Center, Shanghai Jiaotong University School of Medicine, China
[c] Guangzhou Brain Hospital, Affiliated Psychiatric Hospital of Guangzhou Medical University, China
[d] Florida State University, United States

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ABSTRACT

Mobile health applications offer unique opportunities for monitoring patient progress, providing education materials to patients and family members, receiving personalized prompts and support, collecting ecologically valid data, and using self-management interventions when and where they are needed. Mobile health application services to mental illness have evidenced success in Western countries. However, they are still in the initial stage of development in China. The purpose of this paper is to identify needs for mobile health in China, present major mobile health products and technology in China, introduce mobile and digital psychiatric services, and discuss ethical issues and challenges in mobile health development in a country with the largest population in the world.

Contents

Digital-health, E-health or mobile-health has been developing rapidly in western and developed countries. Currently about 85% (BBC, 2012)–97% (Sanou, 2013) of the world's population have access to a mobile phone. Mobile health is defined as the use of small, portable computers or telecommunications equipment to meet the needs of consumers about health care or health information services (Chen, 2012). Mobile communication devices include laptops, portable computers, wireless phones, tablets, smart phones, and radio frequency identification (RFID) technology, etc. One important development, however, is smart phone applications of mobile health (Wu, 2013). The mobile health applications offer unique opportunities for monitoring progress, providing education materials, receiving personalized prompts and support, collecting ecologically valid data, and using self-management interventions when and where they are needed (Donker et al., 2013). The purpose of this paper is to identify needs and current status of mobile health in China. This paper is composed of six sections: (1) needs for mobile health in China, (2) major mobile health products and technology in China, (3) mobile and digital psychiatric services, (4) ethical issues related to mobile health, (5) challenges in mobile health development, and (6) prospectus of mobile health technology development in China.

1. The needs for mobile health in China

Mobile phones are widely distributed in different parts of the world due to its decreasing cost. The global smart phone users will reach 1.4 billion in 2015, of which one-third of the users will install

* Corresponding author. Tel.: +1 850 412 6608.
E-mail addresses: huijun.li@famu.edu, huisofi@gmail.com (H. Li).

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health-related mobile applications in their phones (Gao, 2012). In 2011, the Price Waterhouse Consulting Corporation (PwC) commissioned the Economist Intelligence Unit (EIU) for the investigation of market potential of mobile health worldwide (involving a total of more than 1000 patients, 433 doctors and 345 clients) (Zhang, 2012). This survey included 103 Chinese patients, 76 Chinese doctors, 31 hospitals and 14 government officials and managers within the medical insurance field. The survey results indicate a great need for the development of Chinese mobile health market. In addition, China has approximately 1.2 billion mobile phone users (total Chinese population is 1.38 billion), this number is still growing (Woodhouse, 2013). According to the International Telecommunication Union and the Chinese Ministry of Industry and Information Industry Data, mobile phone users will reach about 95% coverage in 2015. Meanwhile, China's basic medical insurance coverage is also expanding and will reach about 97% coverage in 2015 (Zhang, 2012).

Mobile health application services to mental illness have evidenced success in Western countries (Wang and Guo, 2011). However, they are still in the initial stage of development in China. Currently, the U.S. leads in mobile health application development, making up more than 50% worldwide. Europe accounts for 20%, Africa and Latin America, 12%, and, Asia-Pacific, only 4% (Wang and Guo, 2011). Therefore, it seems the promotion of mobile health application development in China is much needed.

As indicated above, mobile health services are just emerging in China, creating great potential to serve patients with mental illness. Mobile health provides clinical services and information through PDAs, mobile phones and satellite communication technology. Mobile health is a new concept for most patients with mental and illness in China. Yet, many Chinese people are familiar with wireless network technology, tablet PC, and smart phones. Through wireless network technology and tablet PC, medical staff can obtain medical records in a faster, more accurate, and more effective way allowing medical decisions to be made and delivered quickly. Furthermore, patients can get medical services in a more convenient way through network technology collaboration and medical information system integration technology. This kind of integration and combination of mobile information technology and/or designated mobile vehicles and medical health services will optimize medical resource allocation to a maximum degree, and in the end, to benefit patients.

In addition, the traditional face-to-face medical model can no longer meet the increasing patient needs for medical services in China. Mobile health can be widely used in information dissemination and communication, followed by diagnostic and treatment applications. Mobile health functions can facilitate illness surveillance and monitoring, and subsequently improve medical resources allocation at a national level. Furthermore, at an individual level, mobile health may alleviate patient burden, such as expensive travel and accommodation costs (Ha and Ji, 2013). Mobile health may also decrease delayed or aborted treatments and prevent problematic interactions between doctors and patients/patient family, which have increased tremendously over the last few years (Medical Information, undated). With the emergence of individualized smart phones and the development of mobile health applications, mobile health service may become a promising direction for Chinese people who are in need of health services and information (Ha and Ji, 2013), mental health care in particular.

2. Mobile health applications in treating mental illnesses in China

Statistics released by China Center for Disease Control in 2009 shows that there are more than 100 million people with mental illness and over 16 million with major mental disorders (Medical Information, n.d.). In other words, one in 13 people develop some kind of mental disorder in China, and approximately one in 100 experience serious mental disorders. Unfortunately, few people seek help from mental health professionals due to stigma, culturally formed beliefs about mental illness, and lack of access to services. For example, the life-time prevalence of depression amounts to 4% of Chinese population, or approximately 26 million people. Only about one third of those affected sought mental health treatment and 10% have received proper medication (Medical Information, n.d.). Most patients abandon treatment right after their first hospital visit.

In addition, schizophrenia is a chronic mental illness with high rate of relapse and disability, accounting for 50% hospitalized psychiatric patients (Wang and Fang, 2011). About 75% of schizophrenia patients have social function deficits. Furthermore, these patients often experience difficulties in managing their social life, family responsibilities and social obligations. According to a research report in China, schizophrenia leads to 93.6% of disability rate, bringing about a significant burden to China's mental health services (Wang and Ma, 2012). Furthermore, there is an extreme lack of mental health services. By the end of 2005, there were only 575 mental health medical institutions nationwide, with a number of 132,000 beds. This means that there were 1.04 beds per 10,000 people on average, fewer than the world average, which was 4.3 per 10,000 (Medical Information, undated).

Therefore, a type of de-stigmatized and culturally sensitive mobile health application may be a great option to engage patients in self and professional help and benefit patients and care-givers in terms of long-term care and family burden reduction. However, there are very limited mobile health applications for mental disorders in China. A graduate student from Beijing University of Posts and Telecommunications designed and implemented a mobile mental health service application to provide services to people who experienced a traumatic earthquake (Zhang, 2010). This seems to be one of the earlier attempts to address mental health with mobile health technology, while most mobile health in China focuses on physical health.

3. Mobile health and tele-consultation in China

Mobile health technology has promoted the development of teleconsultation. Teleconsultation is cross-regional medical consultation by means of computer and communication technology between medical institutions. The First Affiliated Hospital of Zhejiang University School of Medicine began an official implementation of a new model of health care services called "smart medicine, handheld Zhejiang Hospital" (Wang et al, 2012). Based on the framework of digital hospital construction, they innovatively designed the first medical mobile applications, integrating medical information gathered from pre-diagnosis, diagnosis, and post-diagnosis stages. This mobile health application includes smart triage for medical help, real-time registration, phone inquiry, and medicine information. People are also able to browse health information from an encyclopedia like source, which is regularly updated on the mobile applications. To a certain extent, this mobile health application, though not specifically for mental health, may change the disease intervention to prevention, keeping healthy people away from disease, including mental illness.

4. Ethical issues related to mobile health services

Mobile health systems may improve quality of healthcare and patients' and family members' quality of life, they may also generate new security and privacy issues for patients. Those concerns have to be addressed before mobile health is widely

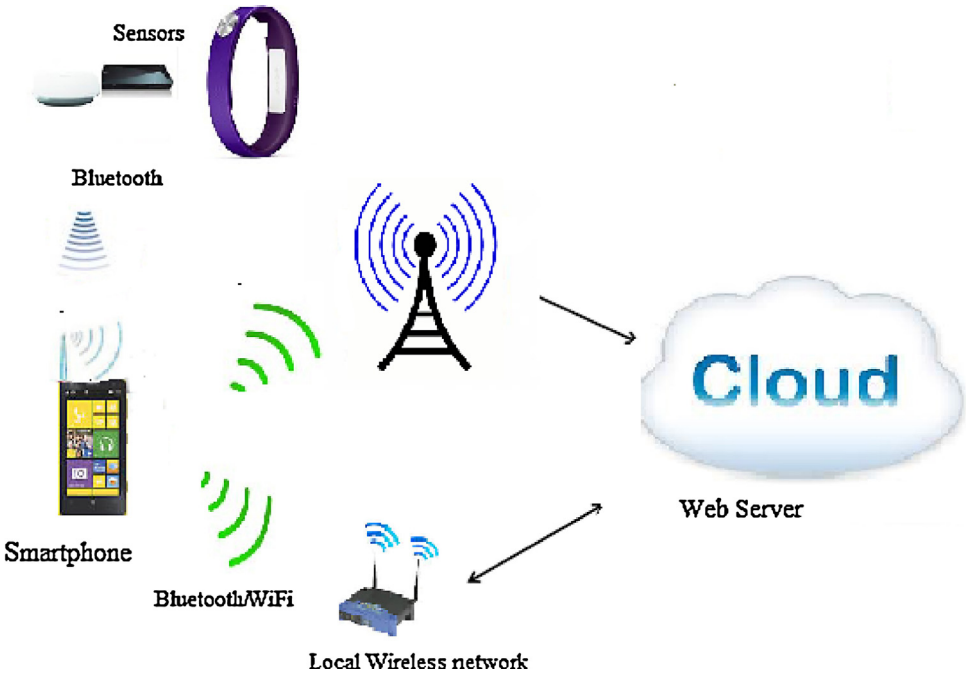

Fig. 1. A system structure for mobile health.

adopted. Fig. 1 illustrates one basic system structure of mobile health system and this system includes three components: wearable sensors, smartphone, and web server (Zhou et al., 2010). The smart phones store test results into the patient's electronic health records, which will be posted on web-based service site. The patient's doctor will get a notification to look at the test results and give the immediate feedback to the patient. Breach of privacy and confidential information may occur at any stage. For example, mobile phones can easily get lost and that makes patients' data in jeopardy.

From a cultural perspective, mental illness is often considered as a family problem in Chinese families (Kim and Omizo, 2003; Phillips et al., 2013). Seeking mental health services implies a loss of "face" (Shea and Yeh, 2008), and has to be weighed seriously not solely by the individual with mental illness but by family members (Phillips et al., 2013; Pearson, 1993). Although China's first Mental Health Law stipulates that patient treatment needs to be voluntary, many outpatients are accompanied by their family members when they seek help in a mental health hospital or clinic. Furthermore, most patients with severe mental disorders requiring hospitalization are still admitted involuntarily by their family members (Phillips et al., 2013). Therefore, culturally sensitive ethical principles are needed to safeguard privacy between patient and family members and among patient and family members and health care providers.

5. Challenges and promises of mobile health development in China

Mobile mental health services create great opportunities in China. Several fundamental challenges need to be addressed if mobile health is to fulfill its promise of transforming the delivery of health services in China. First of all, there is no family doctors system like U.S., patients in China have to know where and who they can trust and who will respond to their requests and give feedback. Meanwhile, doctors are overwhelmed during their daily work and they may not have time and energy to give feedback to remote patients. Secondly, nationwide regulation and standards have to in place before mobile health can be widely delivered. Without established standards and regulations, mobile health developers, patients, health providers, and policy makers may not understand how the systems or standards work. This may hinder technical capacity development and service utilization (The PLOS, 2013). Hospitals, academia, industries, and government agencies have to work together to explore standards and regulations for mobile health services. Thirdly, training and educating stakeholders (patients, health professionals, and mobile health developers) is a huge task in China. Since patients are in control of their own electronic health record, patients have to understand when, who, where and what to release their records and the risks of doing so. Some trusted organizations need to be in place if patients need help to consult their rights and concerns.

Nevertheless, China is far more mobile than any other country in the world and it may lead mobile health revolution along with the United States (West and Bleiberg, 2014). First, as most of existing mental health applications are developed and used in developed countries (Wang and Guo, 2011), researchers, clinicians, and computer scientists can work together to modify mental health applications in use in the western countries to fit the need of Chinese mental health patients, families, and hospitals. Secondly, they can develop their own mental health applications targeting different mental illness to provide informal support or formal treatment, promote greater self-monitoring, increase positive behavior change, and enhance contact and relationship between patients and mental health professionals. Thirdly, stakeholders in China may integrate evidence-based and culturally sensitive intervention strategies involving family members into software applications for smartphones in China, opening the possibility of applying similar intervention modalities for different mental illnesses. Fourthly, tele-consultation technology and model focusing on mental illnesses can be developed to reach more remote areas where mental health services is greatly lacking.

In short, mobile health applications have the potential to provide more convenient health care services, improve or maintain the health status and quality of life of patients and their family members, and promote the development of the health industry as well as the health environment in the most populous country like China (Yu, 2013). Based on the needs reviewed above, resources in

existence, analysis of market demand, and the advantages of mobile medical services, we believe that it is urgent that the application of mobile health technology in health, mental health services in particular, be promoted in China.

Contributors

Huijun Li conceptualized the paper. Huijun Li, Hongmei Chi, Tianhong Zhang, Yue Li, and Yinmei Chen wrote the first draft of the paper. Jijun Wang edited the paper. All authors have approved the final manuscript.

Conflict of interest

There are no conflicts of interest to report.

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Appendix

Summary of non-indexed articles cited

Gao, Y.F., 2012. Promise and prospects of mobile health. *Chinese Hospital Presidents* 9, 65–68.

The author reviewed the current status of global mobile health in the following themes: (1) promising trend, (2) applications for different settings (emergency, hospitals, etc.), and (3) applications for medical professionals and patients, and finally challenges (such as technical, policy, theoretical related issues) in implementing mobile health applications.

Wang, Y., Ma, L., 2012. The implementation of whole intervention service model among patients with schizophrenia in recovery. Chin. Nurs. Manage. 04, 22–24.

The authors reported the prevalence of schizophrenia, hospitalization rate, and negative impact in patients and family members' life in China. Specifically, they presented foreign and domestic psychiatric service status, the whole intervention services model from diagnosis, intervention, to recovery, for patients with schizophrenia, case presentation of this model being used in one hospital.

Yu, L.J., Y.Q., 2013. The implementation and development of mobile health technology in medical services. Health Econ. Res. 8, 60–62.

The authors introduced the development of web-based appointment, virtual clinical diagnosis, mobile hospital in China. Their article consists of the following major sections: (1) implication of mobile health, (2) implementation of mobile health application services among patients, (3) development trend of mobile/virtual hospitals.

Zhang, W.Y., 2012. Great potential of Chinese mobile health market. Chin. Med. School CEO 18, 28–29.

The author analyzed the potential mobile health market in China with existing reports on mobile health development. The author presented information on rapid mobile phone user development in China and challenges in health care due to the increase of people who are getting health insurance. Traditional face-to-face health care may not be able to meet the patient demand, opening a great opportunity for mobile health services. The author also described different demands for mobile health from patients and health care providers and different service modalities.

Wang, H.Y., Guo, Zh.J., 2011. Overseas mobile health information development. Mod. Electron. Inform. Technol. 04, 10–14.

The authors reviewed mobile health service development overseas. The following areas are covered in their article: (1) current application status of mobile medical information services, including mobile medical service terminals as well as service types, prevalence, and environment, (2) involvement of enterprise in medical information development, including establishing health information department at an enterprise, establishing partnership, arranging basic network security measures. Lastly, the authors presented the contribution of AT& T to mobile and web-based health service development.

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