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# Prospective Analysis of the Mobile Health Information Systems in China

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**ABSTRACT**

With the rapidly growing economy in the past few decades, people of China (mainland) are now enjoying increasingly more economic benefits than ever before. Of many growing technologies, mobile devices, especially cell phones, have been gaining popularity throughout the country. According to the latest statistics in 2007, more than one third of Chinese have cell phones. In addition to the basic uses of voice communication, cell phones have many other promising applications. Particularly, as a pervasive technology, mobile devices offer a great opportunity to deliver health information directly to people with an affordable cost. This paper analyzes the potential of mobile health information systems in China. This prospective analysis will be conducted from four important perspectives: technology, market demand, business model, and government policy.

**Keywords**

Mobile phone, health information system, mobile commerce.

## INTRODUCTION

With the appearance of various mobile devices such as cell phone and personal digital assistant (PDA), mobile commerce applications have been developed and studied widely. Mobile commerce is quite popular in many areas, such as mobile financial services, location-based services, user and location specific mobile advertising, mobile inventory management, wireless business re-engineering, mobile entertainment services and games, and product locating and searching (Malloy, Varshney and Snow, 2002; Ngai and Gunasekaran, 2007). The mobile devices are able to offer very personalized services to consumers based on their needs, preference, personality, and other personal information. As a persuasive communication device and interaction tool, mobile devices will play an even more important role in serving people's information needs in the future.

In the past few decades, the Chinese economy has been rapidly growing. People enjoy more benefits from the increasing economy than ever before. More and more new electronic devices come into people's life and make their life happier and easier. Offering health information service to Chinese people is a very promising area of mobile application. From their cell phones, people can acquire personalized health information, such as just-in-time diet suggestion, alert of medicine and exercise, reminder of regular health examination, and important government policy and news. The mobile health information service will have significant social implications in improving people's healthcare. In China, wealthy people are not satisfied with enough food and clothes, but are looking for a quality life of high nutrient food, comfortable living, health care and other quality services (Hubacek, Guan, and Barua, 2007). The mobile health information service will help Chinese people achieve their increasing expectation to quality healthcare. As we know, healthcare is very expensive, even in developed countries, such as the US and Canada. Building a nation wide healthcare system is not easy to many developing countries. Healthcare is lagging far behind many other social changes in China. In particular, people in rural areas are facing serious problems in getting health care (Dummer and Cook, 2007). In addition to the financial problem in offering health care in rural areas, the pervasiveness of health information and knowledge is another major concern.

This paper will conduct a prospective analysis of Chinese mobile health information systems based on published articles and published official data from both industry and government. In the following sections, this paper will review the importance of health information services in China; propose a framework of mobile health information systems of China; conduct a prospective analysis of the proposed systems; summarize findings, and draw conclusions.

## HEALTH INFORMATION SERVICES IN THE INTERNET AGE

People are facing various health issues, such as heart disease, diabetes and mental disease, which seriously affect their life and life quality. In developed countries, many lifestyle related problems have existed for a long time, and their people already accumulated education from their families and schools. The development of medical science offers people more opportunities to receive early diagnosis and treatment. To keep healthy, people keep watching some important numbers of their bodies. These numbers tell them whether their body is in the normal range. For example, in cardiovascular health awareness, people are aware of normal or desired health values, such as body mass index, blood sugar level, blood cholesterol level, and blood pressure (King, Harrell, Hester, Johnson, Wofford and Noble, 2004). Also, the healthcare systems in developed countries have practiced awareness alerting through regular health check of their citizens.

Public education of health care knowledge is an effective means of increasing health awareness, promoting lifestyle modifications, and improving early disease detection (Fuster, 2007). The health information and knowledge is especially important in the rapidly developing countries like China. Although China has enjoyed the rapid economic development in past few decades, Chinese people's health care awareness is still far behind. The timely awareness of health condition helps people to discover their health problems early, to receive appropriate treatment, and to take appropriate preventive approaches. In China, some non-healthy life styles are still considered as a fashion, for example: smoking and heavy alcohol drinking. With the economic development and a change toward a lifestyle that is lacking in physical activity and rich in high-fat diet, prevalence of diabetes of the Chinese populations are on the rise (Wong and Wang, 2006). An increasing incidence of coronary artery disease also can be attributed to the increasing affluence, the westernization of everyday dietary habit and lifestyle, and the rampant cigarette smoking (Cheng, 2004). Many newer rich people such as successful businessman and celebrities have passed away in their 50s and early 60s if not younger. In China, about 1.5% deaths of this population can be attributed to cigarette smoking and heavy alcohol consumption (Xu, Zhang, Gao, Xiang, Gao, Zheng and Shu, 2007). Chinese people also are increasingly threatened by many other lifestyle related diseases and problems. Most importantly, many Chinese people are lacking the education and awareness of their lifestyle. People go to the hospital to visit doctors only when they realize they are sick. And this is often too late for patients to get timely and appropriate treatment. Indeed, many people have lost their lives from their ignorance of health knowledge.

As an important innovation in the age of information and knowledge, Internet is becoming an important approach to deliver and share information and knowledge. Globally, people now are relying on the Internet to access information and knowledge in their work, study, and daily life more and more. Internet in China has experienced rapid development with the number of Internet users increasing from 620,000 in 1997 to 162 million in June 2007 (China Internet Network Information Center, 2007). In China, Internet is becoming an important resource for people to get health information and knowledge. Many information web stations, such as www.people.com.cn and www.sina.com, have links to such websites as news.sina.com.cn/health/ and health.people.com.cn/GB/index.html, which offer health information and knowledge regularly. Specialized health web stations, such as Kangkang net (www.kangkang.com) and CNKang net (www.cnkang.com), are offering a wide range of health information services, including: healthy diet, disease related knowledge, and self-diagnosis tools for example: how to diagnose diabetes. Kangkan and CNKang also offer health related government policy and latest news about medicine and epidemics. This health and medical knowledge is classified into many categories: disease, age, gender, season, to name only a few. These health information web stations also offer information of doctors and hospitals in China. People can join virtual communities to share information, knowledge and experience about different kinds of health and medical issues. They can consult medical experts online about various health questions as well. Internet-based health web stations play a critical role in distributing and sharing health information and knowledge. They are acquiring more popularity among Chinese people.

Nevertheless, the limitation of these existing internet-based medical stations is apparent. The user must have an Internet connected computer to access these health web stations. The development of Internet in China is extremely unbalanced. In rural areas, the number of Internet users is far behind that of the urban areas. "By the end of 2006, the number of computers owned by the rural families was 2.7 per hundred families, far lower than the average of 47.2 per hundred families in urban areas. Compared to the number by the end of 2005, the number of computers owned by every hundred rural families increased by 0.6 while for urban families by 5.7, with the gap in Internet-related infrastructures still enlarging" (China Internet Network Information Center, 2007). In rural areas, 48% of users access the Internet from the Internet Cafes (China Internet Network Information Center, 2007). Therefore, many people who lack health information and knowledge still do not have Internet access or do not know how to access the health knowledge from the Internet. Compared to computers, mobile platform is a more practical way to distribute health information and knowledge in modern China. Now, almost half of the population in China has a cell phone (www.mc21st.com). To most Chinese people, the cell phone is more useful, affordable and convenient. People can access the health information and knowledge from their cell phones.

## MOBILE HEALTH INFORMATION SYSTEMS

With the development of mobile technologies, mobile devices, especially the personal digital assistants, have been gradually adopted into the health/medical information systems to support the medical related activities by physicians and other health-care professionals (Baumgart, 2005). As reviewed by Lu, Xiao, Sears and Jacko (2005), the PDA based medical applications include decision support, administrative support, documentation, professional activities, education and research. For example, a PDA based online medical ordering system was developed to help physicians in their daily clinical activities (Chen, Chiu, Tsai, Chang and Chong, 2007). In the United States and Canada, the PDA adoption rate for medical professionals, such as physicians, pharmacists, and nurses, is approximately 40% (Lu et al., 2005). In Australia, the PDA based held clinical care management system is used to help the data collection at an Aged Care Facility (Chau and Turner, 2006). A personal digital assistant based clinical learning tool is used to promote professional education and training of medical students and professionals (Garrett and Jackson, 2006).

The wide acceptance of mobile devices has induced great societal changes in China (Sangwan and Pau, 2005). Due to its mobility, pervasiveness, popularity and affordability, the cell phone is becoming a very promising tool to solve the issue of information unbalance in China. The cell phones allow more people to interact with the online health information resources than any other tools. Particularly, the adoption of mobile phones in Chinese rural areas has been increasing dramatically in the past decade (Wei and Zhang, 2006). According to a national survey, approximately 62 mobile phones were owned by each hundred rural households in 2006, which is 23.5% higher than that of year 2005 (National Bureau of Statistics of China, 2007). The cell phone is the most reachable personal device in both urban and rural areas of China. The cell phone is also an interactive tool. Users can browse the Internet using the cell phone as well as ask questions using the small keyboard easily. Different from what people from other countries might think, the keyboard input of Chinese characters is not very difficult. Various pronunciation based input (pinyin) and shape stroke based input allows people to enter Chinese characters on mobile phones (Lin and Sears, 2005). In China, people enjoy entering and sending short messages to friends such as information alerting, jokes and holiday greetings. By the end of July 2007, there are 328.4 billion short messages transferred over the cell phones from January 2007(www.mc21st.com).

Cell phones enable the delivery of personalized information. For example, the advertiser can schedule ads to reach the prospect consumers at the proper time and place, such as the consumer's coming to a mall (Tripathi and Nair, 2007). Health information services can also be delivered in personalized ways. For example, people with higher cholesterol, can check how much meat they should consume every day. The cell phones can offer people the health information service tailored according to each consumer's personal need and preference.

The mobile health information service can help people from two perspectives:

**Personal Health Information Service:** This category of information includes the health information specific to the individuals. It can include the following information.

- Alert of dangerous health signals and pre-diagnosis recommendation,
- Medicine taking reminders,
- Diet information and Exercise suggestions,
- Regular health check reminders,
- Food and beverage ingredients and nutrition checking,
- Alerting of Traveling in Specific Areas,
- Emergence help and Suggestions,
- Nearby medical service information,
- Etc.

**Public Health Information Service:** This category of information includes the general health information related to the public. It can include the following information.

- News of health and epidemic,
- Government policy and regulations,
- Expert opinions of health issues,
- Education of health and medicine,

- Etc.

With the mobile health information system, mobile users can get timely answers to their personal health related issues. The personal information includes: name, age, gender, marital status, family history, health status, career type and status, location, etc. See Figure 1:

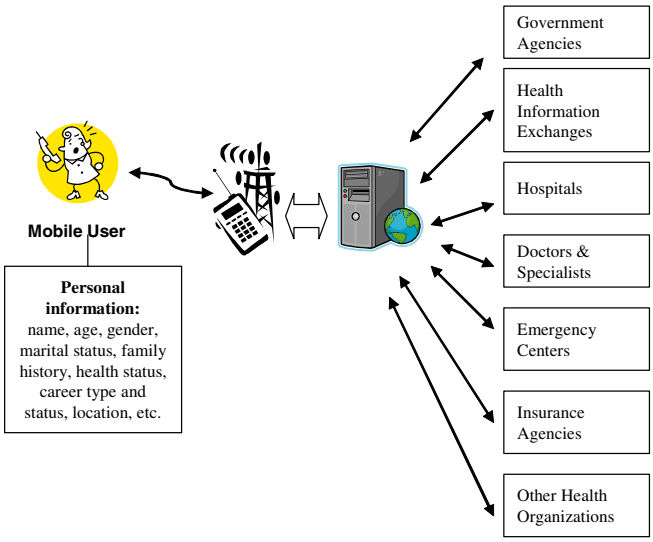


**Figure 1. Framework of Mobile Health Information Systems**

## PROSPECTIVE ANALYSIS OF THE MOBILE HEALTH INFORMATION SYSTEMS IN CHINA

Next, we analyze the potential of mobile health information system from four perspectives based the proved model applied in the same environment of modern China. Yuan, Zheng, Wang, Xu, Yang and Gao (2006) suggested and applied this model in assessing the mobile service in China. Using this model, we compare the mobile health system with computer based Internet health system. This assessment model includes four major stakeholders: the technology perspective from the technology developers, the market demand perspective from the customers, the business model perspective from industry and the government policy perspectives (Yuan et al., 2006). See Table 1:

| **Perspective** | **Dimension** | **Questions** |
|---|---|---|
| Technology (developers) | Cost savings | Does it have advantages of cost savings? |
| | Quality of service | Does it provide high quality of service? |
| Market demand (customers) | Market target | What is the market segment it serves? |
| | Size of the market | How big is the market? |
| | Potential growth | Can it sustain future growth? |
| Business model (industry) | Value proposition | What value can it provide to customers? |
| | Business partnership | Can it form an effective value chain for value-added services? |
| | Competitive advantage | Can it provide competitive advantages over competitors? |

| Perspective | Dimension | Questions |
|---|---|---|
| Government policy (government) | Government objectives | Can it meet government's long term objectives? |
| | Government support | Can it receive financial support from government? |

**Table 1. Theoretical Assessment Model (Adapted from Yuan et al., 2006)**

- Technology

**Cost savings:** In China, the cost of surfing the Internet from a cell phone is several times more expensive than from an Internet connected computer (China Internet Network Information Center, 2008). However, about half of Chinese populations now already have cell phones. Therefore, many people do not need to buy cell phones just for using the mobile health information. At the same time, other competitive advantages of cell phones – pervasiveness, mobility, and popularity, can compensate the disadvantages of higher cost, especially in the rural areas. In rural areas, most people are more inclined to buy a cell phone than to buy a computer, since many people in rural areas consider computer a device for entertainment. On the other hand, if the 3G technology is officially adopted in the near future, the 3G phones' price will be much lower than now. Some Chinese telecommunication experts predict the 3G phones will be as cheap as about 200 Chinese Yuan (about US $28.53), rather than about 2000 Chinese Yuan now (www.mc21st.com). In the future, the cost of using mobile health information systems will become more affordable.

**Quality of service:** Currently, the 3G is not officially adopted in China; surfing the Internet from a cell phone is very slow (China Internet Network Information Center, 2008). According to the report of China Internet network information center (CNNIC), 50.4 million, 21.6% of all cell phone users, are now surfing the Internet (China Internet Network Information Center, 2008). The major mobile Internet users are college students, workers, people in service areas, and professionals like professors, and engineers (China Internet Network Information Center, 2008). This number is rapidly increasing. If the people in rural areas realize that they can get health information and knowledge from the Internet using a cell phone, many people will likely access the Internet from their cell phones or other mobile devices.

In the future, with the adoption of 3G cell phone, people can easily listen to or watch health news, receive medical knowledge and expert advice from their handy cell phone. Audio and video information can play important role in distributing health information and knowledge. A smart phone is a full-featured mobile phone with the functionality similar to a personal computer (en.wikipedia.org). In addition to traditional cell phone personal information management (PIM) applications, other smart phone applications include simple games, built-in camera, audio/video playback and recording, instant messaging, e-mail, wireless Internet, mobile terminal for e-commerce, enterprise applications, and value-added, location-based services (Zheng and Ni, 2006). Now, smart phones are common among white-collar users. However, more and more users will adopt smart phones in the near future. Applications are similar to the personal digital assistant (PDA) function. As a personalized device, smart phones are suitable for personal healthcare recommendations based on personal and location information. With apparent popularity, the smart phone is to be a logical choice as client platform for M-Commerce (Chang and Chen, 2005).

- Market Demand

**Market target and size of the market:** There is a great market of the mobile health service in China. There are 1.3 billion citizens in China and about 700 million of them are living in rural areas. The Chinese population is very dynamic. Many people belong to the floating population. According to wikipedia's definition, under China's household registration system, the floating population left their registered residences in order to work or live in other locations; this is similar to internal migration (zh.wikipedia.org). In 2006, China has a floating population of 150 million people (China Net, 2006). This number has been rapidly increasing since then. Usually, people's healthcare insurance is related in their registered residence; therefore it is inconvenient for the floating population to receive healthcare (zh.wikipedia.org). Mobile health information system will help the floating people and travelers to access health resources quickly no matter where they are.

**Potential growth:** With the rapidly growing economy, there is an increasing demand of quality healthcare. By December 2007, the number of mobile phone subscribers in China has exceeded 547 million (China Ministry of Information Industry, 2008). With huge numbers of cell phone users in China, people would like to receive health information service through their cell phones. The current price of a smart phone is still high. Business people and high income professionals are the primary smart phone users. But we can expect that the use of smart phone will expand. If there are really valuable applications, many people, especially people in the rural areas, will choose a smart phone. On the other hand, one important reason of slow

adoption of 3G in China is the lack of really valuable applications. The mobile health information system is among such types of vital applications of 3G. Therefore, the successful development of health information system will also help the adoption of the 3G and smart phones.

Very often, patients need help from a doctor but the doctor is not in place; a physician sometimes needs help from another physician working in another location. With the 2.5G/3G technologies, the cell phones can transmit medical images between doctors and patients, and other doctors, such as taking pictures of the computed tomography (CT) screen with a built-in camera of a mobile phone (Hyodo, Chihara, Yasumuro, Imura, Manabe, Masuda and Naganaw, 2005). That is, when the required doctor is not on site, people can send medical pictures to the doctor using cell phone for remote diagnosis.

- Business Model

**Value proposition:** The mobile commerce offers consumers more benefits than the traditional electronic commerce: 1) location awareness: mobile commerce can be conducted based on the consumer's specific location; 2) conditions of usage: mobile commerce can be conducted even when the consumer is doing other activities; 3) adaptivity: mobile commerce can be adapted to the environment of the consumers; 4) ubiquity: mobile commerce services and applications are available anywhere at anytime; 5) personalization: mobile commerce must be delivered in personalized forms to enable the consumer to reach the desired services easily; 6) broadcasting: the broadcasting operation can deliver information of common interest to many users (Tsalgatidou and Pitoura, 2001). Since the mobile phones have the much wider adoption than the internet connected computers, the mobile health information system can offer personalized information services to more people. The personalized health services can target patients with specific diseases who require regular and specific treatment and suggestions, and people with more specialized health service requirement. The mobile health information system also offers location based and timely health information services. The mobile devices offer important health and medical information to a wide range of people in a convenient and affordable way.

**Business partnership:** In China, the current telecommunication network operators have already formed mature value chains, which consist of network equipment providers, end user terminal providers, technology developers, network operators, service providers and customers (Yuan et al., 2006). The mobile health information systems can join the existing value chains that cover more mobile users in each area. Current vendors of information web stations could partner with software developers, cell phone service providers, medical service providers and the Chinese ministry of health in providing the mobile health information service. The business model can be based on subscription and charged advertisement from health service providers. For example, the mobile users can pay a monthly fee to receive personalized health services. For the public health education and consultation, the common users can access these services without payment. These general services can be supported by the charged advertisement from various service providers.

**Competitive advantage:** The cell phone has significant competitive advantage over Internet connected computers. The number of Internet users in rural areas is 30% of that in urban areas (China Internet Network Information Center, 2007). In fact, many Internet users in rural areas access the Internet from Internet cafés, and the main purpose of Internet surfing is entertainment (China Internet Network Information Center, 2007). "By the end of 2006, the number of computers owned by the rural families was 2.7 per hundred families, far lower than the average of 47.2 per hundred families in urban areas" (China Internet Network Information Center, 2007). Therefore, most users of the online health information services are in urban areas, although most of the Chinese population is in rural areas. The cell phones have far more pervasiveness in providing health information service to the rural areas.

- Government policy

**Government objectives:** the Chinese government has been working to provide nationwide healthcare for a long time. To provide healthcare for 1.3 billion citizens, especially to people living in rural areas, is an urgent and difficult task for the government. Due to the huge population and the vast geographic span of China, it is very hard to utilize other approaches to reach people in an interactive way all over the country. In the past few decades, various policies and approaches have been developed to provide affordable and effective medical care, health promotion with an emphasis on prevention first strategies and financing of health care through cooperative means (Dummer and Cook, 2007; Hsiao, 1995; Wang, Gu and Dupre, 2008). To promote nation-wide healthcare, the central government has been developing many initiatives using information systems, especially the Internet, to distribute health knowledge, manage community medical information, and support distance medicine (www.moh.gov.cn/menunews/C305.htm).

As indicated in the development guidelines of Chinese nationwide health information system of 2003-2010, in 2010, China will reach the goal of developing a nationwide public health information system; this health information system will include the following important functions: e-government, medical insurance services, community health services, doctor referral, electronic medical records of residents, telemedicine, online health education and consultation, with the goal of providing an

integrated health information system to support preventive health services, medical service and medical management (China Ministry of Health, 2003).

**Government support:** We do not have the exact number of financial investment from the Chinese government to the mobile health information system. However, the officially published document clearly indicates that the all levels of Chinese government will increase the investment in the health information system (China Ministry of Health, 2003). In China, significant resources have been committed and will continue to be committed to construct and improve the hospital health information systems and public health information systems (Zhang, Xu, Shang and Rao, 2007). With the mobility, pervasiveness and wide acceptance of mobile devices, especially the cell phone in China, the development of mobile health information system is highly aligned with the Chinese government's strategic goal in promoting people's health using modern information technologies. The mobile health information system can support many of the suggested functions mentioned in the development guidelines of Chinese nationwide health information system of 2003-2010. With the cell phone, mobile users can check the health related government policy, information, news, and alerts; mobile users can access their insurance information so they can pay the received health care no matter where they are; mobile users can find the nearby doctors when they are traveling and away from their permanent residence; mobile users can consult the doctors opinions when they have an emergency.

## SUMMARY AND CONCLUSIONS

This paper investigates the potential of Chinese mobile health information system from four perspectives: technology, market, business model, and government policy. The analysis results indicate that the mobile health information system will be a very promising application in China. The mobile communication service providers and health service providers can open a new and promising market. It can run on the profits of offered services.

The mobile health systems will facilitate the development of patient-centered health care in China. One of the major goals of modern health care is to provide networked, patient-centered health care (Haux, Ammenwerth, Herzog and Knaup, 2002). Patient-centered health care information systems allow healthcare providers to exchange up-to-date patient health information (Cotter, 2007). With the wide adoption of mobile devices in China, especially the cell phones, the mobile health information systems can provide an opportunity to support the people-centered, networked health care.

With the proposed mobile health information systems, people can get timely health information and health education services through their personal mobile devices. The knowledge transfer will help health practitioners in their professional education. Most importantly, the mobile health information systems can promote the knowledge transfer to common people. This application will bring great benefits to Chinese citizens in accessing important health information. From the mobile devices, especially the widely accepted cell phones, people can get the knowledge about health and diseases. This will enhance the health awareness among Chinese people.

With the development of more advanced mobile technology, Chinese people will benefit more from using mobile health information system without any doubt. Since April 2008, China has started the pilot implementation of 3G in several major cities (www.mc21st.com). This initiative brings an opportunity to mobile health information services. As the administrator and major enabler in telecommunication and nation's health care, Chinese government should take this opportunity to promote the nation wide mobile health information services. The effort towards the mobile health information services is aligned with the nation's long-term strategic goal to promote people's benefits. In addition to other mobile commerce applications, the mobile network operators would consider the health service as an important motivator of their 3G businesses. The mobile health information services will facilitate the full adoption by all Chinese, living in both urban and rural areas.

Although this analysis is conducted in the context of modern China, it also can benefit other developing countries; or even some developed countries. Of course, people should conduct their own analysis based on different needs and specific social environments. Many very promising application and research issues need to be further investigated in real situations. At the same time, social, cultural and legal issues must also be taken into account.

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