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Perspective

Mobile health: new technologies, new modes and new era

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In the past decade, tremendous developments have been made in mobile communicating technologies, such as fourth generation communication, satellite communication, and wireless network, which, when combined with healthcare, promoted the development of mobile health (mhealth). Mobile health is defined by the Healthcare Information and Management Systems Society (HIMSS) as the use of small, portable computers or telecommunication equipments to meet the needs of consumers for health care or health information services. It is a combination of the biomedical sensor technology, mobile computing technology and networking technology. The surge in mobile communication technologies has transformed the mode and quality of clinical research and healthcare on a global scale. Consequently, mhealth is the new edge on healthcare innovation and heralds the arrival of new era of healthcare.

Within a surprisingly short period of time, a myriad of applications and devices related to mhealth emerged throughout the world. Especially with the advent of smart mobile devices that support 3rd and 4th generation mobile networks for data transporting, mobile computing has been the main attraction of research and business communities. It offers numerous opportunities to create efficient mhealth solutions. There are two modes of mhealth: one is B2B mode which targets medical care personnel, and the other is B2C mode which targets patients. The mhealth applications offer unique opportunities for almost every part of healthcare in pre-, in- and post-hospital periods, including monitoring progress, receiving personalized prompts and support, providing education materials, collecting ecologic data, self-management interventions, and teleconsultaion when and where they are needed[1]. Because of the increase in the number of sub-health population, the aging of the population, and early onset of chronic diseases, more and more of the population attention was paid to mhealth that has gotten a solid foundation for numerous developments of mobile communication devices, such as smart phones and, especially, wearable devices. At the end of 2010, more than 200 million mhealth applications were downloaded and about 70% of worldwide citizens were interested in access to, at least, one mhealth application. It is predicted that, in 2017, more than 1.7 billion people will have downloaded health APPs with mhealth market revenue of a total of 26 billion dollars[2]. In order to promote and standardize the development of mhealth, many countries have formulated corresponding policy and regulations. As a country with the most mhealth applications, U.S. Food and Drug Administration issued *Mobile Medical Applications-Guidance for Industry and Food and Drug Staff* in September 2013[3]. In developed countries, mhealth has been used for diabetes, obesity, cardiology, smoking cessation, and elderly care and chronic diseases. These different medical specialties employ mhealth essentially for monitoring, detection, diagnosis, treatment and prevention of diseases. Meanwhile, in developing countries, mhealth services are also becoming popular, and mobile applications for healthcare systems are rapidly growing and evolving.

China has about one fifth of the world population. Due to the imbalance of regional economic development, there is a significant difference in the level of medical services across the country. Most of the high level medical personnel and advanced medical

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equipments are concentrated in a few large hospitals of metropolitan cities; on the contrary, in the majority of remote and underdeveloped areas, medical services cannot meet the needs of patients. For example, stroke is now the first cause of death in Chinese, but many hospitals do not have a neurospecialist. The rate of intravenous thrombolysis with rt-PA or urokinase (In China, in addition to rt-PA, intravenous urokinase within 6 hours has also been approved by the China Food and Drug Administration, and recommended by the 2010 Chinese Guidelines for the Diagnosis and Treatment of Patients with Acute Ischemic Stroke) for ischemic stroke is extremely low in China. In order to improve this situation, the Chinese government has implemented a series of medical reform programs, among which, telemedicine and mobile healthcare are emphasized. Although Chinese mhealth started later than developed countries, there has been an explosive growth of mobile health services in recent years. For medical personnel, electronic medical record, wireless ward round management, mobile teleconsultation, and mobile wireless nursing workstation were developed. For citizens or patients, sleep and exercise monitoring, blood pressure and heart rate monitoring, and out-hospital consultation can be carried out based on smart phones and devices.

In the past decade, telestroke services have been widely employed in North America and Europe[4-5], helping to resolve the shortage of neurological expertise, and enabling thrombolytic therapy to be administered in non-specialised hospitals. To find solution for geographical disparity for neurological expertise between urban and rural areas and the low rate of intravenous rt-PA in China, we have established a mhealth network for telestroke based on an interactive, two-way, wireless, audiovisual system using portable devices in Shaanxi Province of China (ClinicalTrials.gov, NCT02088346), and performed a clinical research, the *Acute Stroke Advancing Program using Telemedicine* (ASAP-Tel)[6], to evaluate the effectiveness and safety of decision-making regarding intravenous thrombolysis *via* a telemedicine consultation system for acute ischemic stroke patients in China. Differing from the other telestroke studies, our telemedicine consultation system is based on easily portable devices such as tablet computers and smart phones. Furthermore, Google Glass, a kind of wearable devices, was employed to make local physicians hand-free and give teleneurohospitalists a face-to-face way to evaluate patients, with the exact functions for interactive audiovisual telemedicine. Through this mhealth system, a 58-year-old woman with suspected stroke received timely examination, accurate diagnosis, and intravenous rt-PA thrombolysis in the time-window from the local physician under the guidance of a teleneurohospitalist[7]. This system may help to increase the rate of intravenous thrombolysis and improve stroke care quality in local hospitals.

In short, the mhealth has many advantages to improve or maintain the health status and quality of life of people, provide more convenient health care services, and promote the development of the health industry as well as the health environment in most countries.

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