Chapter 27
Healthinfo Engineering:
Technology Perspectives from Evidence-Based mHealth Study in WE-CARE Project

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ABSTRACT

Driven by the commission to proliferate information and communication technologies to health services globally, a new multidisciplinary direction is born, which can be named as Health Information (termed as a new word, Healthinfo) Engineering. To highlight the significances of Healthinfo Engineering, the evidence-based mHealth study in the WE-CARE project demonstrates technology perspectives. In this project, the authors built up a WE-CARE system, which integrate various necessary information and communication technologies to fulfill online healthcare services, even including advances from related math/modelling, physics sciences, etc. Without any doubt, such a system is a promising tool to change healthcare delivery. But this project also reveals there are many explicit and implicit factors left when using system-level integration in order to perform healthinfo applications. In general, in contrast to an explicit factor, an implicit factor is hidden from practical applications, which is the critical risk that may break down a healthinfo system. This phenomenon motivates us to investigate what's real bottlenecks in healthinfo systems. Based on the motivation, this paper summarizes healthinfo challenges from evidence study in the WE-CARE project, for instance, scheduling strategy, system light-loading, virtual clinical perception, privacy protection, etc. This technology summary shows that more extensive attention should be needed for healthinfo study not only in mobile and medical areas, and also in computer science, maths, physics, even including ethic, law, etc. In return, the new interdisciplinary cutting-edge science, Healthinfo Engineering, can make contributions to offer a practical life-cycle health management for all human being, including cancer supportive care.

INTRODUCTION

According to the reports from WHO (World Health Organization) (WHO and ITU Joint Report, 2014; WHO and ITU Joint Report, 2013), healthcare cost is becoming the unaffordable socio-economic problem in the world. Let us take cardiovascular disease (CVD) as an example. Only cardiovascular disease has contributed counting up to 29% of the total global deaths (Huang, 2014). Official statistics in (Huang, 2014) show that 230 million people in China - 1/5 of Chinese adults - suffer from cardiovascular diseases. On average, one patient dies from CVD every 10 seconds in China. In return, if the mortality rate from CVD could be reduced by 1% in next 3 decades, the reduction in total social cost would be about 10.7 trillion US dollars (68% of the 2010 Chinese fiscal year GDP). The cost of CVD has attracted attention from academic and industry communities in order to develop an early warning system for CVD monitoring (Global Survey Report, 2011; Estrin, 2010; Collins, 2012; Silva, 2013). The main causes of fatal cardiovascular disease include serious myocardial ischemia (acute myocardial infarction), heart failure, and malignant arrhythmia. As shown in (Bacquer, 1998; Falchuk, 2010; Usher, 2013), most of these symptoms can be predicted by observing certain specific manifestations of electrocardiogram (ECG) signals. If a system can detect such manifestations at an early phase, it can save valuable time for taking precautions against the cardiovascular disease (Caldeira, 2012; Zhang, 2012; Caldeira, 2013; Xie, 2014). To satisfy the requirement above, health conditions of CVD affected people must be collected and delivered to a professional healthcare center online, without unexpected disruption and distortion. Recent advances in information and communication technologies and engineering have provided an opportunity to accomplish this objective. Correspondingly, technology and engineering are becoming the indispensable ingredients for health information services today and future. Driven by this new trend, a new multidisciplinary area, Healthinfo Engineering, is born, which is changing health-care delivery today and at the core of responsive health systems in the future.

The rest of the paper is organized as follows: Section II introduces related works and presents a common architecture for Healthinfo Engineering. In Section III, we discuss real challenges to Healthinfo Engineering, which are revealed from an implementation of WE-CARE project. Finally, we discuss system tests and clinical trials of WE-CARE in Section IV.

A COMMON ARCHITECTURE FOR HEALTHINFO SYSTEMS

As well known, healthcare cost is becoming the huge socio-economic problem. Only in terms of falling-related injuries, the annual direct and indirect cost is expected to reach $67.7 billion by 2020 (the dollar value in the 2012 fiscal year) (CDC Report, 2014). To handle this challenge, there is a new trend to proliferate information and communication technologies for offering healthcare services over cyber-infrastructures, called Health Information (Healthinfo) Engineering. So far, there are already a number of Healthinfo systems that can be classified into three types below.

The first type focuses on signal sensing and acquisition (Woojae, 2010; Peng, 2010; Paglinawan, 2009; Chen, 2007). The reference (Woojae, 2010) proposed an enhancement of CMRR (Common Mode Rejection Ratio) for higher amplifier gain and lower noises when extracting physiological signals. In the literature (Peng, 2010), an acquisition function of multi-physiological parameters was embedded into a healthinfo system. In the literature (Paglinawan, 2009; Chen, 2007), the authors discussed the sensor power consumption issue with CMOS (Complementary Metal Oxide Semiconductor) and RF (Radio Frequency) circuit techniques. In the literature (Xie, 2014), the developed WE-CARE system can offer a 7-lead

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