Chapter 9
Wired and Wireless Distributed *e*–Home Healthcare System

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ABSTRACT

The proactive development in electronic health (e-health) has introduced seemingly endless number of applications such as telemedicine, electronic records, healthcare score cards, healthcare monitoring etc. Yet, these applications confront the key challenges of network dependence and medical personnel necessity, which hinders the development of universality of e-health services. To mitigate such key challenges, this chapter presents a versatile wired and wireless distributed e-home healthcare system. By exploiting the benefit of body sensor network and information communication technology, the dedicated system model methodically integrates some of the comprehensive functions such as pervasive health monitoring, remote healthcare data access, point-of-care signal interpretation and diagnosis, disease-driven uplink update and synchronization (UUS) scheme and emergency management to design a complete and independent e-home healthcare system.

INTRODUCTION

Along with socioeconomic progress and development, three global crises come into being that threatens human medical service industry, including population aging, prevalence of chronic diseases, and soaring health cost. Driven by falling fertility rate and increasing life expectancy, older population (above age 65) is escalating with surprising speed and will outnumber young children (under age 4) in the very near future. As reported by World Health Organization (WHO, 2011), between 2010 and 2050, the proportion of older adults will double from 7.7% to 15.6%. While global population aging represents a triumph

of medical, social, and economic advances over diseases, it also presents tremendous challenges to the society and healthcare services. What's more, such demographic changes result in inevitable increase in the prevalence of chronic diseases or non-communicable diseases (NCDs). As the leading cause of fatality throughout the world, according to Mathers and Loncar (2006), NCDs take up 63% among the total deaths and the aged-related NCDs mortality is projected to rise to 69% in 2030. Among the four main types of NCDs, cardiovascular disease (CVD) is prevalent and closely linked with aging population. According to the survey conducted by WHO in 2008, 17 million, which represents 30% of global deaths, were due to CVD and it is estimated that by 2030, this could further increase to 23 million. To effectively prevent the mortality rate due to CVD, early detection and timely treatment would be the ideal choice. However, this imposes huge burden on the medical personnel during long-term monitoring and diagnosis. To make things worse, the cost of healthcare service is increasing continuously and outpaces economic growth in gross domestic product (GDP). As revealed by the third national health survey by Liu et al. (2007), during 1998–2003 the annual increase of healthcare expense was 11.8% whilst the average income of people in rural areas increased by only 2.4% annually during the same period. The skyrocketing health cost not only prevents lot of people from seeking for early medical care, but also brings about large disparities in service quality and accessibility among different income groups and between rural and urban populations (Powell, 2005).

Therefore, in view of demographic and epidemiologic needs and escalating expenditure of the current healthcare system, improving healthcare service is a top priority issue throughout the entire world. Targeting at developing long-term, low-cost, sustainable, and accessible healthcare service, practical enactment of taking preventive measures in the traditional healthcare environment has always been a challenge. Thus, exploiting the advancement of multiple key technologies including information & communication technology (ICT), mobile technology, wireless body sensor networks (WBSN), intelligent technology etc., research over the past decade has focused on improving the quality, safety and efficiency of healthcare services by creating an electronic healthcare (*e*-healthcare) environment. With the aim to provide healthcare to anyone, anytime and anywhere, the development of *e*-healthcare has not only improved the convenience and quality of healthcare services towards patients and healthcare consumers, but also has drastically facilitated medical personnel to pursue early detection and diagnosis of various pathologies. In realizing the vision of *e*-healthcare systems, there exist numerous technical and non-technical challenges. Here, some of the crucial requirements and challenges are listed as follows.

1. **Privacy and Security:** Since wireless/wired transfer of biomedical signals and pathological information are concerned in *e*-healthcare systems, user privacy should be guaranteed to avoid malicious and illegal abuse. Security of the entire system, WBSN, and wireless/wired network is of great significance (Kara, 2001; Zhang et al., 2002);
2. **Reliability:** To ensure the successful message transfer between healthcare consumers and providers, reliability of the networks should be strictly controlled with low error tolerance. Particularly for wireless network, robust infrastructure and protocols are demanded to support the reliability and quality of wireless communication (Varshney, 2007);
3. **Patient Engagement:** Taking into consideration of various users with varying education level/ knowledge, an accessible *e*-healthcare system with user-friendly operations and comprehensible functions are desired. Especially for elder population who have very little interests in accessing state-of-the-art technologies, the key challenge allies on effectively engaging them to properly use such systems (White et al., 2006);

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