Chapter 1.10
Mobile Telemonitoring Insights

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ABSTRACT

Technology advances create new possibilities for healthcare monitoring, management, and support, focusing on prevention rather than disease management. The provision of personalized healthcare applications is also greatly supported. Developments in the wireless and mobile markets are capitalized by the medical device industry. Services are becoming personalized and location independent to fulfill the increasing patient needs for self-empowerment and quality in the healthcare delivery away from the traditional nursing areas. This overview discusses the new opportunities for the healthcare domain in the mobile times we live.

INTRODUCTION

The healthcare industry is experiencing a substantial shift to care delivery away from the traditional nursing areas due to the convergence of several technology areas. Increasingly capable health-monitoring systems are moving the point of care closer to the patient, while the patient, better informed and aware now, undertakes an active role to self-care and/or -prevention. Emerging ICTs in conjunction with the medical device industry development (intelligent devices, biosensors, novel software, etc.) demonstrate personalized healthcare delivery's potential without geographical limitations.

The concept of prevention prevails now against disease management and treatment plans. As patient-centric processes emerge, the citizens and patients undertake an active role in monitoring their health status. Meanwhile, e-wellness evolves to address the rising expectations of the e-health consumers, who are better informed, more demanding, and empowered. The empowered, worried-well consumers require quality health services on the spot. The drivers are now connectivity, speed, and personalization (McKnight, 2000).

MOBILE HEALTHCARE PROVISION

Waves of technology incorporation and scientific discoveries have driven the sector from reliance on direct communication and physician experience to

a higher reliance on technology and community information. This new Web-enabled environment has taken healthcare from local areas, where telemedicine left it, literally into the patient's home and, more recently with m-Internet, to wherever the patient might be and whenever he or she needs it (Simão, 2001).

M-Internet enables information exchange and promotes the availability of services and communication modes to serve working teams with increasing mobility requirements.

Services are becoming personalized and location independent to serve increasing patient needs for self-empowerment and quality in healthcare delivery away from the traditional nursing areas.

Furthering the new approaches in the provision of healthcare services in the frame of e-health, wireless developments create new opportunities for healthcare professionals, individuals and organizations, patients, and health authorities. The scope of mobile health addresses clinical, administrative, and consumer health-information applications and, as it could contribute to the improvement of health outcomes, m-health may be utilized to measure health status and population welfare.

Many healthcare organizations are investing in IT projects that take advantage of new technologies in the mobile healthcare application space. Functionality that augments the capture of evidence-based patient plans of care is essential and must map and bridge the information flow for both inpatient and outpatient work-flow clinical-practice guidelines. As the medical community continues to embrace these new technologies, system integrators must provide functionality that reduces costs, improves the quality of care, and improves the ease with which caregivers can perform their everyday tasks (Wolf, 2001).

The most significant challenge posed by mobile technology is the seamless integration of multiple hardware and software platforms with reliable, uninterrupted wireless services in a secure manner, which will become mission critical to successful healthcare organizations, payers, and providers (Wolf, 2001).

The current state-of-the-art technology in medical sensors allows for the easy and unobtrusive electronic measurement of several health conditions. The sensors are often stand-alone devices and sometimes comprised of two or more elements connected by a cable or wireless technology. Medical sensors have the capability to measure vital signs such as blood pressure, pulse rate, respiration frequency, and so forth. Based on these medical parameters, the medical professionals can monitor the patient's health condition and act in case of an anomaly.

The application areas of the medical-device wireless telemonitoring capabilities include the following:

1. Assistance in case of accidents and emergencies
2. Increased capacity and lower costs for hospitals
3. Assistance and monitoring in a home-care setting
4. Monitoring of chronically ill patients
5. Patient involvement in setting a diagnosis
6. Medicine dosage adjustment
7. Physical-state monitoring in sports
8. Monitoring of sporadically occurring symptoms
9. Emergency alarms (Fosse & Haug, 2003)
10. Improved health management

As a result, citizens can enjoy quality healthcare provision and an elevated quality of life. As underlined by the European Council objectives set in Lisbon, "effective integration of healthcare and related support services by electronic means, including the widespread use of telecare, could improve the quality of life of citizens by enabling safer independent living and increased social inclusion."

EVOLUTION FORCES AND CHALLENGES

Empowered patients demand advanced wireless health solutions. Similar to most authors, Lerer (2000) suggests that the e-health consumer is being empowered due to an increased ability to obtain health information and to seek health-related offerings via the Internet. A Deloitte Research (2000) study suggests the e-health consumer is a mix of an empowered and an engaged consumer. Recognizing that e-health consumers' empowerment can increase efficiency and reduce health costs, Lerer argues that consumers' education and empowerment should be a key concern for all health players. E-health consumers, he suggests, are not just the ill, but the potentially ill, the worried, and those adjacent to illness, patients, their relatives, and friends. At the first level, e-health services are information-driven activities, which are mostly "event triggered." The Deloitte Research study suggests that the demographic profile of the e-health consumer population reveals a significant population group with economic clout, information sophistication, and technological familiarity, and that is generally wealthy.

An e-health consumer is an individual who is (a) fully involved in the management of health for himself or herself and his or her family, (b) proactively educated about health issues, especially in the area of prevention, and (c) concerned about the quality of care offered by physicians and institutions, with a willingness to select the highest level of services. In short, an e-health consumer manages health, in all extents possible, as the most important asset of his or her family. The main objective is to maintain the highest level of quality of life (Lerer, 2000)

The rapid proliferation of wireless personal computers, phones, appliances, and other devices will require organizations to look beyond single-platform solutions. System-integration activities have a new level of complexity and cost to support rapidly changing technology (Wolf, 2001). Mobile-health advances generate new capabilities in patient self-care and health-practice administration and reimbursement. Cost-effective solutions minimize effort in monetary and human-input terms, while the creation of new communication modes facilitates both the healthcare professionals and the patients.

When it comes to investing in new technology solutions, affordability is a major milestone to consider. Budget allocation to mobile health applications can be easily influenced both by the technology cost and the user awareness of current and future cost benefits. The complexity and fragmentation of the overall healthcare sector (i.e., centralized vs. decentralized health systems, variations in the public and private funding mix, etc.) often leads to the implementation of fragmented and disposable technological solutions. Interoperability thus is essential for large-scale applications with international scope. Conformance to global (when available) and/or U.S. and European standards enables faster and ubiquitous communications, while also ensuring the compatibility and connectivity of systems and points of care.

According to CEN/TC 251 (2001), the present lack of standardized ICT communication, which prevents appropriate access to health records, may result in important clinical risks for the patients. This is an important safety issue that has not been recognized sufficiently.

Implemented standards are often crucial for any communication, and they are especially important for open, very complex healthcare systems with many different organizations and units, with information systems from different suppliers, providing different parts of the total ICT support.

Furthermore, the wider implementation of mobile solutions requires a robust security plan to reassure the confidentiality of sensitive medical data.

M-HEALTH POTENTIAL

The next few years will witness a rapid deployment of both wireless technologies and mobile Internet-based m-health systems with pervasive computing technologies. The increasing data traffic and demands from different medical applications and roaming applications will be compatible with the data rates of 3G (third-generation) systems in specific mobility conditions. The implementation and penetration of 4G (fourth-generation) systems are expected to help close the gap in medical care. Specifically, in a society penetrated by 4G systems, home medical care and remote diagnosis will become common, checkups by specialists and the prescription of drugs will be enabled at home and in underpopulated areas based on high-resolution image-transmission technologies and remote surgery, and virtual hospitals with no resident doctors will be realized. Preventive medical care will also be emphasized: For individual health management, data will constantly be transmitted to the hospital through a built-in sensor in the individual's watch or another item worn daily, and diagnosis results will be fed back to the individual (Istepanian et al., 2004)

A fourth-generation m-health solution builds upon the mobile information portal of a 3G solution by adding the multiple devices rendering the capability of the 2G (second-generation) solutions. Now, an end user has the ability to access any application with any device ("Going Mobile," 2001). 4G solutions embrace the distributed and loosely coupled HIS applications throughout a health unit. A 4G solution can allow for the acquisition of data from various sources and for the mobile end user to view, analyze, manipulate, graph, and merge data according to his or her needs right on the mobile device.

In the home of the future, some devices will contribute physiological information about the patient (e.g., heart rate, blood pressure), while other devices in and around the home will contribute information about the patient's environment (e.g., humidity, temperature, carbon-monoxide level). In some cases, groups of devices will have enough collective awareness to function autonomously based on sensor data.

The challenge for healthcare providers and health authorities lies in the comprehension of the end users' needs for the effective integration of new technological capabilities with existing settings in order to leverage their capacities and quality of service.

CONCLUSION

Systematically sensitizing users and providing them with specific information on new mobile and wearable computing technologies will help to discover possible fields of new applications. The initiation of a dialogue between users in healthcare and developers of mobile IT solutions eventually may lead to the identification of new application fields (i.e., medical specialties) and related practices in mobile healthcare provision.

A first step to this end is the identification and definition of mobile-activities profiles, and stakeholder profiles and their level of involvement, as well as mobile application scenarios. Technologies should be designed for people rather than making people adapt to technologies in order to capitalize on the capabilities that wireless technologies create in the healthcare domain.

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KEY TERMS

3G and 4G: Third- and fourth-generation wireless Internet devices. The major distinction of 4G over 3G communications is increased data transmission rates. 4G is expected to deliver more advanced versions of the same improvements promised by 3G, such as enhanced multimedia, smooth streaming video, universal access, and portability across all types of devices. 4G enhancements are expected to include worldwide roaming capability and are likely to incorporate global positioning services (GPSs). As was projected for the ultimate 3G system, 4G might actually connect the entire globe and be operable from any location on or above the surface of the earth.

Ambient Intelligence: The concept of ambient intelligence provides a vision of the information society in which the emphasis is on user friendliness, efficient and distributed services support, user empowerment, and support for human interactions. People are surrounded by intelligent, intuitive interfaces that are embedded in all kinds of objects in an environment that is capable of recognizing and responding to the presence of different individuals in a seamless, unobtrusive, and often invisible way.

E-Health Consumer: Self-reliance and empowerment are the core characteristics of the e-health consumer, who actively pursues patient-centric quality services in a frame of information-supported activities.

Empowered Patient: A patient whose self-management is based on informed decisions and who takes into account his or her quality of life, including both physical well-being and psychological state, as well as other dimensions.

E-Wellness: The utilization of Internet capabilities (information, Web-based health services, etc.) in order to maintain a condition of good physical and mental health.

Medical Sensor: A device, such as a photoelectric cell, that receives and responds to a signal or stimulus.

M-Health: Mobile health refers to ambulatory-care provision enabled by third-generation devices that allow for the collection, management, and processing of the patient's vital data. Mobile health services range from the recording of the patient's medical signs and the synchronous or asynchronous communication with health professionals via mobile communication means, to the automatic diagnosis of the data recorded to personal sensors and alarm notices in case of an emergency. Mobile health or m-health is a step beyond electronic healthcare as it enhances ubiquitous health provision regardless of the patient's or physician's geographic location.

Telemonitoring: The science and technology of automatic measurement via medical sensors and the transmission of data by radio or other

means from remote sources to receiving stations for recording and analysis. Data transfer can be achieved via wireless communications means and/or via other media, such as a telephone, a computer network, or an optical link.

Vital Signs: The pulse rate, blood pressure, body temperature, and rate of respiration of a person. The vital signs are usually measured to obtain a quick evaluation of the person's general physical condition.

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