Mobile telemonitoring insights

Pantelis Angelidis
Vidavo Ltd

Introduction

The health care 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, whereas the patient, better informed and aware now, undertakes an active role to self care and/or prevention. Emerging ICT technologies in conjunction to the medical device industry development (intelligent devices, biosensors, novel software, etc) demonstrate the personalized healthcare delivery potential without geographical limitations.

The concept of prevention prevails now against disease management and treatment plans. As patient-centric processes emerge, the citizens/patients undertake an active role in monitoring their health status, whereas *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 discovers, 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 health care from local areas, where Telemedecine left it, literally in to the patient home, and more recently with the m-Internet, to wherever the patient might be and whenever he need it (Simão, 2001).

m-Internet enables information exchange and promotes availability of services and communication modes to serve working teams with increasing mobility requirements. Services are becoming personalised and location independent to serve increasing patients needs for self-empowerment and quality in the healthcare delivery away from the traditional nursing areas.

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

Many healthcare organizations are investing in Information Technology (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 workflow 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 that 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 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 etc. 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:

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 diagnosis
6. Medicine dosage adjustment
7. Physical state monitoring in sports
8. Monitoring of sporadically occurring symptoms
9. Emergency alarms (Fosse and Haug 2003)
10. Improved health management

As a result, the citizens can enjoy quality in the 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 & Challenges

Empowered patients demand for 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 Internet. A Deloitte (2000) study suggests the e-health consumer is a mix of an empowered and an engaged consumer. Recognizing that e-health consumer's empowerment can increase efficiency and reduce health cost, Lerer (2000) argues that consumers' education and empowerment should be a key concern for all health players. An e-health consumer, he suggests, isn't just the ill, but the potential ill, the "worried", and those adjacent to illness, patients, their relatives and friends. And at first level, e-health services are an information driven activity, which is mostly "event triggered". Deloitte (2000) 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 generally wealthy.

An "e-health consumer" is an individual who is (1) fully involved in the management of health (2) for him/herself and his/her family (3) proactively educated about health issues, especially in the area of prevention (4) 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 extent possible, as the most important asset of his/her family. The main objective is to maintain the highest level of quality of life (Insead on the e-health consumer 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, whereas creating 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/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 US and European Standards enables faster and ubiquitous communications, while also ensuring compatibility and connectivity of systems and points of care.

According to CEN/TC 251, the present lack of standardised ICT communication that 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 are important for the open very complex health care systems with many different organizations and

units with information systems from different suppliers providing different parts of the total ICT support.

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

m-health potential

The next few years will witness a rapid deployment in 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 application will be compatible with the data rates of 3G systems in specific mobility conditions. The implementation and penetration of 4G systems is 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, check-up by specialists and prescription of drugs will be enabled at home and in underpopulated areas based on high resolution image transmission technologies and remote surgery, and virtual hospital 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, accessories, or other items worn daily, and diagnosis results will be fed back to the individual (Istepanian, 2004)

A 4th Generation m-health solution builds upon the Mobile Information Portal of a 3G solution by adding the multiple devices rendering capability of the 2G solutions. Now an end user has the ability to access any application with any device (Daou Systems, 2001). 4G solutions embrace the distributed and loosely coupled HIS applications throughout a health unit. A 4G solution can allow for acquisition of data from various sources and allow 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 the healthcare providers and health authorities lies on the comprehension of the end users needs for the effective integration of new technological capabilities to existing settings in order to leverage their capacities an quality of services.

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 health care and developers of mobile IT solutions leading eventually may lead in the identification of new application fields (i.e. medical specialties) and according practices in the mobile healthcare provision.

A first step to this end, is the identification and definition of mobile activities profiles, stakeholders' profiling and 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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Terminology

1. **3G – 4G:** 3rd and 4th-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 (GPS). 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.

2. **Ambient Intelligence:** The concept of Ambient Intelligence provides a vision of the Information Society where 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 and an environment that is capable of recognizing and responding to the presence of different individuals in a seamless, unobtrusive and often invisible way.

3. **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.

4. **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

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

6. **m-health:** Mobile health refers to ambulatory care provision, enabled by the third generation devices, which allow for the collection, management, and processing of the patient 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 emergency. Mobile health or mhealth is a step beyond electronic healthcare as it enhances ubiquitous health provision regardless of patient / physician geographic location.

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

8. **Telemonitoring:** The science and technology of automatic measurement via medical sensors and 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 data transfer over other media, such as a telephone or computer network or via an optical link.

9. **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