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Emerging Mobile Communication Technologies for Health: Some Imperative notes on m-health

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Abstract— The next generation of "wireless e-health technologies" is a new and evolving topic in the areas of telemedical and telecare systems. These technologies involve the exploitation of mobile telecommunication and multimedia technologies to provide better access to healthcare personnel on the move, by removing the key disadvantage of trailing wires in current systems. These technologies provide equal access to medical information and expert care by overcoming the boundaries of separation that exist today between different users of such medical information. A great benefit to all users will be a more efficient use of resources and far greater location independence. In this paper we will address some notes and future trends in these emerging areas and their applications for m-health systems. We will also discuss current as well as future strategies for implementing these system within important healthcare sectors as well as critical medical environments.

***Index Terms*— m-health, telemedicine, wireless telemedicine, wireless communications, UMTS, GPRS, e-health**

I. INTRODUCTION

It is well know that wireless telemedicine (or "m-health") is now considered an important and emerging area in telemedical and telecare systems. m-health involves the exploitation of the mobile telecommunication and multimedia technologies and their integration into new mobile health care delivery systems. Essential new telemedicine technologies will be able to provide equal access to medical information and expert care by overcoming the boundaries of separation that exists between different users. This scenario will also be achieved with a more efficient use of available resources and greater location independence.

The recent developments in digital mobile telephonic technologies (and their impact on mobility issues in different telemedical and telecare applications) are clearly reflected in the fast growing commercial domain of mobile telemedical services. Those mobile services were not possible with the standard Plain Old Telephone System (POTS) and Integrated Services Digital Network (ISDN) services. Current examples include: mobile ECG transmissions; video images and teleradiology; wireless ambulance services to predict emergency and stroke morbidity; and other integrated mobile telemedical monitoring systems [1-4]. However, the current (second) generation of digital cellular system has limitations in terms of both their bitrates (about 10 kbps) as well as global operational coverage that are much lower than the existing POTS services. Hence, currently-available digital cellular systems will provide limited capabilities for real-time transmission of data with narrow use and spectrum to these services and generic telecare and telehealth applications.

However, the recent launch of the Third Generation (3G) cellular technologies and services in some countries (such as the UK and Japan) and the imminent global usage of these wireless technologies elsewhere, will change such scenario and possibly the existing semantics of telemedicine. These advances will soon replace the current diverse collection of cellular technologies (such as high and low mobility cellular/PCS, fixed access via cordless, and satellites) to a converging set of services including voice, data, multimedia, wireless messaging and mobile computing [5,6].

3G advances will provide both mobile patients and normal working end users the choices that will fit their lifestyle and make easier for them to interactively get the medical attention and advice they need. When and where is required and how they want it regardless of any geographical barriers or mobility constraints. The concept of including high-speed data and other services integrated with voice services is emerging as one of the main points of the future telecommunication and multimedia priorities with the relevant benefits to citizen-centered healthcare systems. These creative methodologies will support the development of new and effective medical care delivery systems into the 21 Century. The new wireless technologies will allow both physicians and patients to roam freely, while maintaining access to critical medical information.

AN OVERVIEW OF MOBILE TELEMEDICINE SYSTEMS

1) Current mobile technologies

In recent years there has been increased research on wireless telemedicine using current mobile communication systems, especially in USA and Europe, for conventional civilian and military use [7-15]. However, the increased equipment cost (such as satellite-based systems) and the limited bandwidth of the current generation of cellular telecommunication systems, have restricted the wider use of these systems within the most promising segments of the health care structures in general.

However, in recent years some emerging 2.5G- and 3G-based m-health systems with Bluetooth medical wireless technologies have been cited in the literature [2].

2) Limitations of Existing Wireless Technologies for m-health

The current mobile telemedicine systems can be characterized by the following drawbacks:

- The lack of a flexible and integrated telemedical linkage of the different mobile telecommunication options. This lack of linkage exists due to the difficulty of achieving

operational compatibility between the telecommunication services and the current mobile standards.

- The high cost of communication links, especially between satellites and global mobile devices.
- The limited data transfer rate of the current mobile telephonic systems (around 9.6 Kbit/s). Specially when compared to the costly new ISDN l and Primary Rate Interface (PRI) of less than 2Mbit/s, or even DSL at 8Mbit/s [12].
- The limited availability of mobile Internet connectivity and information access due to the current bandwidth limitations.
- Healthcare is a very complex industry and difficult to change.
- Organizational changes are very often required for healthcare institutions to benefit from mobile telemedicine.
- Those required organizational changes most likely have an impact on how physicians and other staff members lose or gain power as a result of those changes.
- The short term and long-term economic consequences and working conditions for physicians and healthcare systems are not yet fully understood.
- The methods of payment for such mobile telemedicine are not yet fully developed and standardized.
- There is a lack of incentive for busy specialists to practice mobile telemedicine because it is seen as yet another imposition for which they are not paid.
- The currently available telemedicine equipment can sometimes be difficult to handle.
- There is a lack of integration between mobile telemedicine systems and other information systems e.g. referral and ordering systems, medical records etc.
- There are not enough numbers of demonstration projects that show mobile telemedicine's real savings potential.

The above are some of the factors that have hindered the wider applications of mobile telemedicine technologies thus far across healthcare systems and on critical medical applications.

THE NEXT GENREATION OF M-HEALTH SYTEMS

The next few years will witness a rapid deployment in both UMTS 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. However, it is well known that current Healthcare systems are stuck with the equation:

Current Organization + New Technology = Expensive Current Organisation. Hence, the expectations are for these new generation mobile and wireless technologies to be acceptable for sort of examples that represent challenges for these technologies such as:

1. Citizens become customers
2. Input measures are replaced by output measures
3. Citizen relationship costs fall
4. Taxes are lowered because of competition.

In addition there is hope for the wider deployment of mobile telemedicine system because of some global changes, which are likely to have a major effect on the healthcare industry. Those changes are:

1. Increasing numbers of older adults and fewer young people so that to sustain the economy, the elderly will have to be persuaded to continue working longer. To be able to do this, a greater emphasis on the health of the elderly will mean an increase in demand for healthcare. At the moment an obstacle to the implementation of telemedicine is that commercial organisations do not regard the health economy as large enough to invest time and research. The growing demand for healthcare services and the reduced supply of service providers and care-givers will mean that telemedicine suddenly acquires a heightened importance.
2. Fragmentation of care caused by the twin pulls of generalisation to push down costs and specialisation to meet the increasing needs of rapid advances. Co-operation in healthcare, which has been anathema to healthcare workers, will have to be achieved by patient power rather than central directive.
3. Increased patient expectation because of easier access to information will mean that the pre-eminence of the physician will be challenged. Patient lifestyles will mean that at least affluent ones will demand treatment wherever they are at the time because of a new leisure-oriented lifestyle. On the other hand patients at the lower end of the socio-economic scale may have to settle for lower expectations.
4. Increased complexity of assessment, diagnosis, investigations and treatment will mean a knowledge explosion and the falling short of the quick dissemination of the knowledge and expertise. Again, telemedicine may serve a useful function of rapid dissemination of the skills and knowledge.

Cultural, commercial and operational change:

A nation's health service is fashioned by its economy, demography, culture, and medical tradition, among other factors. This identity poses a challenge to telemedicine, which can make it better. In addition it has to deal with the problem of component management. Component management derives from the observation that the providers and payers of health care view health challenges only through the specific window of care for which they are responsible.

One of the main incentives of health care is the reimbursement, which is basic to the cost of health care. Providers are forced to organise their packages into reimbursable ones. Any task, which falls outside these packages, tends to be overlooked or receive low priority. Thus component management systems serve patients poorly. Thus the emphasis is on treatment rather than prevention, there is a lack of incentive for providers to treat the entire disease process, which leads to an uncoordinated delivery system.

Some other key factors that may accelerate the diffusion of m-health systems are:

1. Management perspective when planning the implementation of telemedicine to favor mobile solutions rather than fixed ones.
2. Economic perspective – mobile telemedicine costs and savings will probably appear on different accounts.
3. Development of payment systems to include mobile telemedicine.
4. Government intervention to fund exemplars of mobile telemedicine integrated into the healthcare system.
5. Comprehensive assessments rather than feasibility reports by enthusiasts.
6. A need to educate and inform key players of what is available and what can be achieved in the future.
7. Clarification of the legal and ethical issues

CONCLUSIONS

This paper addresses some of the fundamental issues and future scenarios regarding the next generation of mobile telemedicine systems. It is conclusive that some of the current and successful telemedicine systems will be more geared toward emerging wireless solutions in healthcare scenarios that are not feasible with the current generation of cellular telephonic and Internet services. The imminent launch of the next generation of wireless and Internet technologies will fundamentally change the current structures of telemedical and healthcare delivery systems.

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