mobiHealth: A System for Health Care in India

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Abstract

In the healthcare domain, a major challenge is how to provide better healthcare services to an increasing number of people using limited financial and human resources. Now a days MobiHealth can be defined as the application of emerging mobile communications and network technologies for health care systems. It involves the use of mobile computing, medical sensors, and communications technologies for health care. The needs to provide medical services in remote areas have motivated researchers to develop the telemedicine system using mobile technology. Wireless technology enhances patient self-management and quality of life. Disease management facilitated through information and communication technology (ICT) implies more effective and efficient care of patients with chronic illnesses. Successful implementation of MobiHealth makes the right information available at the right place, at the right time, and in the correct form at low cost. As wireless technology increases in flexibility, popularity, and distribution, it will play a key role in the new health care delivery model.

Keywords—medical sensors, Cost-effective,life saving, digital transmission, remotely monitoring, bottom-of-the pyrami, connectig the un-connected, reaching the un-reached, early siagnosis, anywhere & anytime,quality of life, suit-case based communication, e-education, e-governance.

INTRODUCTION

In last two decades technology in general and Information Communication Technologies (ICT) in particular have been advancing at a fast pace. Medical services are one of the major beneficiaries of this technology, using this most of the medical systems can move from traditional paper form to digital forms.The communications advantages of MobiHealth mean it has broad-ranging—and potentially lifesaving— clinical and practical applications. India already has several MobiHealth pilot programs in place and is working to integrate MobiHealth into its health care system. Nowadays majority of medical records are stored in digital format. In turn digital transmission and exchange of medical information has become possible by rapid advancements in digital telecommunications networks. A Mobile telemedicine system specifically designed for the vital patient's information monitoring remotely. With the help of information and wireless technologies that can transform our healthcare system, dramatically reducing costs, improving quality and delivery of care and saving lives remotely.

The promise of mobiHealth

"The quickest way to get rid of poverty right now, is to have one mobile telephone," remarked Nobel Laureate Muhammed Yunus of Grameen Bank. This concept can possibly be implemented to health care as well, particularly in developing countries. MobiHealth could be the answer, provided that cost-effective, need-based, and appropriate technology is utilized. The primary aim of MobiHealth should be to strengthen and transform weak health systems, with a goal of moving to new health care delivery models. At present, the total world population served by MobiHealth services is probably less than one hundred thousand, though 80 percent of the world's population lives in areas with mobile phone coverage. [1] MobiHealth can be defined as the application of "emerging mobile communications and network technologies for health care systems, which involves the use of mobile computing, medical sensors, and communications technologies for health care."[2]

Successful implementation of MobiHealth essentially means to make available the right information at the right place, at the right time and in the correct form. Health care providers are now pushing elements of the care process to the edge of their health care networks. As wireless technology increases in flexibility, it will play a key role in the new health care delivery model. MobiHealth have little infrastructure with reduced needs for cable installation and maintenance. Wireless infrastructure is less expensive and faster to deploy. The capital cost of providing mobile coverage is about one-tenth the cost of installing a fixed-line connection. Wireless also has the added benefit of being usable for portable and mobile applications, as well as fixed ones. Mobile solutions can be augmented using newer technologies like high-speed packet access(HSPA). HSPA offers fast and reliable connectivity, better data rates, easier deployment, and improved provisioning. A large segment of the patient population can be treated in their homes and communities, with access to expert care, through mobile technology. As patients consume more resources when they are in hospitals, this will have a significant impact on health economics. By using advances in wireless technologies, one can put the right information in the hands of doctors and patients at the right time. [3]

The health care industry in several areas of the world is poised to adopt wireless devices and applications in large numbers. Wireless technology increases access to patient information

and can improve data accuracy, reduce errors, and result in overall improvement of patient care.[4] As this system can be used in any geographical area in which wireless networks provide coverage, it may help reduce morbidity and mortality and promote monetary savings. [5] The growth of the mobile phone industry across the world reveals that there is significant demand from 'bottom-of-the pyramid' consumers, who are primarily located in rural areas. 3G wireless networks have been reported to be crucial due to their broad geographical coverage and widely deployed infrastructure, which significantly expand the telemedicine system's reach. [5] MobiHealth could be an excellent example of public-private partnership. Offering connectivity alone does not bridge the digital divide. Pilot studies indicate that the powerful broadband experience will result in people becoming enthusiastic and coming back for more. Self-sustaining and economically viable projects may be possible. MobiHealth is the youngest in the various mobile services now available.

CHALLENGES OF WIRELESS TELEMEDICINE:

(1) Acceptance of MobiHealth by the end user and the health care provider particularly in a developing country is itself a challenge. (2) Limited and fluctuant bandwidth of the wireless link is a major issue. (3) Application-specific uplink and downlink speeds need to be configured and a dedicated bandwidth made available.(4) Operating protocols need to be designed to coordinate, prioritize, integrate, and compress the diverse media streams. (5) Distortion of multimedia content or choking of some applications must be avoided. A software architecture that differentiates, prioritizes, and transforms the medical data needs to be implemented. (6) Many medical applications may require bandwidth-hungry data such as images or real-time video.(7) The system should also enable simultaneous transmission of multiple types of medical data. The critical data would thus be delivered reliably, efficiently, and with high quality. (8) Flexibility of spectrum allocation, worldwide standardization, and the support of multimedia communications are equally important.

ADVENTAGES OF WIRELESS TELEMEDICINE:

(1) A striking advantage is connecting the unconnected and reaching the un-reached. (2) The immediate exchange of health information can occur with anyone, anytime, anywhere. (3) Wireless enables better utilization of limited health care resources, such as a specialist, and allows patients to remain in their communities. (4) It reduces the hardships (physical and economic) associated with travel (for patients and those accompanying them) and enables early diagnosis, intervention, and treatment. Unnecessary transportation to tertiary care facilities is avoided.

COMMUNICATION ASPECTS OF MOBIHEALTH

Communication networks are very much relevant to mobile health application. All systems must be backwardly compatible, for example, 3G data cards and modems should also support 2G GPRS/EDGE access. This provides an automatic "fallback" (and session continuity) when the user is out of the home network. The variety and complexity of MobiHealth application scenarios calls for the combined use of wireless technologies (both short-and wide-range), wired communication backbones, and the Internet in a seamless, secure and reliable way. Wireless technologies like Bluetooth, WLAN, WiFi, GSM/GPRS, UMTS, and satellite communications (VSAT) are all used in MobiHealth. Given their excellent coverage, outstanding mobility attributes and availability in numerous spectrum bands, 3G wireless technologies like UMTS and HSPA could well be the preferred solutions. About 3G it needs to be quickly, economically and reliably addressed. EDGE offers the advantages of always-on connectivity and practical data rates up to 128 kbps, which would suffice for a clinical interaction. Szabo[9] has described WiMax as a breakthrough technology to implement wireless and mobile telemedicine services, due to their flexibility in installation, portability and mobility. Other technologies include WLAN (Wireless Local Area Network) and WPAN (Wireless Personal Area Network), 2.5G cellular mobile services (mostly GPRS), in wide-area applications. On the other hand, 3G represents a significant improvement in area coverage and data rate. 3G has often been considered a solution to the "digital world." which is a major obstacle when implementing telemedicine services in many areas.

THE MOBILE PHONE : A EXCELLANCE HARDWARE

A mobile telemedicine system provides a platform for data acquisition from numerous instruments. Inexpensive attachments to turn the digital camera on today's mobile phones into a "microscope" are being evaluated. Mobile phones could send raw imaging data to a base where it could be processed with the sophisticated software needed to create a medical image. This image could then be returned to the mobile phone and viewed. The mobile phone may thus join the stethoscope and the thermometer as an indispensable piece of the medical kit. [10] Rubinsky [11] demonstrated that an imaging system attached to a cell phone can transmit the raw data to another location for processing into an image as easily as if it were a text message. Then the image can be sent back to the cell phone and displayed on the screen for the doctor. Artificial intelligence in telemedicine using medical-decision support systems is now available through the mobile telecommunications platform. [11] GPRS and GSM are being used to achieve high-speed transmissions rates running JAVA-based applications from their mobile terminals. [12].

Using a standard mobile phone Information about heart rate, blood pressure, and temperature is gathered and sent to a consultant from anywhere and anytime. These devices work from any location that offers digital cell phone services. Mobile patient monitoring is now being carried out using wearable individual home-health monitoring systems. [13] Passive in-home monitoring systems based on wireless-accessible sensor populations (WASP) are being used. Data from biological variables (heart rate, accelerometers, body temperature and galvanic skin response) and everyday habits (body position, movements) are transmitted to a central monitoring centre. A body sensor network (worn by the patient and communicating with a personal mobile hub) and an ambient sensor network (a number of wireless sensors

incorporated into the patient's home) are envisaged. [14] Technology in search of an application is often ineffective. It is most reassuring that in wireless telemedicine systems, it is the necessity for clinical applications that has triggered research and development, both in mobile connectivity and in mobile phones. Acute neurosurgical problems were successfully evaluated in a general hospital remotely by university neurosurgeons using JPEG images sent through a mobile phone. [15]. Nugent et al, [16] describe a novel for mobile home-based device to the management of medication, using an Internet-based system and home-based digital television services. A cost-benefit analysis for the mobile self-management of disease suggests time and financial savings for both patients and health care providers. Wireless technology enhances patient self-management and quality of life. Disease management facilitated through information and communication technology (ICT) implies more effective and efficient care of patients with chronic illnesses. [17]

MOBIHEALTH: THE INDIAN PERSPECTIVE

With every sixth human on the planet living in India, providing health care particularly to the 800 million in suburban and rural areas, is to say the least, a challenge. How will MobiHealth be a plausible solution? Simply, because India, an emerging economy, is witnessing an unprecedented, exponential, and phenomenal deployment of Information and Communication Technology. More Internet users are added on mobile every year than cumulative wired base till date. Improving telephone and Internet penetrations in any region is an important economic stimulus with significant improvements to GDP. When 3G becomes available, offering health care using this medium therefore it is more beneficial. In a country like India, it will take considerable time before MobiHealth significantly contributes towards achieving the critical mass, so essential for the successful take off telemedicine services. It is estimated that about 400,000 tele consultations have taken place in India, in the last eight years. 45 percent of the 600 telemedicine units in the country are VSAT enabled (supported by ISRO -Indian Space Research Organization) while the rest are connected by ISDN lines and through IP (Internet protocol) [18]. Recently, Apollo Hospitals, the largest health care provider in Asia and Ericsson one of the world's leaders in telecommunication signed an MoU to initiate for the first time, MobiHealth in India. [19]

Mahatma Gandhi once said, "India lives in its villages". Seventy five percent of the health infrastructure in India, is concentrated in urban areas, where only twenty seven percent of the population lives. The health status especially that of the rural population, is still a cause for concern, The Ministry of Health and Family Welfare, Government of India, is faced with some of the most challenging tasks in providing health care to the suburban and rural population in the country. The Primary Health Center (PHC) set up to cater to the grass-root population, serves as the first point of contact between the village community and health care. A PHC acts as a referral Unit for 6 Sub-Centres and has four to six beds for patients. It performs curative, preventive, promotive and family welfare services. There are 22,669 PHCs functioning in the country. Facilities for providing remote specialist tele-consultations to the PHCs makes available the much needed expertise to the doctor at the PHC. Direct interaction with the paramedical staff would also be an attractive option, to obviate the occasional absence of the doctor at the PHC. Under the National Common Minimum Program(NCMP) of the Government of India, health care is one of the seven thrust areas. The NCMP mandates an increase in expenditure in health sector, with the main focus on Primary Health Care from the current level of 0.9 percent of GDP to 2-3 percent of GDP over the next five years.[6]

"We are now aspiring to taking the total allocation for the health sector to 2-3 per cent of our GDP in the 12th (Five Year) Plan period," Ghulam Nabi Azad said, addressing a seminar in Pune. According to the health minister, the government has invested over Rs 45,000 crore in the last five years in the health sector.[7] In the budget of year 2011-12, the Indian government decided the total outlay for health is Rs. 125 crore. [8] The National Rural Health Mission (NHRM) launched by the Ministry of Health and Family Welfare (MoHFW) is primarily to provide the rural population access to health care services. A National Rural Telemedicine Network is being viewed as an effective tool to achieve this purpose. This includes the design, development, and implementation of low-cost rural telemedicine infrastructure. This would consist of varied technology platforms ranging from fixed, mobile, handhelds, and Broadband to wired/wireless Wide Area Networks and VPNs, centering around the district hospital, acting as a hub. Connectivity will be the defining factor, in reaching out to distant locations. Wireless technology will be considered where traditional land-based communication systems have not yet reached the area where poor connectivity are plugged.

Using a combination of ISDN, leased-line, VSAT, Broadband, and wireless solutions, connectivity and bandwidth requirements will be sorted out. Application-specific mobile units are being and will be configured for rural emergency systems. The Indian Space Research Organization (ISRO) proposes to introduce "suitcase-based communication modules" for use in disaster-hit areas. Simplistically, as most mobile phones have cameras and with increasing availability of MMS services, it could even be possible to send simple photographs and video clippings to a doctor from a moving location. Considering the increased efficiency of wireless communication depend on the availability of 3G. Telemedicine including video streaming would be a value-added service. Mobile technology could be used in the collection of health data at the ground level. Under the Integrated Child Development Scheme, one Anganwadi worker is allotted to a population of 1,000. The duty of an Anganwadi worker is to ensure that regular health checkups, child development, adequate nutrition, immunization, health education, and non-formal pre-school education are made available. The data are entered in a mobile. With a one click,

one can access the details of an Anganwadi worker and the children under her care, even if she is in the remotest corner of the state. This exercise in connectivity and the dissemination of information is becoming wireless. Mobile hand-held units are being used in this project as data harvesting points for NRHM at the grassroots level.

THE GRAMJYOTI PROJECT: LIGHT OF THE VILLAGE

In September 2007, Ericsson undertook a three-month project in India that was called Gramjyoti meaning "Light of the Village." The project showcased for the first time the benefits of mobile broadband technology for rural India. GSM is the wireless technology used by more than 80 percent of global mobile subscribers and covering 60 percent of India's population. The later generation of mobile technology, called WCDMA/HSPA, was used in this project to demonstrate the benefits of mobile broadband technology to local stakeholders. Ericsson worked in partnership with Apollo Hospitals, Hand in Hand (a local NGO), Edurite, One97, CNN and the Cartoon Network to deliver a range of services including telemedicine, e-education, e-governance, voice and video call services and live television and entertainment. Currently 3G technology can be implement for this project.

FUTURE ENHANCEMENT:

A 3G-enabled ambulance was stationed at strategic centers at different times in different villages. With the help of a non-governmental organization social service agency, villagers requiring medical attention were brought to the medical centers. Male and female nurses used the equipment that could record and transmit pulse rate, blood pressure readings and temperature. A stethoscope was placed over the chest of the patient by a nurse. The heart sounds were transmitted through the 3G network to consultants. When clinically indicated, ECG taken by the nurses was also transmitted through the 3G network. Prior to this, the tele-consultant interacted with the patient, listening to the history and doing a clinical examination remotely using a webcam. So the Patient and doctor satisfaction levels will high. Images of plain X-rays, ultrasound and all other investigations can be transferred off-line through wireless technology. Studies are underway now to see if this could be done live, on a real-time basis. This proof of concept validation will hopefully be followed up by two major pilot projects, one in India and one in neighboring Bhutan. This system will extend the reach of the urban-located health care providers and the masses living in the rural areas will benefit.

INTEGRATING MOBIHEALTH INTO THE HEALTH CARE DELIVERY SYSTEM

With developing economies, the expectations of the people in India are increasing. Anyone, anywhere, and anytime will be the buzzwords of the future, and MobiHealth will eventually be a major part of eHealth. This should be incorporated in the medical curriculum so that doctors of the future will be formally trained in MobiHealth. Evolving a system for continuous training in MobiHealth will become necessary. In addition to possessing qualifications, medical professionals will need some extra knowledge and skill that will enable them to use technology safely and effectively (e.g., the skills to operate portable medical devices and to use communication devices). Setting qualifications and standards, in ICT, for health care professionals will be a major task.

LIMITATION OF MOBIHEALTH:

Clinicians should be aware of the underlying possibility of a wrong or missed diagnosis because of the loss of data during transmission or because of the poor quality of digital images transmitted through a mobile network or using a mobile phone.Standards for various aspects of MobiHealth, clear rules regarding operational procedures, well-defined responsibilities for individual stakeholders—and systems to monitor, prevent, and penalize instances of negligence, fraud, and abuse—must be drawn up and enforced. To achieve seamless connectivity and ubiquitous access, it is necessary to establish a critical review of different technologies that can be used in the setting of a developing country, emphasizing its advantages, disadvantages and limitations. Good outcomes can be expected by deploying MobiHealth in the India. The necessity of impact analysis and subsequent third-party independent evaluation of pilot projects on MobiHealth must be mandatory. Clinical applications in MobiHealth cannot be considered in isolation. Far from being stand-alone, they have to be part of a larger e-governance system. In a broad sense, MobiHealth will include the use of public-service messages, SMS, educational programs, and the use of mobiles in disaster management. Real-time health monitoring of the chronically ill (e.g. those with diabetes, asthma, and respiratory and cardiovascular disorders) will also be done on mobile or wearable computing devices.

Valid supporting information (such as clinical data, patient records, best-practice information, e-prescription and drug information and access to medical literature) should be made available on a mobile phone. "Sufficient" information should be easily and readily available, to enable a correct decision to be made. The environment in which a health care service is going to be delivered will affect its performance. This will be taken into consideration when designing or managing the service. Quality should be at the heart of all mobile telemedicine health systems, to guarantee a high level of care for patients. Due the complexity of the operating environment, a strong risk-management and quality assurance system is required. The proposed good practice framework for mobile health systems would take into account security and confidentiality. Any mobile health solution should take into account the limitations of handheld devices and medical sensors, device interference with other medical equipment, privacy concerns, and managerial system implementation issues. Providing health care through wireless technology will be the ultimate societal application. A proper MobiHealth system in place may therefore be the biggest contribution of the 21st century. Improbable? Yes. Impossible? No.

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