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Telemedicine: E-Health and Hospital of the Future

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The term telemedicine encompasses a wide range of telecommunication, information technologies and many clinical applications. Telemedicine has proliferated throughout much of the industrialized world. It will play a crucial role in the health care scenario of the developing countries in the coming years. With the phenomenal expansion of the Internet, telemedicine is now a reality. However, there are many medico-legal and technological problems that have to be sorted out before telemedicine concept really turns to virtual hospitals of future. This article highlights the current status and the future prospects of telemedicine, especially in developing countries.

Introduction

Telemedicine is a new health care delivery system [1] and can be broadly defined as the use of telecommunication technology for transfer of medical data from one site to another. The application brings "*health care on line*" [2]. Brismar [3] has described it as a situation where hospitals are virtually without any borders. Recently, the issue has been raised pertaining to the validity of the term "telemedicine" and its suitability as an accurate descriptor of the field. Should it be abandoned in favour of more inclusive or more positive term such as telehealth and /or e-health is now debated[1].

The term "telehealth" date back to at least 1978 (ref. 4). The World Health Organization (WHO) proposed the concept of *health telematics* to refer all "health-related activities, services, and systems carried over a distance by means of information and communication technology." And most recently the phenomenal expansion of the Internet, and its use in seeking and exchanging health information, consultation with providers, clinical decision support, informal support groups, and educational programming has prompted the introduction of e-health into the nomenclature of this field[1]. None the less, e-health ventures are different from telemedicine, and most of them are motivated by anticipated large financial gains from huge untapped market.

Telemedicine: from Past to Present

In 1998, the WHO defined telemedicine as:

"..... the delivery of healthcare services, where distance is the critical factor, by all healthcare professional using information and communication technologies for the prevention of disease and injuries, research and evaluation, and for the continuing education of healthcare providers all in the interest of advancing the health of individuals and their communities."

Based on the definition the earliest documented telemedical treatment dates from the year 1666, with a physician examining a plague patient from the opposite side of the river, minimizing the risk of infection. During the 19th century, postal communication with a physician was not uncommon, with the diagnosis and a prescription returned by the medical professional upon written description of the patient's symptoms. With the emerging electronic age, telegraphy was the first means recorded to deliver distance medical support. In 1917 in a rural area of Northwest Australia, a postal official was instructed to perform a cystostomy on a patient with severe pelvic injury. With the growing success of the telephone in the 20th century, distant home care by phone gained reasonable attention, in 1964 first report of data transmis-

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sion via the telephone described set-ups for remote ECG monitoring. In 1959, the first functionally interactive televised medical programme was used at the Nebraska Psychiatric Institute, USA to conduct regular group therapy session. In 1968, Massachusetts General Hospital, USA established a videolink to Boston's Logan airport and more than 1000 patients have been examined using the link. The first true telemedical network servicing ten rural sites in Vermont and New Hampshire, USA with consultation and tele-education date back to December 1968 (ref. 5).

During the past decade the vision of telemedicine has changed radically. The success of the Internet and, more importantly, of its standardizing, powerful, inexpensive technology has enabled the development of universal hospital infrastructures. The electronic patient record, as rudimentary as it may look in most institutions today, is easily accessible through integration concepts, i.e. based on the technology of the World Wide Web[6]. As a consequence, electronic patient information distribution in and outside the hospital has become possible, with a suspected dramatic impact on medical workflow.

Telemedicine and Medical Diagnosis

One of the major challenges faced by the medical profession today is put together all the medical information that already exist in such way as to render it an effective tool for reaching diagnosis. Today large amounts of diagnostic equipment generate electronic output, and the vision is to include this as digital data in the medical record. Experiments with telemedicine for remote diagnosis have resulted in its regular life in sparsely populated areas [7]. Remote real-time consultations such as laparoscopy, dermatology, ear and nose throat examination require the simultaneous presence of medical staff at both the diagnosis and the expert sites. This presents a logistical challenge and the services require more medical resources than ordinary consultations. However, technical solutions and already available when the expert sites can be asynchronous, as in the case of teleradiology, telemedicine is easier to organize and may not be more costly than in-house diagnosis[8].

Medical information is already, to a large degree, available on the Internet today. In the future we will have access to all necessary information in our hand-held computer, which will be fitted with a cordless connection to the Internet. To shift the large volume of information on the Internet, intelligent search mechanism will be developed and such mechanism will collect relevant information for the problem question and improve differential diagnosis. Computer aided diagnosis has become a reality in areas, such as mammography, bone densitometry, and electrocardiography. In future, these methods will be used to screen the healthy population, relieving the physician to oversee suspected cases. However, despite the technological advancement the key to a successful diagnosis will still mainly depend on the physician's judgment based on experience and diagnostic imagination[8].

The morphologic diagnosis of tumour specimens with precise tumour typing, staging, and grading remains the basis of almost all cancer treatments. Thus, a histologic diagnosis of the highest quality should be the physician's priority. In approximately 10-20 per cent of tumour cases, diagnostic uncertainty remains to some extent, requiring a second opinion in determining the biologic behaviour, the histogenesis, the grade of dedifferentiation, or any other parameter. Facilitating the communication between pathologists and the exchange of cases, telepathology has gained more and more importance. To benefit from this technical development the International Union Against Cancer (UICC) has decided to establish a telepathology Consultation Center (UICC-TPCC) for interested pathologists around the world. If a pathologist, anywhere on the globe, is confronted with the diagnosis of a difficult tumour case, he takes digitized histologic images (5-40 in number) and sends them along with sufficient clinical data to the server of the UICC-TPCC, asking for a second opinion. The center checks the case and transfers it to one of the UICC experts. This expert makes his or her diagnostic suggestion, which is then transferred back to the requesting pathologist via the UICC-TPCC. This method provides rapid and inexpensive diagnostic aid to pathologists all over the world, offering the possibility of a second opinion in accordance with the UICC-TNM and World Health Organization (WHO) standards[9].

Telemedicine and Medico-Legal Aspect

There are widespread concerns regarding confidentiality of medical information on the web. There are also potential legal issues regarding this and the limitations of medical advice without a face-to-face consultation or clinical examination[10]. In future, all

information on patient (i.e. medical records, radiographs, audiotapes, images, video from different imaging devices, real-time sensor data) may be presented in a Web-browser user interface, very strict access control must be used to prevent unauthorized access to medical information. As an example the patient may bring a smart card with his access key, or the iris or fingerprint of the patients may be used as a basis for the access key[8].

To maintain privacy of data within a closed informative, such as a hospital work, introduction by login and password is usually sufficient to regulate access. However, identification of a caller's address or phone number is mandatory if external access is sought. Once logged into the system, server administration must ensure role-based navigation, to present review of records not directly related to the physical seeking access. Documentation of access to the system and, most important, documentation of changes to a patient record as well as the time they took is essential to ensure the integrity of an electronic patient record. In most European countries, legal authorities have accepted digital signatures, thereby enabling paperless data handling and transmission between medical professional. For transmission of medical data over public networks such as the Internet of ISDN, encryption of data, already highly recommended today, is likely to become mandatory in future. No authoritative indication has been give yet if 40 bit encryption as supplied by SSL (Secure Socket Layer) which is associated to common web-browser is sufficient. As an alternative, IPsec (Internet Protocol Security Architecture) with 128 bit encryption may be provided, however, additional software installation is required by the client and servers, and its speed of transmission suffers from extensive encryption or decryption delays in cases of high data volume like images [5]. The relatively recent advances, viz. firewall technology and public key cryptography will make high-level security possible in future[11].

The most common experienced barrier in all countries is physician resistance. Physicians are concerned that they may be relegated to a less important role, as patients may establish direct contact with telemedicine centers for future consultations. They are hesitant to refer patient for utilizing telemedicine services.

Since telemedicine involves practicing medicine across states or international borders, several questions regarding license and liability issues arise must a physician be licensed in the state where the central telemedicine department is located or where peripheral connection is made or at both places. In 1994 the American College of Radiologists recommended that physician who interpret teleradiology images must maintain, practicing license, both of transmitting and receiving states. The college of American Pathologists says that a physician must be licensed in the state where the physician is located. The vital question arises, shall a physician whose patients are scattered in other countries across the globe, will have to be registered at all these places? For that, he may be asked to pass all examinations, which is not possible in one-life-time. Obtaining and maintaining multiple licenses with cumulative licensing fees, will be extremely burdensome and unpractical[2].

In a litigant society (like USA), medico-legal aspects of inter-state licensing are of paramount importance. For example, can a physician in New York give telemedicine advice to patient in state of California? In the case of malpractice suit where will the physician defend himself? In New York court or in California court? Laws of which state apply on him? Patient may claim that he had electronically transferred his physician to California, whereas the physician may insist that he saw the patient and his data on a video-conferencing monitor in New York in his clinic. It is a precarious situation in the West which is yet to be resolved. In India, this problem does not exist because all state practice common medical law[2].

There exists a question mark on adequacy and accuracy of electronically transmitted data for establishing a correct diagnosis and for providing expert advice to a patient or to a physician at distance. If due to technical malfunction, patients' data is not transferred promptly and correctly, e.g. image degradation in an echocardiogram or in a histopathology slide, that will alter the diagnosis and treatment leading to medico-legal complication, who will be held responsible: attending physician? Hospital? Manufacture or distributor of equipment? tele-communication department or the satellite company?

Non- reimbursement of telemedicine cost is a disincentive. So far only few governments have passed state legislation to provide telemedicine reimbursement. In Asia, Malaysia is the first country to pass the "Telemedicine Act". India should follow suit. Telemedicine programme must be expanded particularly to help rural communities[2].

Telemedicine and the Third World

Until recently, many feared that increased use of the Internet would widen further the knowledge gap between the industrialized and the developed countries. But such pessimism has given way to optimism that the new technology may instead help spur a renaissance of science and technology (S & T) in poorer countries. Use of the Internet in the developing countries is now growing faster than elsewhere. According to a report from the International Data Corporation, the number of users in the Asia-Pacific region will grow from 6.5 million last year to 29.3 million by 2001[12]. In Africa, few years ago, only 12 countries had Internet access, it is now available, at least in the capital city, in 53 out of 54 African countries[13].

Many developing countries have an acute shortage of doctors, particularly specialists, Sub-Saharan Africa has, on average, fewer than 10 doctors per 100 000 people, and 14 countries do not have a single radiologist. The specialists and services that are available are concentrated in cities. Workers in rural care, who serve most of the population, are isolated from specialist support and up to date information by poor roads, scare and expensive telephone, and lack of library facilities[14]. Internet and Telemedicine can play a crucial role in bridging this gap. Free online resources include journals, research databases, and training courses are available on the Internet. Electronic communication has many advantages in poor countries: it is cost-effective, hardware and software requirements are simple, and the information does not have to transmit in real time [13]. As computer hardware and software improve and become less costly, assess to this technology will be more common place and establish itself as an acceptable standard of practice[15].

SatelLife, a charitable organization based in Boston[16], using a low earth orbit satellite and phone lines, is providing Internet access in 140 countries, serving over 10,000 health care workers. Where adequate telecommunication links exist, SatelLife and other organization provide higher capacity e-mail and Internet connections. These allow sending e-mail attachments, such as image files, permitting low- cost telemedicine[13].

During the visit to India the US President Clinton watched a women enter a village health centre, call up a webpage on the computer, and collect information on how to care for her baby. It is possible that this baby will have better health because of the availability of information on the Internet. However, it is rare for a rural woman in a developing country to have access to the Internet. In Africa, which has a population of 700 million, fewer that one million people had access to the Internet in 1998, and of this number 80 per cent were in South Africa. Among the other 20 per cent the ratio of people who have access to the Internet to those who do not is 1 to 5000, in the United States or Europe the ratio is 1 to 6. The Financial barriers to Internet access are considerable, even just counting the cost of usage fees and telephone time, which range from $ 100 to $1800 annually and average about $704 in Africa [17].

In the Cuba meeting, the group of 77, the largest formal coalition of the developing countries within the United Nations, decided that efforts be made to ensure that their countries would not be left behind by the rapid development of the Internet. At the Millennium Assembly of the United Nations in September 2000, it was proposed that the right of universal access to information and communication services be added as a new component of the UN's principle and conventions on human rights and development. This will hopefully be implemented through a global initiative that will provide access to the Internet, especially through community without such access by the end of 2004 (ref. 17).

Telemedicine and India

Patients in remote areas in southern India will be able to get access to doctors and specialists in the cities without leaving their village, because of a telemedicine project launched in April 2000 at Aragonda, Andhra Pradesh. The idea of the project is to take modern health care to the remotest of villages, using advances in information technology (IT). In the second phase of the project the facility will be extended to cover 125 primary health centers, 25 district hospitals, and three tertiary centers in five states of India. It is now felt that such projects can bring down the costs of health care radically, as patients do not have to travel to big cities. "Patients tend to spend much more on travel and on the family's stay than on their medical bills." Secondly, hospitals will have a locational cost advantage – it is much cheaper to set up telemedicine centers in smaller town than to open big hospitals in large cities[18].

Trans-telephonic Electro Cardiographic Monitoring (TTEM) is an easy-to-use tool, now freely

available in India. Between May 1996 and May 1997, 398 patients registered at Escorts Heart Alert Centre for TTEM, out of 664 symptomatic transmission, 531 required either re-assurance or drug-dose adjustment on telephone, 97 were called to OPD on elective basis, 36 patients were advised immediate hospitalization for acute management. TTEM was useful in avoiding 628 unnecessary visits to the hospital, whereas 36 patients were immediately hospitalized for receiving acute life-saving interventions[19].

The telemedicine system developed by Online Telemedicine Research Institute (OTRI), Ahmedabad, features automatic switching to the available communication links like VSAT/ISDN/SAT Com/PSTN and adapts itself to the available line speed. A range of portable medical equipment has been developed which can be used with the telemedicine system, especially in remote areas [20]. During recent Maha-Kumbha mela in Allahabad, SGPGIMS, Lucknow along with OTRI had setup telemedicine network to provide expert medical guidance to pilgrims requiring medical attention in the mela site. About 170 patients were attended including 64 cases of cardiac problems. Tele-monitoring of public health activities and health facility was also carried out[21].

After the recent earthquake in Gujarat, a skeletal telemedicine system was deployed for disaster management, apart from providing emergency telehealth care. The video conferencing and databases facilities were effectively utilized for monitoring public health activities, food distribution, rehabilitation process, etc., in the affected areas[20].

The northeastern regions of the country do not have major hospitals. Besides, due to hilly terrain and inadequate transport facilities, patients cannot reach even existing hospitals for timely medical advice. The Government is now considering setting up of telemedicine facilities at district hospitals so that expert medical advice can be provided from specialized hospital like AIIMS, PGI, Chandigarh, and Lucknow[20].

Regional Cancer Centre (RCC) at Thiruvananthapuram the only referral cancer hospital in Kerala, is developing a web-based telemedicine system, linking various cancer centers of the state. Patients can now go to the nearest centre or teleclinic and with the help of the doctor at the local teleclinic can access specialist at RCC for consultation and follow-up[22].

A major challenge for the introduction of telemedicine systems in India is to provide the service at an affordable cost using available telecommunication infrastructure. The bandwidth limitation in POTS (Plain Old Telephone Service) is the major technological bottleneck; researchers at Indian Institute of Technology (IIT), Kharagpur have adopted a store-and-forward approach to maximize bandwidth utilization. The medical test reports (histopathology, radiology etc.), previous treatment details (prescriptions) and the complaints of a patient who seeks advice from experts at distant place, are first stored at the nodal centre (the end where the patient first reports). Before the actual live telemedicine session begins, these data are sent to the other end, i.e. referral centre, where medical experts are available. Such communication may be carried out when the channels are relatively free, e.g., at night. This strategy has three-fold benefits: (i) The expert can initially browse through the patient's data and may suggest a modified line of treatment without an actual live telemedicine session. This reduces undesirable information exchange and hence, in the long run reduces the running cost of the system, (ii) Since the majority bulk of data are being sent during low-load period the actual data transfer during live telemedicine session would be minimal, (iii) If a patient comes later for another telemedicine session may be as a follow-up of an earlier session or may be with a new complains, then the medical history of the patient need not be sent again to the referral centre. Moreover the databases maintained for patients' complain and the treatments suggested by experts might be used to build a medical knowledge-base. A prototype of the system has been developed for tropical diseases related to dermatology and hematology and is under test and runs between School of Tropical Medicine, Calcutta and IIT, Kharagpur[23].

Telemedicine and Patient Satisfaction

Over the past 3 y, the Georgia Statewide Telemedicine Program has developed an on-going relationship with several rural sites in the United State to provide continuity telepsychiatry clinics. The patient satisfaction survey conducted on 50 outpatients (or their parents) indicated that patients perceived their care to be at least equal to that delivered by more traditional methods[24].

Krousel-Wood *et al.* [25] have conducted a 12 month study on patient and physician satisfaction with telemedicine for the care of a hypertensive population. The recruited, participants were seen both, in person, and via telemedicine. The physicians reported

a small but significant increase in workload, mental effort, technical skills and visit duration for telemedicine when compared with face-to-face consultations. They noted that the telemedicine system worked well in the majority of cases and could reduce the need for future treatment. Patients reported slight but significantly higher satisfaction scores for in-person than for telemedicine meetings, technical quality, interpersonal care and time spent. Patients reported high satisfaction scores for both telemedicine and in-person visit.

A pilot trial conducted by Agrell *et al.*[26]on patients' perception regarding home telecare revealed that some interviewees felt uncomfortable disclosing intimate information during televisits, and other lamented the reduced amount of time nurses spent as compared to in-person visits. However, despite concerns regarding its confidentiality and its ability to approximate the social stimulation of in-person nursing visit, patients in this pilot trial were satisfied with home telecare and seemed ready to accept its widespread use.

Web Site of Interest in Telemedicine

With the spreading of the Internet, scientific information and literature previously available only in libraries is now directly available to widespread group of researchers, clinicians and common public. The Internet is now perceived as the world's biggest library. One can now explore the Internet to discover information about Telemedicine. Few web sites of interest related to Telemedicine are given in Table 1.

The Future of Telemedicine

Telemedicine is having a promising future, especially in home telecare for rural and urban population [27]. Increasing data from a few sites demonstrate that IT can improve physician's decision-making and clinical effectiveness. For example, computer-based physician orders entry system, automated laboratory alert system, and artificial neural network have demonstrated significant reductions in medical errors. In addition, Internet service to disseminate new knowledge and safety alert to physicians more rationally and effectively and rapidly developing and telemedicine to improve rural access to specialty service is undergoing substantial growth[28].

Telemedicine will become an important tool for cardiologist in future. Tele-cardiology has been in practice for the past many years which includes TTEM, echocardiography, angiography, stethoscopy and tele-transfer of haemodynamic, blood gas and biochemistry parameters for intensive cardiac care services. Tele-cardiology centers are now expanding all over the world [2]. In the field of pediatric cardiology, delay in either the diagnosis or the management of a major cardic abnormality may increase morbidity and mortality rates. Furthermore the transportation of critically ill child from a remote area to a referral centre involves risk, delay and expenses. Tele-cardiology in these circumstances would be of big help[29].

The study of Gray *et al.*[30] have demonstrated that Internet-based telemedicine program can reduce the cost of cure to provide enhanced medical informational and emotional support to families of very low birth weight infants during and after their neonatal intensive care unit stay. Diabetes mellitus is becoming a major public health problem. Despite enormous efforts to change the delivery of diabetes care the outcome has not been entirely positive. Telemedicine can play an important role in diabetes care by altering the caring environment and care delivery process[31].

The movement of telemedicine to wireless and mobile Internet application is imminent in the coming years. This migration from desktop platforms to wireless and mobile configuration will have a significant impact on future health care delivery system and their globalization. Recent telecommunications advance will significantly enhance the current methodologies of telemedicine and telecare systems. The next generation Internet and third generation of mobile system have geared for future telemedical applications. These will provide new dimensions to existing medical service and areas of outreach that are not possible with the current generation that will have tremendous impact on low health care delivery in the 21st century[32].

Since the advent of improved telecommunication, greater bandwidth capability medical robotics, and digital video technology, telesurgical telementoring an advanced form of telemedicine are now possible. An experienced surgeon can conduct, guide and mentor a second surgeon from a remote location [33]. This technique also helps in distance teaching, as it enables the medical students to understand the procedures much better [34]. Surgical simulation increasingly appears to be an essential aspect of tomorrow's surgery. The development of surgery simulator is an advanced concept calling for a new writing system, which will transform the medical world. Virtual reality extends the perception of our five senses by repre-

Table 1— Telemedicine related web sites

WWW Telemedicine Resources	http://icsl.ee.washington.edu/~clau/tmresources.html http://www.com.msu.edu/othermed/r-health/telres.htm
Telemedicine	http://oasi.asti.it/aimf/lacchia/internat/telemed.htm http://www.feed-back.com/
Guide to Medical Informatics	http://www.coiera.com/
Galaxy Telemedicine	http://galaxy.einet.net/galaxy/Medicine/Medical-Informatics/Telemedicine.htm
Telemedicine Primer	http://www.telemedprimer.com/
UK National Database of Telemedicine	http://www.dis.port.ac.uk/ndtm
Telemedicine Program at ECU	http://www.telemed.med.ecu.edu/
Telemedicine and rural health	http://www.lib.uiowa.edu/hardin/md/telemed.html
Rural Telemedicine	http://telemed.medicine.uiowa.edu/
Center for Telemedicine	http://www.ttuhsc.edu/telemedicine
California Telehealth & Telemedicine Center	http://www.telehealth.calhealth.org/
HealthWeb: Telemedicine	http://www.lib.uiowa.edu/hw/telemed
Telemedicine Links	http://www.jma.com.au/telelink.htm
Telemedicine & TeleHealth Kansas Medical Center	http://www2.kumc.edu/telemedicine
WWAMI Rural Telemedicine Network	http://www.fammed.washington.edu/telemed
Rural Telemedicine Consortium	http://www.mrtc-iowa.org/
Georgia Telemedicine Program	http://www.mcg.edu/Telemedicine/Index.html
Telemedicine Group Home	http://www.telemedicine.com/
MedNets an International Medical	http://www.internets.com/mednets/telemedicine.htm
Resource	
MedWebPlus – Telemedicine	http://www.medwebplus.com/subject/Telemedicine.html
Law	
Center for Telemedicine Law	http://www.ctl.org/
Telemedicine and the Law	http://www.arentfox.com/telemedicine.html
Health Law Resource	http://www.netreach.net/~wmanning/index.html
Telemedicine Information Exchange	http://tie.telemed.org/legal
	http://tie.telemed.org/
U of M Telemed Home Page	http://www.med.umich.edu/telemedicine
Association	
The American Telemedicine Association	http://www.atmeda.org/
European Telemedicine Center	http://www.gets.cadrus.fr/
The Association of Telehealth Service Providers	http://www.atsp.org/
Scottish Telemedicine Action Forum	http://www.nhsis.co.uk/telemedicine
Magazine/articles	
Telemedicine Today Magazine	http://telemedtoday.com/
Federal Telemedicine Update	http://www.cbloch.com/
TIE: Telemedicine Journals	http://tie.telemed.org/journals
Research/Project	
University of Virginia Telemedicine	http://www.telemed.virginia.edu/
Telemedicine Research Center	http://tie.telemed.org/SiteMap.asp
Telemedicine Research Center	http://www.telemed.org/
	http://trc.telemed.org/
Department of Defense Telemedicine	http://www.tatrc.org/
Telemedicine Test Bed	http://www.matmo.org/
University of Virginia Telemedicine	http://www.telemed.virginia.edu/
Telemedicine at Mayo Clinic	http://www.mayo.edu/telmed/telmed.html
Johns Hopkins Telemedicine	http://www.med.jhu.edu/telemedicine
Technology	
American Medical Development Telemedicine Products	http://www.americanmeddev.com/
Data View Imaging International	http://www.dataviewimaging.com/
Line Imaging Systems	http://www.lineimaging.com
Rogan Medical Systems	http://www.rogan-medical.com
TVR Communication	http://www.tvrc.com
Interactive Medicine- resources	http://www.intemed.net
Healthcare Open System & Trials	http://www.hostnet.org

senting more than the real state of things by the means of computer sciences and robotics. It consists of three concepts :(i) Immersion, (ii) Navigation, and (iii) Interaction. The simulator provides the surgeon with a comprehensive visualization of the organ. It helps in planning and surgical simulation that could be compared with the detailed flight-plan for a commercial jet pilot[35].

The rate of control of high blood pressure is disappointing. In general the lack of regular communication between the patient and the physician, as occurring in the traditional model of clinic based care, predicts a low rate of blood pressure control. In addition, clinic-based blood pressure rates are notoriously unreliable. A solution to this dilemma is teletransmission of self-measured blood pressure reading, which offers the dual advantage of more reliable measurements and the establishment of regular telephone communication between the patient and the health care providers. Preliminary studies of Pickering *et al.*[36] suggest that high blood pressure control can be improved by this system.

Telemedicine offers new possibilities for multidisciplinary cure of cancer patients, allowing direct communications between different complementary and geographically distant specialists. Thus, it is possible to form oncology committees in small hospitals where all specialties are not represented. Studies conducted by Sezeur *et al.*[37] on the medical and economic impact of visioconferences in the therapeutic management of cancer patents without access to oncology centers revealed that Visio conference improved management of cancer patients for a weak working cost.

Stroke accounts for more than half of all patients hospitalized for acute neurological diseases. The cost of stroke is devastating in respect of medical costs, family burden, physical, and emotion costs, as well as long-term care. Telerehabilitation is an approach that can reduce health care costs, decrease patient and family burden of care, and increase active participation in their recovery process[38].

Telemedicine offers great potential for homebound older adults. This technology may be particularly beneficial for alleviating communication difficulties. For example, older adults have difficulties in telephone conversation, especially with unfamiliar people. In addition, study by Rogers *et al.*[39] suggests that older individuals rely more heavily on their visual channels to compensate for deficits in hearing and working memory.

Conclusions

Despite growing enthusiasm for 'Telemedicine' the concept of virtual hospital still has many limitations to overcome. Nevertheless, telemedicine is beginning to have an impact on many aspects of health care in the developing countries. When implemented well, telemedicine may allow the developing countries to leapfrog over their developed neighbors in successful health care delivery[40].With the 'Next Generation Internet'[41] we can anticipate that it evolves and supports high-speed communication. Clear, full-motion video images will be transferred; high-fidelity audio links will allow physicians to listen to patients' hearts and lungs; and common computing platforms at both ends of the link will help to make this kind of medical practice cost-effective. Patients will avoid unnecessary travel from rural settings to major medical centres, primary care clinician will have personalized expert consultation delivered to them in their offices, and patients will accomplish in single office visits what now takes several visits and imposes major inconvenience. In future, patients will have "home visits" through video links, avoiding unnecessary office or emergency department visits, and physician will have important new tools for monitoring patients and for emphasizing prevention rather than crisis management.

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