Telemedicine: Current and Future Perspectives

Ryhan Ebad, Ph.D

[1] **Department of Computer and Information, Jazan University**
Jazan, KSA

Abstract
Telemedicine is a health-care delivery concept that enables distant patients especially in rural areas to be examined by the physicians using telecommunications technologies. It is given that majority of population dwells in rural areas in developing countries that represent the largest patient base of variety of health issues. Access to basic healthcare, doctors, and treatment is hardly reachable. Telemedicine has gained tremendous popularity in developing countries where rural population is deprived access to even basic healthcare. Presently telemedicine is proving extremely viable and feasible solution reaching out to rural population and bridging disparity in quality and access to healthcare between urban and rural regions. The telemedicine market has witnessed spectacular growth lately mainly because of convergence Information technology Communication & Healthcare. This paper examines the current state of telemedicine in developing countries. It further discusses telemedicine implementation cases, lessons learned from the cases, and concludes with potential researchable critical success factors that account for the growth and modest successes of telemedicine. The paper also briefly discusses about the advancements in implementation of telemedicine in developed nations.

Keywords: *ICT, Telemedicine, Telemedicine implementation, e-Health, Health Care Quality, Telemedicine Technologies, Telemedicine Communication.*

In developing countries, the rural population struggles to avail the amenities of modern healthcare. There is always disproportionate number of elderly people, children and adults with chronic illnesses. Information Communication Technologies (ICT) has made a tremendous impact on rural population in terms of enabling access to healthcare via telemedicine. Variety of telemedicine initiatives have been undertaken to connect rural population with healthcare facilities. ICT has simplified telemedicine by which patients can be examined, investigated, monitored, and treated, with the patient and the doctor located at different places. Telemedicine services are being used in radiology, cardiology, ophthalmology, pathology, and tele-education. Other uses include disease surveillance, disaster and disease management, remote consultation, second opinion, telementored procedure, homecare, medical education and public awareness.

This paper is divided into four sections. The first section describes the need of telemedicine. The second section discusses about telemedicine technologies available and the typical infrastructure. The third section describes the economic impact of telemedicine on the community and how it is proving beneficial. The fourth section describes opportunities of telemedicine in developing countries. The fifth and final section touches upon the future role of telemedicine technology (Outcomes of Treatment for Hepatitis C Virus Infection by Primary Healthcare Provider, 2011).

Literature Review
Evidence of the value of telemedicine is wide-ranging. Telemedicine has been shown to improve time-to-diagnosis, facilitate care access for patients in remote regions, and increase patient satisfaction. Health care organizations, networks and government organizations faced with provider shortages, access disparities and budget challenges, are adopting telemedicine to effectively connect geographically-remote patients with specialists based in centers of excellence, to allow scarce specialists to be on call across networks, and to provide remote monitoring of patients (Hospital Mortality, Length of Stay, and Preventable Compilation Among Critically Ill Patients Before and After Tele-ICE Reengineering of Critical Care Processes,2011). A number of recent studies support the view that telemedicine-based interventions can result in comparable outcomes to traditional, in-person meetings, while at the same time offering the potential for cost savings and other efficiencies.

The U.S. Agency for Health Care Quality and Research published findings from a study in the New England Journal of Medicine that support the use of video conferencing technology in the treatment of patients with hepatitis C virus infections. (Outcomes of Treatment for Hepatitis C Virus Infection by Primary Healthcare Provider, 2011).The study found that, for several hundred hepatitis C patients in New Mexico, the rate of serious adverse events was significantly reduced and cure rates were comparable for patients treated by local primary care providers and patients seen at the geographically distant University of New Mexico hepatitis C clinic. The authors concluded that local providers, properly supported via

telemedicine by specialists, tended to be more culturally competent with regard to their specific community. Therefore, by allowing the patients to stay close to home instead of traveling for care, patients' adherence to treatment tended to improve and they were generally in more frequent contact with their providers (Evaluation of the Effect of Consultant Characteristics of Telemedicine Dieagnosis and Treatment , 2011).

Limitations of Study

Although the subject is very broad, it is not possible to discuss all the topics in this paper. However, this paper is limited to just discussing need, implementations, and the benefits of the telemedicine technology. It briefly discusses the impact of adopting telemedicine in both urban and rural communities in developing and developed countries. Further, challenges and other related topics are not discussed in this paper.

Need for Telemedicine in developing countries

Telemedicine is just the future of health care yet it is not commonly known and discussed although it has been around for over a decade now. In advanced and developed countries health care facility is available to the citizens who have easy access backed by advanced technology in cities only. However, even in rural areas of developed countries health care facilities are unavailable to respond to emergency. In developing countries most of the of the healthcare facilities in rural and remote areas do not have qualified staff, a physician, and they are mainly depending on distant nurse practitioner or paramedical staff who are unqualified to make a decision when it comes to critical findings. Hence in such cases a referral to a specialty or a subspecialty is required to get an expert opinion. Consequently, late discovery of ailment, transport time to urban healthcare facilities, and inexperienced primary health-care providers in rural areas is a direct outcome. All such conditions warrant implementation of telemedicine strategies and network to support such patients who need an expert opinion. A study conducted in African nations reveals that people are willing to pay for a service like this because it cuts down on travel time/costs. However it is needless to mention that telemedicine increase access to healthcare, improves healthcare outcomes, reduces healthcare and other costs, assists in addressing the shortages of healthcare providers, and supports clinical education programs. Alternatively online medical help and health care is going to revolutionize the entire health care industry in the near future.

Telemedicine Infrastructure

Telecommunications is an essential link in introducing a telemedicine application. There should be a near zero tolerance telecommunication infrastructure in place for sustenance of reliability, authenticity, and security, the risks of breakdown or even of any corruption of links. Since telemedicine demands an extensive telecommunications network security, a high efficiency level, and adequate transmission capacity, hence security and reliability of telecommunications networks is a decisive factor for introducing telemedicine applications that eventually impacts both economic and practical viability. However in developing countries the existing infrastructures are either obsolete or do not exit and the transmission capacity of is inadequate for telemedicine which is a major challenge. There is a constant pressing need for advanced and reliable technology a typical telemedicine center requires satellite units that must run on the state-of-the art technology with high bandwidth, dedicated servers, high capacity routers and networking equipment to make the telecommunication network one of the robust solutions.

Telemedicine Technologies

Telemedicine ICU consultations involve real-time, live interactive high-definition video and audio communication between the specialist at the regional pediatric ICU and the health care provider at the remote hospital. There are 3 technical components required for a successful consultation, namely, videoconferencing equipment, a telecommunications connection, and 24/7 technical assistance when needed. Telemedicine videoconferencing units used for live telemedicine can vary from low-end, software-based systems to higher end turnkey systems. The software-based systems are used in conjunction with a personal computer and a Webcam where the software uses the computer to make the call and uses the Webcam for the video source, whereas the turnkey systems incorporate video, audio, and the connection in one system. These turnkey units can be connected to a video monitor and microphone and are simple to use. Remotely controlled videoconferencing devices offer a range of quality and can be mounted on a wall, a pole, or even on mobile robotic platforms. Peripheral devices, such as high- resolution exam cameras, stethoscopes, and oto-ophthalmoscopes are available for use with these units.

In recent years, Web portals are being increasingly used as a resource for store and forward telemedicine and to access electronic medical records, including picture archiving communication systems images (Moya, Valdez, Yonas, & Alverson, 2010). Also, there has been an increase in the use of mobile devices such as smartphones and tablets in telemedicine. This is partly because of the increased integration of videoconferencing capability as a result of improvements to both the software and hardware available in these devices (Marcin, Marcin, Sandorra, & Dharmar, 2012).

Telecommunication lines need to be reliable and have adequate bandwidth to maintain quality of service. This may require use of dedicated telecommunication lines, such as complete or fractionated T1 lines, integrated services digital network (ISDN), or some other private networking telecommunication systems. When using a public Internet, connection speeds can vary, and resulting audio–video quality can be unreliable. Furthermore, modifications to allow encryption must be made so that the communications are compliant with the Health Insurance Portability and Accountability Act (HIPAA). A common solution to this is built-in videoconferencing unit encryption and/or establishing a virtual private network (VPN) tunnel. As Internet networks become more reliable and are able to provide more bandwidth, telemedicine programs are more frequently using the Internet with either encryption or VPN over other point-to-point connections such as ISDN, T1, or fiber optic connections that are typically more expensive. When developing an ICU telemedicine program, there are many technical challenges to address, considering the goal is to provide immediate assistance 24 hours a day. Hence, it is important to have an established on-call system not only for the providers but also for the technical personnel at both regional and remote hospitals so that any technical issues can be reliably addressed in a timely manner (Marcin, Marcin, Sandorra, & Dharmar, 2012).

Economic Impact of Telemedicine in a Rural Community

Telemedicine, or the linking of rural residents with urban health specialists, has long held the promise of dramatically improving health care in rural communities. Research has shown that the availability of telemedicine allows rural areas to offer a larger variety of health care services (Rickets 2000); improve the overall perception of health care quality (Nesbitt et al. 2005); and even help with recruitment and retention of physicians (Sargeant, Allen, and Langille 2004, Goetz and Debertin 1996). The nature of telemedicine, however, allows it to do more than simply offer better health services to a community. The economy of a rural community is impacted by the very presence of telemedicine: reduced travel lowers transportation costs and decreases missed time from work; the amount of lab and pharmacy work performed locally increases; and hospitals save from outsourcing telemedicine procedures versus having

to pay an in-house specialist for the same work. Quantifying the economic impact at the community level can be important for areas considering implementing or expanding a telemedicine program, particularly since the basic rationale for the existence of such a program is to provide better service to the community. The current framework for telemedicine evaluation, done at the hospital level, does not allow for this wider view of the potential impacts.

Most of the recent empirical studies on telemedicine have used hospital-level cost analysis frameworks to determine whether or not a particular system was cost-effective (Whitten, Kingsley, and Grigsby 2000). In general, the findings have been somewhat disappointing for telemedicine, as expected cost savings have not been documented. De la Torre, Hernandez-Rodriguez, and Garcia (2004) find that, from a patient's perspective, some instances of telemedicine may not be cost effective when compared to conventional care. Whitten et al. (2002) systematically reviewed over 600 articles that dealt with cost-benefit analysis pertaining to telemedicine and concluded that no solid evidence existed that telemedicine is a cost-effective method for the delivery of health care.

However, very few (if any) studies have focused on the economic benefits of telemedicine from a community perspective. Only Whitacre et al. (2009) developed a framework to look at telemedicine from this viewpoint, although their study was limited to five hospitals within a single state. This paper builds upon (and adds significant detail to) the framework developed by Whitacre et al. and extends the analysis to multiple telemedicine modalities for 24 hospitals in four relatively rural states. A solid understanding of the economic potential of various forms of telemedicine is vital for communities considering implementation of such a program, particularly in light of the unstable financial environment faced by rural hospitals (Stensland, Moscovice, and Christianson 2002). Being able to document the economic impact of a particular telemedicine service could prove to be very beneficial for hospitals seeking approval for city or county sales tax funding, which is typically the case in most rural communities.

Opportunities of Telemedicine in developing countries

Increased access to health care is on the biggest opportunities of telemedicine presents. It has to potential to provide underserved population in developing countries with the means of access healthcare that will completely redefine and positively impact healthcare and delivery of services (Brandling-Bennett & al., 2005) (Pradhan, 2004). The quality of service and accessibility of healthcare has significantly improved allowing distant providers to evaluate, diagnose, treat, and provide follow-up care to patient in developing countries (Kifle, Mbarika, & Datta, 2006) (Mishra, 2003) (Froelich, 2009). The healthcare providers can efficiently provide tertiary care and enable patients to take the privilege of earlier treatments (Kvedar, Heinzelmann, & Jacques, 2006) and improved quality of life for patients with chronic conditions (Chanussot-Deprez & Contreas-Ruiz, 2008).Telemedicine has played a

significant role in adverse situation where either healthcare professional is unavailable or not experienced enough to offer appropriate medical help (Benzion & Helveston, 2007). Using telemedicine remote physician is able to offer required help and specialist opinions on the subject. (Mukundan et al., 2003). It is definitely a sense of reassurance to both patients and doctors. As the reports indicate that there has been marked decrease in number of referrals to off-site facilities and reduction in need of patient transfers by using telemedicine programs. (Henzelmann, Jacques, & Kvedar, 2005) (Latifi, 2009). This is a direct result of remote care and diagnosis via telemedicine that is proving beneficial to both patients and healthcare system. It has also reduced the distance travelled for specialist care and the related expenses, time, and stress (Kifle, Mbarika, & Datta, 2006) (Chanussot-Deprez & Contreas-Ruiz, 2008) (Vassalo). Furthermore, telemedicine programmes have the potential to motivate rural practitioners to remain in rural practice through augmentation of professional support and opportunities for continuing professional development (Gagnon, 2006). Another secondary benefit of telemedicine in developing countries is by the expansion of telemedicine networks. Using the latest telecommunication technologies, it will be much easier to connect remote sites. By opening additional communication channels for telemedicine can connect rural and remote sites with healthcare professionals around the world this overcoming geographical barriers (Mishra, 2003) (Kvedar, Heinzelmann, & Jacques, 2006) (Vassalo). This could lead to increased communication between healthcare facilities in and outside of the country thus opening window of opportunity of inter-country collaboration and networking. Such collaboration can offer support healthcare providers in remote locations through distance learning and training (Kvedar, Heinzelmann, & Jacques, 2006) (Mukundan et al., 2003) (Martinez, 2005). Telemedicine can also present a great opportunity for healthcare professionals by enabling connection doctor-patient encounter in the long term allowing them to experience case-based learning that can be applied to better diagnose and treat future patients. (Patterson,2007). Additionally, telemedicine can connect multiple remote sites which may prove to be a cost effective way of delivering healthcare to these communities thus saving huge cost of constructing infrastructure and engaging healthcare professionals (Sozen, Kisa, & Kavuncubasi, 2003). Furthermore, such systems can also assist in disaster management and organization and collection of patient data, disease management, and effectively mobilizing healthcare delivery mechanisms. (Martinez, 2005). This will also assist in more coordinated and personalized degree of healthcare to patients when their data is already available in the system. With the advancements in telecommunications, the ICTs costs are also reducing which means telemedicine has even greater chance of expansion in developing countries. This will improve increased computing speeds, high speed bandwidths, digital storage, advanced equipments, and hi-tech software. By enhancing the information communication technology infrastructure and developing better communication facilities, telemedicine can also add to the better management of scarce medical resources and day-to-day activities in the developing world (Kifle, Mbarika, & Datta, 2006) (Mishra, 2003).

Some Cases Telemedicine Applications in Developing Countries

India

Telemedicine initiatives

2.1. Department of Information Technology (DIT), Government of India:

DIT is taking a leading role in the implementation of telemedicine initiatives in India. It is involved from the initiation of pilot projects to full scale projects and standardization of telemedicine across the country. It has also rendered financial support in the development of telemedicine software systems developed by C-DAC (Centre for Advanced Development and Computing). The two products of C-DAC are Mercury and Sanjeevani. DIT has also sponsored a major telemedicine project of linking three prestigious medical institutions (SGPGI (Sanjay Gandhi Post Graduate Institute) - Lucknow, AIIMS (All India Institute of Medical Sciences) – New Delhi, and PGIMER (Post Graduate Institute of Medical Education and Research) – Chandigarh (Mishra, Singh, & Chand, 2012).

DIT has established more than 100 nodes all over India in collaboration with the state governments. Telemedicine network is successfully operational in the state of West Bengal for diagnosis and monitoring of tropical diseases and Oncology Network for facilitating cancer care in the states of Kerala and Tamil Nadu.

2.2. Indian Space Research Organization (ISRO):

Indian Satellite System (INSAT) is developed by ISRO in order to utilize it towards the implementation of telemedicine projects across the country. The rural telemedicine initiative is implemented under GRAMSAT (Rural Satellite) program focusing on the development of rural society. ISRO has also collaborated with state governments to establish telemedicine network consisting of 382 Hospitals-306 Remote/Rural, District Hospitals/Health Centers connected to 51 super specialty hospitals located in major states. Sixteen mobile Telemedicine units are part of this network. Andaman & Nicobar Islands in the Bay of Bengal and Lakshadweep

islands in the Arabian sea are the two remote locations of India that are linked to mainland specialty hospitals through satellite connectivity (Mishra, Singh, & Chand, 2012).

ISROs other collaborative initiatives include establishment of Karnataka state telemedicine network where all the district hospitals in the state are connected with five specialty hospitals in Bangalore and Mysore, state of Rajasthan where all the 32 district hospitals are connected with six medical college hospitals and Sawai Man Singh (S.M.S) hospital in Jaipur. ISRO has also assisted other states of Maharashtra, Madhya Pradesh and Orissa in establishing satellite communication based telemedicine pilot projects.

2.3 Ministry of Health and Family Welfare (MoH &FW), Government of India:

Integrated Disease Surveillance Program network is being implemented by the Ministry of Health and Family Welfare (MoH & FW). The initiative links all district hospitals with state medical colleges to facilitate tele-consultation, tele-education/ training of health professionals and monitoring disease trends. OncoNET India project is under implementation which will network 27 Regional Cancer Centers (RCCs) with 108 Peripheral Cancer Centers (PCCs) 155 hospitals to facilitate national cancer control program (Mishra, Singh, & Chand, 2012).

2.5 Telemedicine Initiatives undertaken by Multi Specialty Healthcare Organizations

Country's leading multi specialty healthcare organizations have taken a lead role in implementing telemedicine programs by either collaboration or solo.

SGPGI, Lucknow is already using telemedicine approached over a decade. It has established a network by linking 27 national and international points for the purpose of tele-education and tele-healthcare programs. AIIMS, New Delhi is connected with the states of Jammu & Kashmir, Haryana, Orissa, North East states network and PGIMER, Chandigarh connected with the states of Punjab and Himachal Pradesh network. There are other leading hospitals linked with other distant and remote location of India.

Apollo Hospitals:

The Apollo Hospitals system has become one of Asia's largest private health-care groups and the seventh largest in the world which is also involved in providing telemedicine services. The Apollo Project has opened remote telemedicine centers that link villagers via satellite to specialist services. Apollo's Aragonda project was India's first rural telemedicine station (Sood, 2002). Aragonda is typical of other Indian villages with few registered medical practitioners and rampant malaria, among other diseases. With the Aragonda project, the village was connected to the Apollo hospitals in Chennai bringing tertiary care to the doorsteps of patients (Sood, 2002). Today, the Apollo project has expanded with telemedicine centers at Bangladesh and multiple sites in India. Each center is now connected to the tertiary care Apollo hospitals. The Apollo Hospitals also facilitate Army Hospitals in South India via a network hub to its telemedicine facilities. "News-India: Army hospitals to have telemedicine facilities," Indo-Asian News Service, Jan. 3, 2003.

Asia Heart Foundation:

The Asia Heart Foundation is a not-for-profit charitable organization, established with the objective of providing cardiac care to the general population. The Asia Heart Foundation's telemedicine initiative "Integrated Telecardiology and Telehealth Project" (ITTP) aims at taking cardiac care to the nation's deprived rural and remote population, thereby "bridging the critical knowledge gap" in cardiac care services provided in rural and metro areas. All of ITTP's telemedicine units are linked to its hospitals in Calcutta and Bangalore. The Foundation uses innovations in information and communication technologies including space technology and VSATs developed by the ISRO. ITTP project was replicated in other areas. ITTP offers the largest telemedicine network in India with the support of ISRO and state government.

Mongolia

The aim of the Telemedicine Support to Promote Maternal and Newborn Health in Remote Provinces of Mongolia project is to reduce infant and maternal mortality while addressing the gap between urban and rural health care services. The project started in September 2007, and will continue to December 2010. The project's telemedicine services support Aimags (provinces) with high-risk pregnancy consultations, prenatal ultrasound diagnostics, fetal monitoring, and screening for cervical abnormalities using colposcopy. The services provided by the project are particularly important for women in remote rural regions who do not have the funding to travel for expert opinion. A total of 297 doctors, nurses, and midwives were trained for this programme between March and December 2009. A total of 598 cases were referred in 2009. Of these, 64% were obstetrical, 21% were gynecological pathology, and 15% were neonatal pathology. Only 36 of these cases were referred to Ulaanbaatar for treatment following the diagnosis, substantially saving the resources of rural residents that would otherwise have gone towards travel expenses (Baatar, Suldsuren, Bayanbileg, & Seded, 2012).

Mexico

In 2006 breast cancer became the leading cause of death in Mexican women between the ages of fifty to sixty-nine. The Opportune Breast Cancer Screening and Diagnosis Program (OBCSDP) is meant to transcend economic and personnel barriers through the innovative deployment of ICTs. Aimed to reduce the breast cancer mortality rate in women between the ages of fifty to sixty-nine, the programme will increase the national screening rates from 7.2% in 2007 to 21.6% by 2012. The telemedicine network had the goal to screen 1.3 million women in the 30-month period between May 2010 and December 2012. With over 34 million Mexican pesos (approximately US$ 2.8 million) of seed funding from the federal and state governments and not-for-profit groups, 30 screening sites in 11 states were linked by Internet to two interpretation centres, where results of the screenings could be viewed by radiologists. (In 2012, eight more interpretation sites will be opened, and the programme's operational costs will become self-sustaining.) Due to challenges with Internet connectivity in rural areas of Mexico, many Mexican communities lack the necessary bandwidth for Internet protocol-based image transmission (necessary to transmit mammograms). To overcome this challenge, CDs were used for patient data transfer and long-term data (backup) storage. Each carried four patient images (a full mammography) and up to four patient mammograms. CDs are privately or commercially couriered to the closest interpretation centre (Phase 1). Results with this method, however, took up to three weeks to return to individuals. Communities with Internet access will be evaluating individual partnership agreements with TelMex (a private telecom company) one calendar year after Phase 1 is initiated. If feasible, these should allow for instant data transfer between the screening and interpretation sites and will cut by half the picture-to-result time of 7–21 days required with the use of the CDs.

Quality control of hardware and its interoperability was also a challenge, as was standardizing the skill levels of radiology technicians. Scale up of the programme across Mexico was also a problem initially. The decentralization of partner institutions was also less than ideal, due to independent organizational structures, jurisdictional logistics, and funding schemes – all of which required extensive coordination and time to successfully overcome. Two Secretary of Health subsidiary offices coordinated OBCSDP planning and coordination: the National Centre for Technological Excellence in Health (CENETEC), and the National Directorate for Gender Equity. These offices, along with several other groups facilitated this initiative financially and with other services.

This collaboration led to the programme overcoming a shortage of radiologists to improve equity of access in preventative breast cancer screening and diagnosis for rural and remote residents in over five states in Mexico (WHO, 2010).

Future Role of Telemedicine

The use and role of telemedicine in critical care and ICU medicine is expected to increase. This technology allows subspecialists to extend the reach of their expertise more quickly and over longer distances. Critical care physicians will be able to provide better consultations to remote locations, resulting in higher quality of care. Referring hospitals and physicians will ideally be supported to care for less ill patients that previously were referred to urban tertiary care centers. All these advantages are to the benefit of the patient, the patient's family, the remote physician, the local hospital, regional health care systems, and ideally for payers. Relationships between remote and regionalized ICUs may be enhanced, as subspecialists can provide the latest information to their remote peers, and these peers can educate their

urban peers about the practice of medicine in a non-regionalized hospital. We expect that telemedicine technologies will become more integrated into our daily care, just as computerized physician order entry and the electronic health records are becoming. Different models of care using different technologies will be used depending on the needs of the patients, the remote hospitals, and the regional ICUs. Data have been evaluated and will be updated defining telemedicine impact on efficiency, clinical outcomes, and cost-effectiveness to better define where, when, and for whom the technologies are most clinically and economically effective (Marcin, Marcin, Sandorra, & Dharmar, 2012).

Cutting Edge Technologies in Telemedicine

In Touch Health and iRobot jointly ventured into creation of RP-VITA (Remote Presence Virtual + Independent Telemedicine Assistant) Robot that would completely revolutionalize telemedicine. RP-VITA is capable of enhancing navigation capability that enables it to better manage driving and navigation elements so the health care professional can put more focus on patient care tasks. It is capable to perform autonomous navigation that will allow a remote clinician or bedside nurse to send the RP-VITA to a target destination with a single click, enabling a number of breakthrough clinical applications. RP-VITA can be integrated with live patient data from the electronic medical record and is equipped with the ability to connect with diagnostic devices such as otoscopes and ultrasound. It comes equipped with the latest electronic stethoscope. Also a new, simple to use iPad1 user interface will enable quick and easy navigation to anywhere the RP-VITA needs to go, as well as interaction with the patient, family and care team. (Ackerman, 2012)

CONCLUSION

In the time to come, it is obvious that telemedicine will play a significant role in completely revolutionalizing the entire health care industry. With the advancement in cutting edge technology it will be lot easier to extend affordable health care in distant location and reach out to such remote communities. However, there are a few basic questions that come to the minds of health care professionals that whether we really need telemedicine and if it is cost effective since the initial setup costs are quite significant and there are certain limitations. Just by looking at the bigger picture it is surely an alternative to traditional healthcare. Big companies are devising strategies and inventing sustainable business models to make it profitable and affordable. Undoubtedly, telemedicine is proving to be saving lives, offsetting shortages of general practitioners and medical specialists, providing medical consultation to heath care professionals, providing: Telepsychiatry consultations for rural nursing home residents, Pediatric critical care tele-consultations to emergency departments of distant community hospitals, Tele-palliative care consultations for critically or terminally ill patients who want to receive terminal care in their own community, Tele-dialysis oversight for patients receiving dialysis at remote dialysis centers. (Rabinowitz, 2013)

REFERENCES

[1] Ackerman, E. (2012, July 24). iRobot and InTouch Health Announce RP-VITA Telemedicine Robot. Retrieved October 07, 2013, from IEEE Spectrum: http://spectrum.ieee.org/automaton/robotics/medical-robots/irobot-and-intouch-health-announce-rpvita-telemedicine-robot

[2] Baatar, T., Suldsuren, N., Bayanbileg, S., & Seded, K. (2012). Telemedicine Support of Maternal and Newborn Health to Remote Provinces of Mongolia. In Studies in Health Technology and Informatics (Vol. 182:Global Telehealth 2012, pp. 27-35). http://ebooks.iospress.nl/publication/22108.

[3] Benzion, I., & Helveston, E. M. (2007). Use of telemedicine to assist opthalmologists in developing countries for the diagnosis and management of four categories of opthalmology (30). Clinical Opthalmology , 1(4):489-495.

[4] Brandling-Bennett, H. A., & al., e. (2005). Delivering health care in rural Cambodia via store-and-forward telemedicine:A Pilot Study (23). Telemedicine Journal and e-Health , 11(1)56-62.

[5] Chanussot-Deprez, C., & Contreas-Ruiz, J. (2008). Telemedicine in wound care (29). International Wound Journal , 5(5):651-654.

[6] De La Torre, A., Hernandez-Rodriguez, C., & Garcia, L. (2004). Cost analysis om Telemedicin: Empirical evidence from sites in Arizona. The Journal of Rural Health , 20(3):253-257.

[7] Evaluation of the Effect of Consultant Characteristics of Telemedicine Dieagnosis and Treatment . (2011, May 04). International Journal of Telemedicine and Applications .

[8] Froelich, W. (2009). Case Report: An example of international telemedicine success (26). Journal of Telemedicine and Telecare , 15(4):208-210.

[9] Gagnon, M. P. (2006). Implementing telehealth to support medical practice in rural/remote regions:What are the conditions for success? Implementation Science , 1:18.

[10] Goetz, S., & Debertin, D. (1996). Rural-Urban locationial choices of medical doctors: A country level analysis. Review of Agricultural Economics , 18(4):547:563.

[11] Grisby, J., & Grisby, W. Variables influencing the adoption of telemedicine. State of the Art Symposium on Telemedicine/Telehealth: An International Perspective. Ann Arbor, MI.

[12] Grisby, W., & Goetz, S. (n.d.). Telehealth: What promise does it hold for rural areas? N Glasgow .

[13] Henzelmann, P. J., Jacques, G., & Kvedar, J. C. (2005). Telemedicine by email in remote Cambodia (32). Journal of Telemedicine and Telecare , 11(Suppl.2):S44-S47.

[14] Hospital Mortality, Length of Stay, and Preventable Compilation Among Critically Ill Patients Before and After Tele-ICE Reengineering of Critical Care Processes (20). (2011, June 01). Journal of American Medical Association , 305(21).

[15] Journal, N. E. (2011, June 1). Outcomes of Treatment for Hepatitis C Virus Infection by Primary Care Providers. New England Journal of Medicine , 364:2199-207.

[16] Kifle, M., Mbarika, V., & Datta, P. (2006). Telemedicine in sub-Saharan Africa: The case of teleoptahmology and eye care in Ethiopia (17). Journal of Amerian Society for Information Science & Technology , 57(10):1383-1393.

[17] Kvedar, J., Heinzelmann, P. J., & Jacques, G. (2006). Cancer Diagnosis and Telemedicine: A Case Study of Cambodia (28). Annals of Oncology , 17(Suppl.8):S37-S42.

[18] Latifi, R. e. (2009). <Initiate-build-operate-transfer> - a strategy for establishing sustainable telemedicine programs in developing counteis: Initial lessons from the Balkans (33). Telemedicine and e-Health , 15(4):956.

[19] Marcin, J. P., Marcin, M., Sandorra, C., & Dharmar, M. (2012). The Role of Telemedicine in Treating the Critically Ill. ICU Director , 3 (2), 70-74.

[20] Martinez, A. e. (2005). Analysis of information and communication needs in rural primary health care in developing countries (39). IEEE Transactions on Information Technology in Biomedicine , 9(1):66-72.

[21] Mishra, A. (2003). Telemedicine in otolaryngology: An Indian Perspective (25). Indian Journal of Otolaryngology and Head and Neck Surgery , 55(3):211-212.

[22] Mishra, S. K., Singh, I. P., & Chand, E. D. (2012). Current Status of Telemedicine Network in India and Future Perspective. 32nd Asia-Pacific Advanced Network (APAN) (pp. 151-163). APAN.

[23] Moya, M., Valdez, J., Yonas, H., & Alverson, D. C. (2010). The impact of a telehealth web-based solution on neurosurgery triage and consultation. Telemed J E Health. , 16:945-949.

[24] Mukundan et al., S. (2003). Trial telemedicine system for supporting medical students on elective in the developing world (31). Academic Radiology , 10(7):794-797.

[25] Nesbitt, T., Hilty, D., Kuenneth, T., & Siefkin, A. (2000). Development of a successful telemedicine program. Western

Journal of Medicine , 173(3):169-174.

[26] Nesbitt, T., Marcin, M., Dashbach, M., & Cole, S. (2005). Perceptions of local health care quality in 7 rural communities with telemedicine. The Journal of Rural Health , 21(1):79-85.

[27] Outcomes of Treatment for Hepatitis C Virus Infection by Primary Healthcare Provider. (2011, June 1). New England Journal of Medicine , 364:2199.

[28] Patterson, V. e. (2007). Supporting hospital doctors in the Middle East by email telemedicine: Something the industrialized world can do to help (45). Journal of Medicinal Internet Research , 9(4):e30.

[29] Pradhan, M. R. (2004). ICTs application for better health in Nepal (24). Kathmandu University Medical Journal , 2(2):157-163.

[30] Provider Satisfaction and Patient Outcomes Associated with a Statewide Prison Telemedicine Program in Louisiana (21). (2010, May). Telemedicine and e-Health , 16(4):472-479.

[31] Rabinowitz, T. (2013, May 30). Why rural communities need telemedicine. Retrieved October 08, 2013, from RAGAN's Health Care Communication News: http://www.healthcarecommunication.com/Mobile/Articles/Why_rural_communities_need_telemedicine_10982.aspx

[32] Ricketts, T. C. (2000). The changing nature of rural health care. Annual Review of Public Health , 21(1):639-657.

[33] Sood, S. P. (2002, October-November). India telemedicine venture seeks to improve care, increase access. Telemedicine Today , 23-26.

[34] Sozen, C., Kisa, A., & Kavuncubasi, S. (2003). Can rural telemedicine help to solve the health care access problems in Turkey? (47). Clinical Research and Regulatory Affairs , 20(1):117-126.

[35] Stensland, J., Moscovice, I., & Christianson, J. (2002). Future financial viability of rural hospitals. Health Care Finance Review , 23(4):175-188.

[36] Telemedicine & Advanced Technology Research Center (TATRC). (2013, May 05). Retrieved May 05, 2013, from Telemedicine & Advanced Technology Research Center: www.tatrc.org

[37] Vassalo, D. J. (n.d.). An evaluation of the first year's experience with a low-cost telemedicine link in Bangladesh (34).

[38] Whitacre, B., Hartman, P., Boggs, S., & Schott, V. (2009). A community perspective on quantifying the economic impact of Teleradiology and Telepsychiatry. The Journal of Rural Health , 25(2):194-197.

[39] Whitten, P., & Buis, L. (2007, February). Private payer reimbursement for Telemedicine services in the United States. Retrieved May 06, 2013, from National Center for Biotechnolgy Information (NCBI): http://www.ncbi.nlm.nih.gov/pubmed/17309350

[40] Whitten, P., Mair, F., Haycox, A., May, C., Williams, T., & Hellmich, S. (2002). Systematic review of cost effectiveness studies of Telemedicine interventions. British Medical Journal , 324(7351):1434-1437.

[41] WHO. (2010). Telemedicine:Opportunities and developments in Member States. Geneva, Switzerland: WHO.

[42] 324(7351):1434-1437.