ABSTRACT

Over the last couple of decades, developments in the information and communication technology have made the most palpable impact on health care management all over the world. Newer terms like telemedicine, e-health, telehealth and digital health surfaced to encompass broad concepts like electronic medical records and hospital automation, telemedicine, e-learning in health sector, e-governance and so forth. Telemedicine refers to the application of various telecommunication and networking systems in the delivery of appropriate health care to individuals without limitations of time or distance. It involves the speedy transmission of patient data related to consultations, diagnostic and therapeutic services, patient education and rehabilitative services among the providers, the consumers, the planners and researchers. The advantages range from reduction of travel time and expenses for the patient, optimization of resources, enhanced diagnostic and therapeutic quality, emergency management and early referral of critical cases, cost-effective delivery of specialized services (like follow-up after surgeries) and continued patient education and medical training. These novel concepts showed promising results in several pilot projects in India and now the time has come to apply them to all corners of the country. In this review we tried to search all relevant published data on the introduction of e-health concepts, programs, and the initial results so far from such efforts both from the governmental and non-governmental agencies and analyze the barriers and their possible solutions and to finally answer if India is ready to deliver e-health for all.

Key words: e-health, telemedicine, e-medicine
folds. The smart phones can diagnose arrhythmias and the medical images can reach an expert in no time either at his home or hospital through telemedicine net-work. Emergency alert systems like wrist bands or neck pendants are now available for the elderly enabling them to lead independent and secure lives. These systems utilize tele-networking and GPS technology with which, in emergency situations, detect their location and a health care team can be immediately dispatched for help just by click of a button. Today’s patients are much better informed and more prepared for the interview with their doctors due to numerous web-sites on health issues. Several disease specific social groups and support agencies are operating effectively through social net-working (e.g.-Hemophilia association, Spastic society etc.). Health-tips, diet and exercise advice are only one-click away anytime anywhere. Patients and doctors are also using media like ‘what’s’app’ in their smart-phones for consultations share of medical images and reports in a span of a few minutes. The health planners can access huge patient data accurately in a short span of time thereby facilitating effective health planning for the masses and the timely implementation of these programs.

SITUATION IN INDIA NOW

India, like most other developing nations, is facing several public health challenges like communicable diseases, malnutrition, and cardiovascular disorders. The diversity and heterogeneity of basic facilities and health care delivery mechanisms in different parts of this vast country is an area of concern for any nation-wide program. Several paradoxes and unresolved challenges still exist in the present health care system. While we boast of the recent launch of ‘Tele-ICU’ - an internet based ICU 24x7 Health Care in New Delhi3; there are several po-ckets in the country facing the everyday challenges of poor transport systems, poverty, illiteracy and large families. The doctor-population ratio in India has been worked to be around 1 per 20004. The dispari-ty in urban and rural doctor distribution is dismal. In the rural settings, it is as low as 1 doctor per 25000 people5. It is largely because, 68.8% of the population lives in villages6 but only about 2% of doctors practice in urban areas7. About 75% pract-ice in urban areas and 23% practice in semi-urban areas8. Many young medical professionals are reluctant to work in rural areas due to the challenges of ill-equipped hospitals in poorly accessible location with limited physical facilities. Telemedicine can be a potential answer to the herculean task of reaching the masses and delivering the basic health services to one and all.

TELEMEDICINE IN INDIA SO FAR

Telemedicine in India started with the inauguration of Apollo Arragonda Hospital in Andhra Pradesh in 20009. Since then, Indian Space Research Organization (ISRO), Department of Information Technology-Government of India (DIT), Ministry of Health and Family welfare-Government of India, state governments, medical institutes in public and cor-porate sector have introduced several telemedicine projects10 that have showed a promising future for telemedicine efficiently solving the problems of effective health care delivery in a vast country like India. By 2008, more than 500 telemedicine centers were linked with about 50 specialist hospitals11. Today the numbers are even higher with several suc-cess stories.

Some examples of major telemedicine projects are illustrated in Tables 1, 2 and 3. The Indian government has been tremendously supportive of these telemedicine projects. In the 11th Five Year Plan (2007-2012), Indian government had allocated 2000 million rupees for this purpose12. A Working Group for the development of Indian Health Information Network was set up by the National Knowledge Commission with the objective to design, develop and integrate electronic health care framework to improve public health, health research and delivery of health care13. With the help of Uttar Pradesh state government, SGPGIMS, Luck now has set up School of Telemedicine & Biomedical Informatics which is also recognized as a National Resource Centre by the DIT14. India is now moving into a leadership role by expanding its services beyond its borders by way of projects like SAARC telemedi-cine project and Pan-African e-Network Project (see table 2)14.

POTENTIAL BARRIERS TO THE PROGRAM

Introduction telemedicine on a nationwide scale in India is faced with a number of barriers and chal-lenges.

1. Budget Allocation: The foremost barrier is lack of earmarked budget allocation. Though there is a progressive increase in health budget in successive annual budgets the bulk of this is spent for maintenance of basic health services, upgradation of infrastructure, medical educa-tion and research. There is no ear-marked allo-ca- tion to e-health and telemedicine out of the limited resources.
2. Lack of infrastructure: many peripheral health centers lack dependable electric supply and basic infrastructure like telephones, computers and internet connectivity.
3. Trained personnel: There gross lack of trained personnel to manage the program.
4. Need to establish Central control and regional coordination centers at state capitals
5. Legal and ethical issues to be discussed at length at various levels
6. There urgent need for formulation of guidelines for appropriate use of e-health
7. Patient awareness and acceptance through health education

A recently concluded international conference on ‘Transforming Health care with IT’ held at Hyderabad (2012) highlighted several of these issues. It is indeed a herculean task for any government to set up a perfect e-health system in a vast country like India in a short time. A step-wise approach with proper prioritization is the only practical solution. The telemedicine centers can be opened in all metro and big cities in the initial phase and diversified to district head-quarter hospitals in phases. In the next stage extension of the facilities to community health centers from the district head quarter hospitals and integrating with the existing peripheral health centers and sub-centers can complete nation-wide network.

Table 1: Telemedicine projects in India by agencies

<table>
<thead>
<tr>
<th>Agency/Institute Involved</th>
<th>Telemedicine Activities / Achievements</th>
<th>Website / Reference</th>
</tr>
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<tbody>
<tr>
<td>Ministry of Health and Family Welfare (MoH&amp;FW), Government of India</td>
<td>Currently implementing Integrated Disease Surveillance Program Network (connects all district hospitals to medical colleges)</td>
<td>8, 12</td>
</tr>
<tr>
<td>Department of Information Technology (DIT), Ministry of communication and IT (MICTT), Government of India</td>
<td>1. Telemedicine standardization and practice guidelines 2. &gt;100 nodes in collaboration with state governments especially Punjab, TN, Kerala, WB, Tripura. 3. Northeastern and Himachal Pradesh hilly areas for specialty care 4. Specialty hospitals with District/ Rural Hospitals 5. Development and application of Tele-Radiology- West Bengal 6. Telemedicine module for Tropical Medicine in West Bengal - Webel (Kolkata), IIT, Kharagpur and School of Tropical Medicine, Kolkata 7. Telemedicine and Tele-health Education facilities in Kerala; 3 mobile telemedicine units to cater rural population of Kerala and TN focusing on early detection and preventive medicine. 8. OncoNET Network - Kerala and Tamil Nadu States 9. Telemedicine network for Naga Hospital, Kohima with Apollo Hospital, Delhi</td>
<td>8, 12</td>
</tr>
<tr>
<td>External Affairs Ministry</td>
<td>Pan-African e-Network Project The South Asian Association for Regional Cooperation (SAARC) Telemedicine Network Projects 10 super specialty hospitals will provide tele-health services to 53 remote African Hospitals</td>
<td>8,14</td>
</tr>
<tr>
<td>Indian Space Research Organization (ISRO)</td>
<td>Nationwide network Many State level telemedicine networks established with collaboration between ISRO and the State Governments. Jammu &amp; Kashmir, Andaman &amp; Nicobar Islands, Lakshadweep Islands, North eastern states are also connected through telemedicine network by ISRO About 10 Mobile teleophthalmology facilities for rural areas are available 382 hospitals connected in telemedicine network. 306 Remote/Rural/ District Hospitals/ Health Centres and 16 mobile telemedicine units are connected to 60 Super specialty Hospitals located in major cities</td>
<td><a href="http://www.isro.org">www.isro.org</a></td>
</tr>
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Interestingly, many of youngsters with MBBS and BDS degrees are exploring career options in e-Health and Tele-medicine. Interestingly, many of youngsters with MBBS and BDS degrees are exploring career options in e-Health and Tele-medicine. Interestingly, many of youngsters with MBBS and BDS degrees are exploring career options in e-Health and Tele-medicine. Interestingly, many of youngsters with MBBS and BDS degrees are exploring career options in e-Health and Tele-medicine. Interestingly, many of youngsters with MBBS and BDS degrees are exploring career options in e-Health and Tele-medicine. Interestingly, many of youngsters with MBBS and BDS degrees are exploring career options in e-Health and Tele-medicine. Interestingly, many of youngsters with MBBS and BDS degrees are exploring career options in e-Health and Tele-medicine. Interestingly, many of youngsters with MBBS and BDS degrees are exploring career options in e-Health and Tele-medicine. Interestingly, many of youngsters with MBBS and BDS degrees are exploring career options in e-Health and Tele-medicine. Interestingly, many of youngsters with MBBS and BDS degrees are exploring career options in e-Health and Tele-medicine. Interestingly, many of youngsters with MBBS and BDS degrees are exploring career options in e-Health and Tele-medicine. Interestingly, many of youngsters with MBBS and BDS degrees are exploring career options in e-Health and Tele-medicine. Interestingly, many of youngsters with MBBS and BDS degrees are exploring career options in e-Health and Tele-medicine. Interestingly, many of youngsters with MBBS and BDS degrees are exploring career options in e-Health and Tele-medicine. Interestingly, many of youngsters with MBBS and BDS degrees are exploring career options in e-Health and Tele-medicine. Interestingly, many of youngsters with MBBS and BDS degrees are exploring career options in e-Health and Tele-medicine. Interestingly, many of youngsters with MBBS and BDS degrees are exploring career options in e-Health and Tele-medicine. Interestingly, many of youngsters with MBBS and BDS degrees are exploring career options in e-Health and Tele-medicine. Interestingly, many of youngsters with MBBS and BDS degrees are exploring career options in e-Health and Tele-medicine. Interestingly, many of youngsters with MBBS and BDS degrees are exploring career options in e-Health and Tele-medicine. Interestingly, many of youngsters with MBBS and BDS degrees are exploring career options in e-Health and Tele-medicine. Interestingly, many of youngsters with MBBS and BDS degrees are exploring career options in e-Health and Tele-medicine. Interestingly, many of youngsters with MBBS and BDS degrees are exploring career options in e-Health and Tele-medicine. Interestingly, many of youngsters with MBBS and BDS degrees are exploring career options in e-Health and Tele-medicine. Interestingly, many of youngsters with MBBS and BDS degrees are exploring career options in e-Health and Tele-medicine. Interestingly, many of youngsters with MBBS and BDS degrees are exploring career options in e-Health and Tele-medicine. Interestingly, many of youngsters with MBBS and BDS degrees are exploring career options in e-Health and Tele-medicine. Interestingly, many of youngsters with MBBS and BDS degrees are exploring career options in e-Health and Tele-medicine. Interestingly, many of youngsters with MBBS and BDS degrees are exploring career options in e-Health and Tele-medicine. Interestingly, many of youngsters with MBBS and BDS degrees are exploring career options in e-Health and Tele-medicine. Interestingly, many of youngsters with MBBS and BDS degrees are exploring career options in e-Health and Tele-medicine. Interestingly, many of youngster...
### Table 3: Institutions in Corporate sector

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<th>Agency/Institute Involved</th>
<th>Telemedicine Activities/Achievements</th>
<th>Website/Reference</th>
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<tbody>
<tr>
<td>Apollo Hospitals</td>
<td>1. Networked all its hospitals and use in-house software Installed a number of peripheral telemedicine nodes including 10 overseas. ATNF &gt; 125 peripheral centers, 1 mobile tele-general medicine 2. Telemedicine consultancy and software providers 3. Active participants in providing software telemedicine consultancy in multiple disciplines standardization of activities training personnel in telemedicine 4. Major participant in Pan African e-Network Project 5. Training programs in Chennai in conjunction with Anna University 6. Pioneering efforts in m-health and home healthcare</td>
<td><a href="http://www.telemedicineindia.com/">http://www.telemedicineindia.com/</a></td>
</tr>
<tr>
<td>Apollo Telemedicine Networking Foundation (ATNF)</td>
<td>8, 12</td>
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</tbody>
</table>
| Amrita Institute of Medical Sciences (AIMS), KOCHI | • 166 nodes Lakshadweep Islands, Port Blair on the Andaman Islands and Leh, Ladakh also connected  
• Emergency Medical Center at Pampa (Sabarimala)  
• 1 Mobile tele-hospital: Mobile tele general medicine, tele radiology, tele-ophthalmology, tele gastroenterology, tele cardiology, biochemical testing, with semi autoanalyzer, light microscopy  
• Tele healthcare- multiple specialties.  
• Tele surgeries, tele mentoring, tele-CMEs, distance education  
• Village Resource Center project  
• Telemedicine solution provider  
| Sri Ramachandra University, Chennai | 1. In Partnership with ISRO  
• Connected to Andaman & Nicobar Islands  
• Connects with 165 telemedicine centers in India  
• Connects with 35 specialist centers to share CME programs and live surgeries  
• Village Resource Center project with MSSRF and ISRO  
2. Provide training to WHO fellows on telemedicine  
3. With PACS system, real-time Tele-radiology: connected about 25 private centers including some centers in West Bengal and Northeastern states  
| Fortis Health care Network and Escorts Heart Institute | Tele-cardiology  
| Narayana Hrudayalaya and The Asia Heart Foundation | • Tele-cardiology- Tele consultations, CME tele-education and hrudaya posts (25 post offices are connected with NH)  
• Network of 4-5 ICUs, 20 telemedicine centers  
• TT-ECG Network: 308 centers: India and abroad  
• Pan-African e-Network project  
| Sir Ganga Ram Hospital, New Delhi | Telemedicine centers in Haryana and Rajasthan  
Mobile tele-hospitals  
Supported by ISRO | 8 [http://www.sankaran ethralaya.org/a-step-towards-combating-blindness-in-rural-areas.html](http://www.sankaran ethralaya.org/a-step-towards-combating-blindness-in-rural-areas.html) |
| Sankara Nethralaya | Pioneering activities by Sankara Nethralaya in mobile teleophthalmology since 2003: covers Karnataka, West Bengal, Tamil Nadu, Maharashtra | [http://www.sankaran ethralaya.org/mobileunits-teleophthalmology.html](http://www.sankaran ethralaya.org/mobileunits-teleophthalmology.html) |
| Arvind Eye care | Supported by ISRO  
Mobile Teleophthalmology services also available | [http://www.aravind. org/telemedicine/eyestalkhome.htm](http://www.aravind.org/telemedicine/eyestalkhome.htm) |
| World health Partners: Skyhealth rural Centers (The Global Health Group) | Telemedicine centers in rural Bihar, Uttar Pradesh  
REFERENCES:


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