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eHealth and Telemedicine in India: An Overview on the Health Care Need of the People

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ABSTRACT

We have reached far ahead today when it comes to the telemedicine technology which was first installed in Boston in 1967 that made a regular interaction between physicians and patients at distant locations. Being a developing and lower-middle income country, currently India faces shortage of doctors, nurses & midwives, and healthcare infrastructure. Around 70% of Indian population lives in remote and rural villages lacking access to basic healthcare facilities. In such situations telemedicine plays a great role in providing quality and affordable healthcare to India's poorest people, and is expected to bridge the rural-urban health divide. Whether telemedicine technology meets its objective to provide adequate healthcare services to the poor remote and rural population is matter of great concern. This article aims to provide an overview on this issue.

1. Introduction

India spends 3.8% of GDP (2015) on health which is far below other major countries like USA (16.83), Canada (10.43), UK (9.87), Brazil (8.91), Russia (5.56), China (5.3), Myanmar (4.94) but ahead of other countries like Indonesia (3.3), Laos (2.8) (Total expenditure on health as a percentage of Gross Domestic Product (GDP), 2015). Even the doctor's density per 1000 population in India is 0.6 which is also behind other major countries like USA (2.7), UK (2.1), Brazil (1.7), and China (1.4). In fact the global average of doctor density per 1000 population is 1.23. Moreover, 70% of the Indian population lives in underserved rural areas, where only 2% doctors practice and most of them are registered medical practitioners (Patnaik & Patnaik, 2015). While 23% doctors practice in semi-urban areas and towns, and 75% qualified doctors (specialists) practice in urban areas or in metro cities (Patnaik & Patnaik, 2015). Thus, there exists a huge manpower gap in the health sector in India. In such a situation, emergence of telemedicine technology in India provides new possibilities to overcome the existing shortfalls in the healthcare sector. The first telemedicine center of India was opened by Apollo Hospital in Aragonda village of Chitto or District in Andhra Pradesh and it was connected to Apollo Hospital in Chennai through telemedicine. This first telemedicine center of India was inaugurated by then president of USA Mr. Bill Clinton. Since then, the Indian government is providing funds from time to time for the growth of the telemedicine facilities. The objective of the allocation of this money for telemedicine is to "access all the inaccessible parts" of the Indian subcontinent. Having low doctor to population ratio and low hospitals to population ratio, the telemedicine seems to be only possible and effective solution to overcome the current disease burden and mortality rate (Chandwani & Dwivedi, 2015). The question arises whether telemedicine has really met its objectives of providing adequate and affordable healthcare to the country's poor population? The question is yet to be answered.

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Recent Developments

The government of India has taken many initiatives like National Medical College Network (NMCN)- to establish a national grid to connect medical colleges through high speed internet for medical education; National Rural Telemedicine Network (NRTN)- to design, develop and implement low cost telemedicine infrastructure in rural areas; and mHealth for covering entire country with telemedicine network to bestow rural peoples with tertiary healthcare facilities (Mishra *et al.*, 2012). ISRO has played an imperative role in deployment of telemedicine services by providing satellite services through GRAMSAT, EduSat and INSAT satellites. Currently ISRO covers 384 telemedicine centers with 60 super specialty hospitals, Department of Information Technology (DIT) covers over 100 telemedicine nodes and OncoNet India project has been started by Ministry of Health and Family Welfare (MoH & FW) to connect 108 Peripheral Cancer Centers (PCCs) with 27 Regional Cancer Centers (RCCs) (Mishra *et al.*, 2012). The Karnataka Internet-Assisted Diagnosis of Retinopathy of Prematurity (KIDROP) and the Revised National Tuberculosis Control Program (RNTCP) have been initiated to cure diabetic retinopathy and tuberculosis respectively, in both urban and rural partsof the country (Sheet, 2016). Government of Andhra Pradesh has started MukhyaMantri e-Eye Kendram under National Health Mission (NHM) to provide teleophthalmology services to the people (MukhyaMantri e-Eye Kendram Web Portal, 2019). Currently teleophthalmology services are being provided from 116 Active Centers of MukhyaMantri e-Eye Kendram, and more than 975000 people have visited these centers for their treatment (MukhyaMantri e-Eye Kendram Web Portal, 2019). Government of Andhra Pradesh has also started MukhyaMantri Aarogya Kendra mulu under NHM to provide healthcare services to the people through telemedicine, and more than 38000 teleconsultations have been provided till date through these centers (MukhyaMantri Aarogya Kendramulu Web Portal, 2019).

Schizophrenia Research Foundation (SCARF) has started telemedicine services in rural Tamil Nadu in year 2005, currently it is providing telepsychiatry services to 156 villages covering around 300000 people (SCARF Web Portal, 2019). Further, Madras Diabetes Research Foundation (MDRF) has started Chunampet Rural Diabetes Prevention Project (CRDPP) to provide telemedicine services to rural patients suffering from diabetes (MDRF Web Portal, 2019); Mohan *et al.*, 2014). Telemedicine services at National Institute of Mental Health Sciences (NIMHANS), Bangalore have been started in the year 2001; upto 2014 NIMHANS has provided 755 teleconsultations in psychiatry, 215 in neurology, 93 in neurosurgery and 206 in other medical specialties (NIMHANS Telemedicine Web Portal, 2019). Postgraduate Institute of Medical Education & Research (PGIMER), Chandigarh is also a leading telemedicine service provider in psychiatry as well as in other medical specialties (PGIMER, Chandigarh Telemedicine Web Portal, 2019). PGIMER Chandigarh has also been made Regional Resource Center of Telemedicine for North India under NMCN (National Telemedicine portal, Telemedicine Division, Ministry of Health and Family Welfare, Government of India, 2019). Currently India has more than 600 telemedicine centers widely distributed across diverse geographic and socioeconomic settings (Figure 1 and Table 1). Table 2 describes about the eHealth and mHealth systems developed for better Healthcare Delivery across India.

Telemedicine: Is it an Alternative Option for Conventional Face to Face Consultation?

A cross-sectional study has revealed the satisfaction for telemedicine among 80% patients and all the doctors on the basis of evaluation of perception of patients and doctors towards the use of telemedicine at Apollo Tele Health Services (Acharya & Rai, 2016). Additionally, 90% of the participants have found telemedicine to be cost-effective and 61% of the doctors who have participated in the survey have found an increase in inflow of patients apart from the regular number of patient's visits (Acharya & Rai, 2016). Besides these advantages there are several major concerns that hinders the complete use of telemedicine. For example,

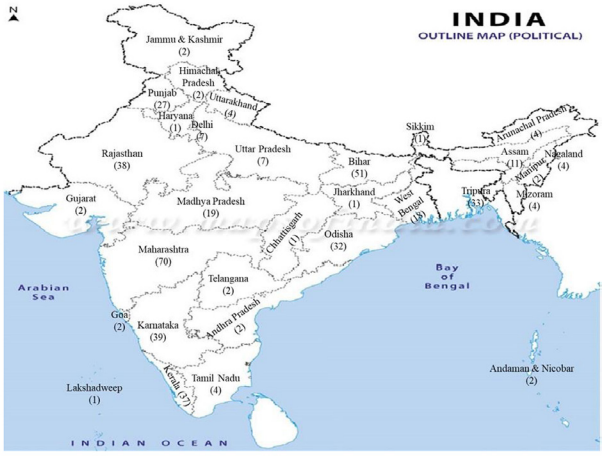

Figure 1: Distribution of Telemedicine Centers in Indian States and Union Territories; No. of telemedicine centers in each state is indicated against name of each state (Mishra *et al.*, 2012; (National Telemedicine portal, 2019; Telemedicine Division Ministry of Health and Family Welfare, Government of India, 2019; SGPGIMS Lucknow Telemedicine Web Portal, 2019; National Health Portal of India, Government of India, 2019); Mathur *et al.*, 2017; Ray *et al.*, 2017).

Table 1: Illustration of Private Telemedicine Service Providers in India (Mishra et al., 2012; Ray et al., 2017; Aravind Eye Care System Web Portal; Venu Eye Institute & Research Center Web Portal; Welcare Telemedicine Web Portal; Ramkumar & Selvakumar, 2016; India Vision Institute Web Portal, 2019).

S. No.	Name of the Institute/Hospital	Specialty	No. of Nodes
1	Amrita Institute Medical of Sciences (AIMS), Kochi	Multi-Specialty	69
2	Apollo Group of Hospitals	Multi-Specialty and Developed "Medintegra" software for telemedicine services	150
3	Asia Heart Foundation (Bengaluru and Mumbai)	Telecardiology	02
4	Fortis Group of Hospitals	Multi-Specialty	20
5	NarayanaHrudayalaya	Telecardiology	26
6	Dr. Balabhai Nanavati Hospital, Mumbai	Multi-Specialty	32
7	Escorts Heart Institute and Research Center	Telecardiology	08
8	Shankara Netralaya	Teleophthalmology	50
9	Aravind eye care systems	Ophthalmology	61
10	Venu Eye Institute and Research center	Ophthalmology	13
11	WELCARE Health systems	Ophthalmology	160
12	Sri Ramchandra Hospital, Chennai	Multi-Specialty	31
13	India vision Institute	Ophthalmology	105 Programs

in case of diagnosis and surgery by using telemedicine, same quality of care as compared to conventional face to face care is not possible. Studies have shown that, despite having positive teleconsultations patients felt that telemedicine cannot be alternative to conventional face to face consultation (Meher & Kant, 2014). Others have demonstrated that out of 114 patients interviewed, 43 respondents said that telemedicine cannot replace face to face consultation and 14 said that they could not rely on tele-consultation (Meher *et al.*, 2009). Also it has been shown that out of 115 patients 56 did not feel comfortable during teleconsultation and 77 said that their privacy was not maintained during teleconsultations done at Himalayan Institute Hospital Trustin Uttarakhand (Suresh & Nath, 2013). Sometimes the doctor needs to analyze the patient by putting his/her hand on patient (or by observing patient physically), in such a situation telemedicine approach becomes limiting. Even if the doctors prescribe a particular medicine to the patients via tele-consultation, it becomes difficult to access the medicine in remote areas of the country due to their non-availability (Ganapathy *et al.*, 2016). How do the patients help themselves in such a situation besides having telemedicine facilities in these remote areas? Even now a days the patients in remote areas have to travel miles from their home (or village) for reaching the teleconsultation facility. More focused approach towards telemedicine is needed so that they patients need not to travel much for availing telemedicine services. In addition, although several evidences indicate telemedicine to be cost-effective, this might not be affordable for the poorest of the poor in India. Telemedicine in fact may be considered complimentary to fulfill healthcare need ofthe poor. Thus, the Indian government needs to recognize the factors hampering utilization of telemedicine along with its limitations.

Policy Majors Taken for Telemedicine Development, Deployment and Promotion

To strengthen the e-health and Telemedicine services and to empower people with better healthcare services Government of India has framed and implemented many policies from time to time. The major policy initiatives taken for telemedicine in India are described below:

1. "National Standards on Telemedicine" have been notified in 2003, "National Steering Committee on Telemedicine under constituted in 2005" and "National Standards for Electronic Health Records (EHR)/ Electronic Medical Records (EMR)" have been drafted during the period of 2010 to 2013 (Telemedicine National Policies, Strategies and Guidelines for implementation, 2019).
2. To standardize telemedicine platform and services, Department of Information Technology, under Ministry of Communication and Information Technology, Government of India has framed a document named "Recommended Guidelines and Standards for Practice of telemedicine in India" and has been released in the year 2003. This document focuses on interoperability of telemedicine services and to assist various telemedicine implementing agencies in the planning and implementation of various telemedicine networks across the country (Mishra *et al.*, 2012).

Table 2: eHealth and mHealth systems developed for better Healthcare Delivery across Country.

S. No.	System	Initiator	Services	Deployment Location	Reference
eHealth Systems developed for remote medical consultation (teleconsultations)					
1	E-Clinic	Nandi Foundation	This system provides medical teleconsultations and healthcare services to cancer patients	Malwa, Punjab	Sharma *et al.*, 2016
2	Health NET	21 Century	This system delivers quality healthcare services to all segments of society including poor people living in remote areas	Goa	Sharma *et al.*, 2016
3	Child Health Monitoring System	Intel	This system provides checkup facilities and diagnostic services to needy children living in urban areas	Chandani Chowk, New Delhi	Sharma *et al.*, 2016
4	Hello Doctor 24*7	MKCG Medical College, Orissa	Provide healthcare information to rural public in form of teleconsultation	Odisha	Sharma *et al.*, 2016
5	School Health Monitoring System	Tata Consultancy Services and Intel	Provides health education and learning to teachers and students of the school	St. Philomena Girls Higher School, Trivandrum	Sharma *et al.*, 2016
6	HealthCare Solution	Hewlett Packard	This system has been designed for patient's management	Maharashtra	Sharma *et al.*, 2016
7	Neonatology	All India Institute of Medical Sciences (AIIMS)	This system has been designed to provide critical information to healthcare professionals regarding care of newborn	Global	Sharma *et al.*, 2016
8	Telemedicine	Government of India, Apollo Telemedicine Networking Foundation (ATNF)	This system has been designed for sharing of knowledge among doctors in course of treatment, for sharing of equipment/ medical tools. It can also be used to provide healthcare training to healthcare personals or ground staff at distant places	Uttaranchal, Uttar Pradesh, Orissa and Karnataka	Sharma *et al.*, 2016
9	Virtual Medical Kiosk	E-Health Access Private Limited	This system has been designed to provide secure and safe environment to doctors and patients for medical consultation	Hyderabad and Andhra Pradesh	Sharma *et al.*, 2016
eHealth systems designed for the purpose of training and learning					
10	Newborn Care	World Health Organization (WHO) and AIIMS	It has been designed to provide e-Learning facilities to healthcare professionals and healthcare workers	Global	Sharma *et al.*, 2016
eHealth systems designed and developed for hospital and record management					
11	Hospital Information System (HIS)	Wipro	This system has been developed for providing services such as registration of patients, digitalization of patient's healthcare data, hospital record management etc.	Six hospitals of Delhi Municipal Corporation	Sharma *et al.*, 2016
12	India HealthCare Projects	Computer Management Corporation(CMC) Ltd.	This system facilitate the user with compilation of healthcare data and generation of reports	Andhra Pradesh	Sharma *et al.*, 2016
13	Electronic Medical Record (EMR)	Tata Consultancy Services and Intel	Collect and saves medical records of patients. Provides medical history of patients	Tamil Nadu	Sharma *et al.*, 2016

Table 2. Continued.

S. No.	System	Initiator	Services	Deployment Location	Reference
14	Individual Tracking and Record Management System	Institute of Electrical and Electronics Engineers (IEEE)	Maintains the history of infants and Vaccination	Ahmadabad	Sharma *et al.*, 2016
Online web portals for healthcare delivery and information and tracking					
15	National Health Portal (NHP)	MoH&FW	It serves as a single point of authentic and reliable healthcare information access to citizens, students, healthcare professionals, researchers and policy makers	All over India Toll free helpline no.- 1800-180-1104	(National Health Portal of India, Government of India, 2019)
16	Online Registration System (ORS)	MoH&FW	Offers services for online registration, payment of fee and appointment, enquiry of blood availability and online diagnostic reports	All over India	(Online Registration System Web Portal, 2019)
17	National Organ and Tissue Transplant Organisation (NOTTO)	MoH&FW	Avail users with Online organ donor pledge, Online hospital registration for Organ/ Tissue Transplant or Retrieval	Located at VMMC and Safdarjung Hospital, New Delhi	(NOTTO Web Portal, 2019)
18	Central Drug Standard Control Organisation (CDSCO)	MoH&FW	CDSCO has been made online through use of software "SUGAM" to avail users with associated facilities	New Delhi	(CDSCO Web Portal, 2019)
19	Nikshay	MoH&FW	Nikshay is case based and web based application software for online monitoring of TB patients	All over India	(Nikshay Web Portal, 2019)
20	Health Information Management System (HMIS)	MoH&FW	It is a web based portal designed and developed for monitoring the programs running under National Health Mission; It compiles data from district level and state level authorities, district level household survey, national family health survey. Around2 lacs health facilities uploading monthly data on performance, and it is also integrated with Global Information System (GIS)	All over India	(HMIS Web Portal, 2019)
21	Integrated Health Information Platform (IHIP)	MoH&FW	MoH&FW is in process for setting up IHIP with a view to establishing a Pan-India integrated health information system along with online Electronic Health Record (EHR) and health information exchange	Pan-India	(IHIP Web Portal, 2019)
Mobile based application for better healthcare awareness and services					
22	mCessation (Quit tobacco)	MoH&FW	This is a program in partnership with WHO and International telecommunication Union (ITU) for helping people in quitting tobacco by continuous messaging	All over India Telephone No.- 011-22901701	(mCessation Programme Quit Tobacco for Life, 2019)

Table 2. Continued.

S. No.	System	Initiator	Services	Deployment Location	Reference
23	mDiabetes	MoH&FW	This is an initiative taken by MoH&FW for prevention and care of diabetes	All over India Telephone No.- 011-22901701	(Ministry of Health and Family Welfare, 2019)
24	Swasthya Bharat	MoH&FW	This is the mobile application that empowers the users with the following services:- Detailed information regarding healthy lifestyle, Information about condition of Disease in alphabetical order (A-Z), including Symptoms, treatment strategies/options and First aid. It also empowers users with public health alert	All over India	(Swasthya Bharat Portal, 2019)
25	India Fights Dengue	MoH&FW	This app provides interactive information to the users for identification of dengue fever, symptoms of dengue fever. It also provides the links of the nearest hospitals and blood banks to the users	All over India	(National Health Portal Gateway of Authentic Health Information, 2019)
26	MeraAspatal	MoH&FW	It is an initiative of MoH&FW for taking feedback on the services received from both private and public healthcare providers (e.g. Hospitals)	All over India	(My Hospital Ministry of Health, Government of India, 2019)
27	Vaccine Tracker (Indradhanush Immunisation)	MoH&FW	This app helps parents for tracking their children's immunization status	All over India	(Indradhanush Immunization, NHP, 2019)
28	Kilkari	MoH&FW	This initiative has been taken for increasing awareness about pregnancy, child birth and child care in women community. Under this 72 audio messages are being delivered free of cost in time appropriate manner on weekly basis. Toll free No.- 1800-3010-1703	Jharkhand, Odisha, UP, MP, Uttarakhand and Rajasthan	(KKMSG Web Portal, 2019)
29	ANM on-Line (ANMOL)	MoH&FW	It is a tablet based application that aims to bring better healthcare services and better consultation to pregnant women, mothers and newborns	Pan-India	(ANMOL Web Portal, 2019)
Private online web portals/apps providing healthcare services					
30	Televital	Televital	Provides telemedicine services to 400+ hospitals in India. They have also partnered with ISRO to provide telemedicine and eHealth services to remotest parts of the country. We have initiator of anesthesia monitoring through telemedicine.	Remotest villages of North-East, Andaman & Nicobar Islands, Andhra Pradesh and Karnataka etc.	(Televital-Enhancing the Quality of Life, Web Portal, 2019)
31	AskApollo	Apollo Group of Hospitals	This platform facilitates the users to book online appointments for consultation, diagnosis, health checkup etc. in almost all the hospitals of Apollo group distributed in India.	All major metro cities in India	(AskApollo Web Portal, 2019)

Table 2. Continued.

S. No.	System	Initiator	Services	Deployment Location	Reference
32	Practo	Practo	This facilitates users to book online appointment with doctors, diagnostic tests, health checkups and medicines	All over India	(Practo Web Portal, 2019)
33	Portea	Portea Heal at home	This provides hospital quality services at home. It also facilitates users to book online appointment with doctors, diagnostic tests, health checkups etc.	Almost all major metro cities in India	(Portea Web Portal, 2019)
34	Lybrate	Lybrate	Provides medical advice. Facilitates users to book online appointments for consultation and lab test	All over India	(Lybrate Web Portal, 2019)
35	Doctor INSTA	Doctor INSTA	Facilitate the users with instant consultation with doctors and specialist	All over India	(Doctor INSTA Web Portal, 2019)

3. **"**The framework for Information Technology Infrastructure for Health" has been prepared by DIT for addressing the information needs of people (Mishra *et al.*, 2012).
4. "National Task Force on Telemedicine" has been set up by MoH&FW, Government of India in 2005 to fulfill multiple objectives of telemedicine and eHealth, such as to resolve interoperability issues, to define national telemedicine grid, to prepare pilot projects for connectivity of hospitals, to prepare curriculum and projects for Continuing Medical Education (CME), and most importantly drafting of a national policy for "Telemedicine and Telemedical Education" (Mishra *et al.*, 2012).
5. MoH & FW has notified EHR standards for country with a view to their requirement and applicability in country. These were supported by major telemedicine providers and stakeholders (EHR Standards for India, Government of India, 2019).
6. MoH&FW has also led initiative to constitute "National Digital Health Authority (NDHA)" in National Health Policy 2017. NDHA will act as promotional, regulatory and standard setting organisation for eHealth and Telemedicine in India (National Health Policy Government of India, 2017).

Challenges and Barriers

About 75% doctors in Kangra District of Himachal Pradesh (HP) revealed that hospitals lack diagnostics facilities for Acute Myocardial Infarction (AMI) and 94% agreed to the fact that Telecardiology services can improve healthcare services for AMI patients (Vivek & Vikrant, 2016). A study has shown that 3 out of 14 ISRO established telemedicine centers at District hospitals (Betul, Shajapur and Khargone) in Madhya Pradesh (MP) did not have adequate electric supply (Bali *et al.*, 2016). This problem is not limited to only MP, but affects functionality of telemedicine all over Indian subcontinent. Another study has revealed that frequent power failure occurred at four telemedicine centers (Nagthat, Kwanu, Lakhamandal and Thano) in tribal hilly areas of Uttarakhand (UK) (Suresh & Nath, 2013). Similarly, because of power failure out of 194 teleconsulations planned with SGPGIMS Lucknow, 9 sessions at base hospital Almora and 19 sessions at base hospital Srinagar were held cancelled in hilly areas of Uttarakhand (SGPGIMS Lucknow Telemedicine Web Portal, 2019). Likewise, in HP, Wireless connectivity (WiFi and WiMax) was not possible because of high Himalayan range altitude and Terrestrial optic fiber connectivity was not possible due to cable cut (Ganapathy *et al.*, 2016). Though ISRO has provided satellite connectivity to more than 100 hospitals, many remote villages are still to be connected to super specialty hospitals (GIM India, 2012). In addition, although, the government of HP was willing to pay three times of the salary what doctors usually get, even then doctors do not want to work in hilly Himalayan areas of HP (Ganapathy *et al.*, 2016). Almost 80% of the telemedicine infrastructure provided by ISRO is not in use because of mismanagement (Jarosławski & Saberwal, 2014). Undoubtedly, telemedicine has penetrated in remote areas, but its functionality is a matter of great concern. The Indian government needs to pay attention towards such emerging issues. Table 3 describes major challenges hampering use of telemedicine in India.

Table 3: Description of various challenges and barriers towards telemedicine.

Challenges and barriers	Reference
Shortage of Electricity	Suresh & Nath, 2013; Bali *et al.*, 2016
Unavailability of Internet connectivity	Suresh & Nath, 2013,Ganapathy *et al.*, 2016; Hemalatha, 2015
Lack of Manpower	Patnaik & Patnaik, 2015; Suresh & Nath, 2013; Bali *et al.*, 2016; Jarosławski & Saberwal, 2014; Apollo Telemedicine Network Foundation (ATNF) report 2011
Lack of amenities supporting Telemedicine	Ganapathy *et al.*, 2016; Bali *et al.*, 2016
Technological Issues	Sharma *et al.*, 2016; Suresh & Nath, 2013; Bali *et al.*, 2016; Jarosławski & Saberwal, 2014; Gogia *et al.*, 2016
Funding Associated Problems	Sharma *et al.*, 2016; Ganapathy *et al.*, 2016; Jarosławski & Saberwal, 2014; Syed-Abdul, 2011
Doctor's Resistance towards Telemedicine	Patnaik & Patnaik, 2015; Meher *et al.*, 2009; Bali *et al.*, 2016; Arivanandan, 2016; Boringi, 2015
Fear of Technology failure	Suresh & Nath, 2013; Raman *et al.*,2014; Mohanan *et al.*, 2016
Lack of Awareness towards Telemedicine	Meher & Kant, 2014; Ganapathy *et al.*, 2016; Boringi *et al.*, 2015
Patient's Resistance towards Telemedicine	Meher *et al.*, 2009; Jain *et al.*, 2015

However, to resolve these challenges various initiatives are being taken by the central and state governments. Recently released National Health Policy 2017 has envisioned that, a National Digital Health Authority (NDHA) will be constituted to implement, promote and regulate the telemedicine in India (National Health Policy Government of India, 2017). Further, under National Telemedicine Network (NTN) the high-speed internet connectivity will be provided through National Knowledge Network (NKN), National Optical Fiber Network (NOFN), SATCOM (satellite communication) and terrestrial high-speed internet to boost the telemedicine services in the country (Concept Note on National Telemedicine Network (NTN); Government of India, 2019). To resolve other challenges government has initiated to provide telemedicine service in Public Private Partnership (PPP) mode (Concept Note on National Telemedicine Network (NTN)-Government of India, 2019). Telemedicine services in PPP have been effective and successful under diverse geographic and socio-economic settings in the country including inaccessible and remote areas of Himachal Pradesh (Ganapathy *et al.*, 2016; Ganapathy, 2014; Ganapathy *et al.*, 2018; CSC Annual Report 2015-16). Apollo Telehealth Services (ATHS), Medanta Hospital are the leading stakeholders in providing telemedicine services in PPP mode (Ganapathy *et al.*, 2016; Ganapathy, 2014; Ganapathy *et al.*, 2018; CSC Annual Report 2015-16).

Recommendations

- More emphasis is required on education and training of health workers, programs to promote telemedicine awareness needs to be started.
- Health workforce should be motivated and promoted for using telemedicine, and government doctors should be provided with extra emoluments for using telemedicine so that their participation in telemedicine can be enhanced.
- Issues like low bandwidth and lack of interoperability standards for software that reduce the efficiency of this technology need to be rectified along with legal, ethical and social issues.
- An integration model based on mobile App including teleconsultation services, video conferencing, patient's diagnosis details, pathology and alert system can be designed and developed to provide quality healthcare services to each and every individual through telemedicine. All healthcare services and facilities can be provided through single mobile App, this may resolve the problem of specialist's non-availability and delay in treatment.
- Telemedicine facilities in the area of neurology and neurosurgery must be deployed to extend their reach to patients residing in rural areas. A public–private partnership model may be promoted as a viable option for telemedicine to be successful.
- Awareness among both the stakeholder's viz. patients and healthcare providers may be created about telemedicine for delivery of quality healthcare services in rural and remote areas.
- Efficient revenue models should be designed for developing infrastructure, training of manpower and research and development for successful implementation and utilization of telemedicine.

Limitation of the Study

Although thorough search has been made to find out n umber of telemedicine centers (Both public and private) in India (Figure 1 and Table 1), eHealth and mHealth

systems (Table 2). However, it was difficult for authors to provide accurate number and details of telemedicine centers, eHealth systems and mHealth systems, because of the non-availability of a common source for finding out all the available information regarding the centers and systems provided in Figure 1, Table 1 and Table 2. Rather information about eHealth and Telemedicine is available in discrete form. Further, regular development and release/ opening of new telemedicine centers, eHealth platforms and mHealth platforms pose limit to find out their exact number.

Ethical Approval

Being this is a review article manuscript, obtaining ethical approval was not required. Since this is a review article and information provided herein are totally based on pre-published articles and information accessed from various health web portals, and no new empirical data were collected for writing this manuscript.

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Competing interest

The Authors have no competing or conflict of interest.

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