

Telemedicine: Transforming healthcare in India

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Abstract

Background: Telemedicine is useful for providing and supporting healthcare when distance separates the participants. Telemedicine may even be useful in developing more cost-effective methods of providing healthcare in private clinics or organizations that present difficult computer integration and communication challenges because of their size and geographic distribution. This review article aims to provide a broad insight into the history, applications, barriers, and challenges of telemedicine, especially from the Indian perspective. **Methodology:** In this article, we reviewed the Indian and global scenario about history and guidelines for the application of telemedicine. Articles with keywords such as 'telemedicine' and 'telehealth' in the title or abstract were searched on PubMed and Google Scholar. Only the articles in English and freely available full text were reviewed. **Results:** It was observed that the Government of India recognized the potential of telemedicine as a novel, advanced, and evolving frontier in health care, which may facilitate and provide essential medical care to people living even in the remotest areas. Along with government's imperfect telemedicine guidelines, India faces the dual challenge of a vast and widely diverse population coupled with deficient and unevenly distributed health resources. **Conclusion:** Increasing awareness among healthcare providers and government initiatives coupled with cautious and responsible practices will facilitate a successful transition to a mixed approach. Incorporating telemedicine with time and deliberation, the current guidelines can be perfected and refined to deal with medico-legal aspects.

Keywords: telehealth, telemedicine, COVID-19 pandemic, India

Introduction

"Tele" is a Greek word meaning "distance", and "mederi" is a Latin word meaning "to heal". It is often used as the umbrella term to encompass healthcare delivery in addition to other activities such as education, research, health surveillance, and public health promotion⁽¹⁾.

According to American Telemedicine Association (ATA), "Telemedicine is the natural evolution of healthcare in the digital world"⁽²⁾. Telemedicine uses electronic information and communication technologies to provide and support healthcare when distance separates the participants⁽³⁾. The World Health Organization (WHO) has defined telemedicine as "the delivery of healthcare services, where distance is a critical factor, by all healthcare professionals using information and communication technologies for the exchange of valid information, for the diagnosis, treatment, and prevention of disease and injuries, research and evaluation, and for the continuing education of healthcare providers, all in the interests of advancing the health of individuals and their communities"⁽⁴⁾.

When did telemedicine start?

From house calls to urgent care clinics on-demand, healthcare has always been a hot commodity. After all, nobody schedules strep throat or a twisted ankle ahead of

time. The modern patient expects 24/7 access to their doctor, and physicians today can use telemedicine to monetize remote assistance. Linking patients and physicians through the internet may increase the involvement of patients in supervising and documenting their health care, processes that may activate patients and contribute to improved health⁽⁵⁾. Health care is the diagnosis and treatment of illness. Diagnosis of illness involves two basic tasks: collecting information about the patient (both current and previous conditions) and analysis of that information to decide the cause of illness⁽⁶⁻⁸⁾.

Telemedicine may even be useful in developing more cost-effective methods of providing healthcare in private clinics or organizations, presenting difficult computer integration and communication challenges because of their size and geographic distribution⁽⁹⁾. Worldwide, people living in rural and remote areas struggle to access timely, good-quality specialty medical care. Telemedicine has the potential to bridge this distance and facilitate healthcare in these remote areas^(10,11). Home health service is one of the fastest-growing areas of health care in many countries. Among the reasons for this rapid growth are several factors, including an aging population, patient preference for care provided in their own homes, and earlier discharge from acute care settings⁽¹²⁻¹⁶⁾.

Optimal utilization of technology in the healthcare delivery system requires overcoming barriers at multiple policies, resources, and socio-cultural levels. This can raise several ethical and legal issues; for example, telemedicine can potentially jeopardize the privacy and confidentiality of sensitive medical information, confusion regarding accountability towards patients, lack of clarity on reimbursement of treatment provided by telemedicine, and the increasing dependence upon technology for achieving the outcomes. Medical services in India are covered under the Consumer Protection Act (1986), and there has been an increase in legal suits against doctors⁽¹⁷⁾.

Despite the increasing technological capabilities and affordability, a significantly large proportion of developing nations' population still lacks resources to own basic information and communication technologies such as computers and the internet⁽¹⁸⁾. The lack of broadband infrastructure in India is another major technological bottleneck in the scaling up and sustainability of telehealth in our country. The recent pandemic has reiterated the significance of telemedicine and solidified its place as an important public health advance.

This review article aims to provide a broad insight into the history, applications, barriers, and challenges of telemedicine, especially from the Indian perspective. Articles having keywords such as 'telemedicine', and 'telehealth' in their title or abstract were searched on PubMed and Google Scholar. Only the articles in English and freely available full text were reviewed. The present review is based on 42 articles published from 1965 to 2021. Thirty-five original articles, four reviews, two reports, and one book were used in this review article, amongst which 18 were Indian studies, and 24 articles were from other countries.

History of Telemedicine

The advent of telemedicine

The communication of warning signals to commercial as well as Mosre Code naval ships was the beginning of the use of telecommunication in the health sector as early as the 1900's⁽¹⁹⁾. In the 1960's and 70's, NASA, the Department of Defence, and the US. Health and Human Services Department invested their resources in telemedicine research⁽²⁰⁾. Early attempts with radio and telephonic consultations were followed by audio-video communications with the advancement of technology⁽²¹⁾. Historically, telemedicine can be traced back to the mid-to-late 19th century. One of the first published accounts occurred in the early 20th century when electrocardiograph data were transmitted over telephone wires.

Modern telemedicine was first started in the 1960's in the United States through two healthcare projects incorporating concepts of telemedicine in the actual healthcare delivery

system. One project was an interactive audio-visual communication system between one psychiatric institute and a mental hospital. The whole purpose was to facilitate medical consultation and education of both patients and healthcare workers. The other was the interaction between Boston's Massachusetts General Hospital and Logan International Airport Medical Station. The patients at the airport received medical advice through audio-visual communication⁽²²⁻²⁴⁾.

History of telemedicine in India

In India, telemedicine entered the healthcare scenario later compared to the western world. The health departments of state governments and ISRO have already initiated telemedicine program in about 400 hospitals, more than 50 specialty hospitals, over three hundred CHCs, and district hospitals or medical colleges in distant places. Department of Space (DOS) has provided the required software and hardware, including communication with satellite bandwidth through the Indian Space Research Organisation (ISRO)⁽²⁵⁾.

In India, millions of pilgrims visit some difficult-to-reach terrains, including the Chardhams (Kedarnath, Badrinath, Gangotri, and Jamnotri). Other important pilgrim centers include Ayappa and Amarnath. Ministry of Health and Family Welfare (MoHFW) and the Department of Science and Technology (DST) together have already initiated satellite-based communication-based telemedicine nodes at these pilgrims' places along with several difficult-to-reach areas. The services include the screening of non-communicable diseases, consultation, and behavioral change communication. This was an outshoot of Hon. Prime Minister's vision and desire to use space technology to address the shortage of human resources, particularly doctors in remote difficult-to-reach areas⁽²⁵⁾.

External Affairs Ministry, Government of India, under Pan African eNetwork and the South Asian Association for Regional Cooperation (SAARC), had started international telemedicine network projects. These projects have strategically positioned Indian telemedicine in the global scenario⁽²⁵⁾.

There are numerous well-established telemedicine projects in India. But following few are examples of grand success; (1) the mammography services started by Sri Ganga Ram Hospital, Delhi, (2) tele-oncology services at Regional Cancer Centre, Trivandrum, (3) surgical services at Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow^(27,28). During Maha Kumbhamelas, attended by millions of pilgrims, the Government of Uttar Pradesh deployed Mobile Telemedicine system vans equipped with video-conferencing systems. This approach enabled doctors in remote places to interact with the enlisted hospitals and super specialty hospitals with this telemedicine facility for expert opinion⁽²⁹⁾.

Corporate private hospitals have taken the torch-bearer's role in establishing telemedicine in India. Some noteworthy include Amrita Institute of Medical Sciences Cochin, Apollo Telemedicine Enterprises, Aravind Eye Care, Asia Heart Foundation, Escorts Heart Institute, Fortis Hospital, Noida, and Narayana Hrudayalaya^(30,31). The telemedicine network has penetrated remote areas to connect 45 rural hospitals and 15 super specialty hospitals. The remote nodes list includes some rural/district hospitals in some states, Medical College hospitals in Orissa, the hilly regions of Jammu and Kashmir, the islands of Andaman and Nicobar, and Lakshadweep⁽³²⁾.

Telemedicine in health care delivery in India

In the early 2000's, in different parts of the country Department of Information Technology (DIT) started some telemedicine projects⁽³³⁾. In the eastern part of India, particularly in the state of West Bengal, the State Government, in collaboration with the Indian Institute of Technology (IIT), Kharagpur, Webel Electronic Communication Systems Ltd (Webel ECS), started several projects. The sole aim was to deliver healthcare under various subspecialties like internal medicine, pediatrics, Human Immunodeficiency Virus (HIV), dermatology, orthopedics, radiology, cardiology, neurology, and oncology to various regions from tertiary care to primary medical centers to the most remote parts of the country^(34,35).

In 2000, in North East part of India, the DOS, ISRO, and the North Eastern Council (NEC), in collaboration, established the North Eastern Space Applications Centre (NESAC). Within a few years of establishment, NESAC initiated an ISRO-NEC telemedicine project. The project was based on satellite communication through the 'Very Small Aperture Terminal' (VSAT)⁽³⁶⁾. In Tripura, a telemedicine network has been established in 31 hospitals. In recent years, there has been a significant increase in the number of consultations in radiology and orthopedics⁽³⁷⁾.

The first rural telemedicine center was started at Aragonda, a small village in Andhra Pradesh with collaborative efforts of ISRO, and Apollo Hospitals. This was made possible due to the initiatives taken by Dr. Ganapathy, a prominent neurosurgeon and known as the father of Indian Telemedicine. In recent times, Apollo Telemedicine Networking Foundation (ATNF) has more than 125 peripheral centers in India and ten overseas. It is certainly India's largest private healthcare provider in the field of Telemedicine⁽³⁸⁾.

One of India's most successful telemedicine projects is the Kerala Oncology Network or the Onconet Kerala. It was started in 2001. The unique characteristic is establishing a web-enabled Hospital Information System Telemedicine Enabled Java based Hospital Automation System ('TEJHAS'). It can be described as a huge electronic database

of patients' medical records, easily accessible to all the medical centers in the region. It is used in the early detection of cancer, its treatment, pain management, and follow-up services^(39,40).

Similarly, two more institutes in southern states, Sankar Nethralaya and Aravind Eye Hospital in Chennai, Tamil Nadu have successfully planned, initiated, implemented, and demonstrated the use of telemedicine in ophthalmology. Aspired by these two giant institutes, many teleophthalmology projects have been established in rural India⁽⁴¹⁻⁴⁴⁾. Cardiac care units are also not lagging behind. In February 2002, Narayan Hrudayalaya established its first tele-cardiac care unit in a district hospital, Chamarajanagar, Karnataka. Narayan Hrudayalaya now has 130 cardiac telemedicine centers across India⁽⁴⁵⁻⁴⁷⁾.

Telemedicine in public health

The availability of extensive information on open access certainly and indirectly assists in promoting positive health by improving community members' knowledge, attitudes/beliefs, and practices. Telemedicine may be in the form of audio-video clips, audio-visual aids, video conferencing, mobile apps, zoom or Google meet telecasting, and healthcare-related events/conversations with clinicians/public health officers. This may serve as best supporting system to inform and motivate people. National Telemedicine Network (NTN) is expected to provide Telemedicine Services to remote areas. It is also envisaged that existing Government Healthcare Facilities [Main Center (MC), District Hospital (DH), Sub-District Hospital (SDH), Community Health Center (CHC), and Primary Health Center (PHC)] in States may be upgraded using NTN. Telemedicine nodes across India are being created, interconnecting all institutions including the most peripheral public sector institutions, to Medical Colleges in every State to provide citizen-centric services. Geographic Information Systems (GIS) have emerged as an additional tool for gathering information about the healthcare system. GIS can play an important role in epidemiological surveillance and give insights regarding the geographical distribution of various diseases, their prevalence, and the overall health of a population. It facilitates the aggregation and integration of disparate data from diverse sources to guide the formulation of public health programs and policy decisions^(34,48). Besides, national programmes as the National Rural Telemedicine Network, the Integrated Health Information Platform (IHIP), the Digital Medical Library Network, and the National Medical College Network, link the medical colleges especially for e-education⁽⁴⁹⁾.

Indian telemedicine during the COVID-19 pandemic

The Government of India had imposed strict lockdown throughout the nation in response to the pandemic. The

Outpatient Departments (OPD) in most of the government and private medical colleges were shut down. The physical distance between a clinician and the patient may be at remote place vanished by telemedicine. The clinician can diagnose, provide intra-operative assistance, prescribe medicines, advise investigations, and counsel patients. Patient can consult another doctor or health care provider at another site⁽³³⁾. Several private healthcare facilities commenced telemedicine services for their patients online through WhatsApp and Zoom video calls. After the emergence of the COVID-19 pandemic, telemedicine was implemented on a large scale in the private sector.

The Medical Council of India (MCI), through the Board of Governors, prepared the guidelines for the practice of telemedicine in consultation with the National Institution for Transforming India (NITI) Aayog and issued them on 25 March 2020. The guidelines include provision of three different modes of communication as audio, video, and text for practitioners. It also mentions the limitations of these modes of communications⁽⁵⁰⁾. However, the clarity regarding the confidentiality of patient data and informed consent are lacking.

With respect to data confidentiality, the current guidelines suggest that the entire responsibility of maintaining and managing the records of all communications between the doctor and the patient lies with the practitioners themselves. The guidelines do explain the concepts of implicit and explicit consent. The act of initiating teleconsultation by the patient may be considered implicit consent. However, the norms about informed consent and obtaining and record it while practicing telemedicine, are deficient in the current guidelines.

Soon the government of India recognized the need and scope for introducing telemedicine in public health in the context of the COVID-19 pandemic. On 9 August 2020, the government of India introduced its telemedicine service, eSanjeevani, as a part of its 'Digital India' initiative. The program allows two types of telehealth services: (1) Doctor to Doctor - which is known as eSanjeevani, and (2) Patient to the doctor, known as eSanjeevani OPD. With its expansion, medical colleges and hospitals, along with large government hospitals would act as 'hubs'. These 'hubs' would provide telehealth services to the community through PHCs called as 'spokes' (a "hub and spoke" model)⁽⁵¹⁾.

Benefits and Barriers of Telemedicine

Benefits of Telemedicine

Telemedicine is a boon for a resource-deficient country like India, where the majority of the population hails from rural areas with poor accessibility to specialty healthcare. In addition, the skewed distribution of the health force largely concentrated in and around the urban areas further

compounds the problem. Telemedicine provides convenient options to people living in places that do not have easy access to super specialty hospitals. Telemedicine is an important stepping stone on the way to achieving 'Universal Health Coverage' (UHC). Another advantage of telemedicine is that it eliminates the in-person visit to a healthcare facility. Eliminating the in-person visit to a healthcare facility vastly reduces the risk of exposure and the chances of cross-infection. It also saves time, money, and energy by cutting down travel time, expenses, and the tiredness of long journeys that would otherwise have been unavoidable^(52,53).

Barriers to Telemedicine

The biggest barrier to the widespread adoption of telemedicine in India is the lack of appropriate infrastructure. The major portion of the country is still rural. Although the country has made an advancement in telecommunication in last two decades, these rural areas lack digitalized services. As per the data from the government regulatory, the Telecom Regulatory Authority of India (TRAI), the internet subscribers and the internet subscriptions reached 687.62 million and 52.08 per 100 population respectively in September 2019⁽⁵⁴⁾.

India's internet penetration rate stood at 47% of the total population at the start of 2022. Kepios analysis indicates that internet users in India increased by 34 million (5.4%) between 2021 and 2022. For perspective, these user figures reveal that 742 million people in India did not use the internet at the start of 2022, meaning that 53% of the population remained offline at the beginning of the year⁽⁵⁵⁾. The lack of broadband infrastructure is a major challenge that should be overcome to enable high-demand video and store-and-forward services⁽⁵⁵⁾.

Another major challenge of a telecommunication-based consult is the lack of in-person interaction between the doctor and the patient. Forming a diagnosis or prescribing the treatment without a hands-on approach is not always possible. Different tests like imaging and serological examinations often require the patient to be physically present.

Maintaining the privacy of data and its secure storage is a major concern in telehealth. However, insurance companies have started to cover the expenses of telemedicine. Telemedicine is still a new concept, and many of the expenses may not have been included under insurance coverage which may lead to more expenses⁽⁵⁶⁾.

An effective telemedicine consult largely determined the practitioners' competency in using technology. These skills differ largely from the traditional consult. Training healthcare personnel in telemedicine is another challenge for its broad application in India. Teaching medical professionals effective digital communication and good 'web-side'

manners, including skills for conducting exams, group discussions, developing skills and prompt troubleshooting are essential before telemedicine can be streamlined as a mainstream public health approach. Telemedicine needs to be incorporated in medical education at undergraduate and postgraduate level.

Ethics and medico-legal aspects of telemedicine

Generally speaking, the medico-legal position of doctors involved in a telemedicine consultation will be similar to that when telephone, fax, email, or letter are used in providing advice from a distance, and the normal standards of care and skill will apply. The most important medico-legal concerns are the doctor's accountability, the duty of care, liability, quality of care, misdiagnosis, the doctor's responsibility, data security, and patient confidentiality.

Any teleconsultation system in place must satisfy data security, privacy, authenticity, and integrity with access limited to authorized personnel and avoid patient confidentiality breaches. Adequate backup systems are needed to prevent accidental loss of data. Encryption is one method to protect data, and E-Consultations encryption software is available to prevent the original data from being altered, sometimes fraudulently. In the case of a specialist teleconsult, the local primary physician would normally be accountable for the patient management decisions.

They must consider all the available information, weigh the evidence, consider different options and make an informed decision. They are therefore unlikely to escape liability even in case of bad specialist advice. Telehealth also challenges 'what informed consent means', when new technologies require education about the benefits and burdens associated with their use. It is critical that the patient has been informed and made sure that the patient understands the scope of telemedicine^(57,58).

Conclusion

The early fantasies of telemedicine since the 1900's, radio and telegraphic consults have paved the way to the modern-day telemedicine practice aided by audio-video consults to provide essential medical care to people living even in the remotest areas. Increasing awareness among healthcare providers and government initiatives coupled with cautious and responsible practices will facilitate a successful transition to a mixed approach. Incorporating telemedicine with time and deliberations, the current guidelines can be perfected and refined to deal with medico-legal aspects. Apart from curative services, telemedicine can be employed as a tool for improving common people's knowledge, beliefs, and attitudes, which can revolutionize health education, promotion, and reporting via teleconsultations to help us achieve the goal of UHC.

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