**Telemedicine: A New Horizon in Health Care system**

**Sri Venkateswara Rao Vaddiparthy\***

Professor of pharmacy, Head of the Department of Pharmaceutics, MB School of Pharmaceutical Sciences, Sree Vidyanikethan college of Pharmacy, Mohan Babu University, Tirupati -517102, Andhra Pradesh

**Introduction**

Healthcare has become one of India’s largest sectors, both in terms of revenue and employment. Healthcare comprises hospitals, medical devices, clinical trials, outsourcing, telemedicine, medical tourism, health insurance and medical equipment. The Indian healthcare sector is growing at a brisk pace due to its strengthening coverage, services, and increasing expenditure by public as well private players.

India’s healthcare delivery system is categorised into two major components - public and private. The government, i.e., public healthcare system, comprises limited secondary and tertiary care institutions in key cities and focuses on providing basic healthcare facilities in the form of Primary Healthcare Centers (PHCs) in rural areas. The private sector provides majority of secondary, tertiary, and quaternary care institutions with major concentration in metros, tier-I, and tier-II cities.

Health care is the diagnosis, treatment, prevention of illness, injury, and other physical and mental impairments in humans through the services offered by the medical and allied health professions. Healthcare, like food and shelter, is a basic need of humanity

Healthcare and hospitals industry is the largest contributor of GDP in the service sector. The healthcare sector is a mammoth sector in India. It remains carefully fragmented and uncompetitive. However, the size of the sector is assured one- lakh core rupees and is estimated to grow by 13 to 15% every year and accounts for nearly 5% of GDP .

Telemedicine is the use of electronic information to communicate technologies to provide and support healthcare when distance separates the participants. *Tele*” is a Greek word meaning “distance “and “*mederi*” is a Latin word meaning “to heal”. Time magazine called telemedicine “healing by wire”. Although initially considered “futuristic” and “experimental,” telemedicine is today a reality and has come to stay. Telemedicine has a variety of applications in patient care, education, research, administration and public health.

The World Health Organization (WHO) defines 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 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.”

 Worldwide, people living in rural and remote areas struggle to access timely, good-quality specialty medical care. Residents of these areas often have substandard access to specialty healthcare, primarily because specialist physicians are more likely to be located in areas of concentrated urban population. Telemedicine has the potential to bridge the distance and facilitate healthcare in remote areas.

While the explosion of interest in telemedicine over the past four or five years makes it appear as a relatively new use of telecommunications technology, the truth is that telemedicine has been in use in some form or the other for over thirty years. The National Aeronautics and Space Administration (NASA) played an important part in the early development of telemedicine. NASA's efforts in telemedicine began in the early 1960s when humans began flying in space.

One of the earliest endeavors in telemedicine, Space Technology Applied to Rural Papago Advanced Health Care (STARPAHC) delivered medical care to the Papago Indian Reservation in Arizona. It ran from 1972–1975 and was conceived by the NASA. Its goals were to provide healthcare to astronauts in space and to provide general medical care to the Papago Reservation.

 In 1971, 26 sites in Alaska were chosen by the National Library of Medicine's Lister Hill National Center for Biomedical Communication to see if reliable communication would improve village healthcare. It used ATS-1, the first in NASA's series of Applied Technology Satellites launched in 1966. The primary purpose was to investigate the use of satellite video consultation to improve the quality of rural healthcare in Alaska. Since 1977, the Telemedicine Centre at the Memorial University of Newfoundland has worked toward developing interactive audio networks for educational programs and the transmission of medical data.

 The North-West Telemedicine Project was set up in 1984 in Australia to pilot-test a government satellite communications network (the Q-Network). The project goals were to provide healthcare to people in five remote towns south of the Gulf of Carpentaria. In 1989, NASA conducted the first international telemedicine program, Space Bridge to Armenia/Ufa. Under the auspices of the US/USSR Joint Working Group on Space Biology, telemedicine consultations were conducted using one-way video, voice and facsimile technologies between a medical center in Yerevan, Armenia and four medical centers in the US. A modern telemedicine system as shown in fig.1



**Fig.1: A Modern Telemedicine System (Ref: IJCM 33-3-goo1.jpg)**

**Role and Type of Technology in Telemedicine**

Two different kinds of technology make up most of the telemedicine applications in use today. The first, called store and forward is used to transfer digital images from one location to another. A digital image is taken using a digital camera, ‘stored’ and then sent (‘forwarded’) by a computer to another location. This is typically used for non-emergent situations, when a diagnosis or consultation may be made in the next 24-48 hours and sent back. Teleradiology, telepathology and teledermatology are a few examples.

The other widely used technology, the two-way interactive television (IATV), is used when a ‘face-to-face’ consultation is necessary. The patient and sometimes their provider or more commonly a nurse practitioner or telemedicine coordinator (or any combination of the three), are at the originating site. The specialist is at the referral site, most often at an urban medical center. Videoconferencing equipment at both locations allow a ‘real-time’ consultation to take place. Almost all specialties of medicine have been found to be conducive to this kind of consultation including psychiatry, internal medicine, rehabilitation, cardiology, pediatrics, obstetrics and gynecology and neurology.

The first among the challenging questions arising when planning a telemedicine network is ‘What is bandwidth?’ Bandwidth is the capacity that determines how quickly bits may be sent down the channels in a telecommunication medium. Bandwidth is proportional to the complexity of the data for a given level of system performance. The following technologies are currently in use:

**Integrated Services Digital Network (ISDN)**

ISDN is a dial-up (not dedicated but used on a call-by-call basis) digital connection to the telecommunication carrier. An ISDN line can carry information at nearly five times the fastest rate achievable using analog modems over POTS (plain old telephone service). This is the backbone of digital service provided to the end user (typically business) in USA today which transmits voice and data digitally at 1.554 megabits per second (Mbps). It can be used to carry analog and digital voice, data and video signals and can even be configured for ISDN service.

**Plain Old Telephone Service (POTS)**

POTS transmits data at a rate of up to 56 kilobits per second (kbps) and is the most widely available telecommunication technology in the world. POTS can be suitable for audio conferencing, store-and-forward communication, Internet and low bandwidth videophone conferencing.

**Internet**

The Internet has a strong impact in delivering certain kinds of care to patients. In a survey of 1,000 Chief Intelligence Officers (CIOs) conducted by Internet Health Care Magazine, 65% said their organization had a Web presence and another 24% had one in development. With the increasing proliferation of e-health sites on the Web today, many consumers are finding access to online patient scheduling, health education, review of lab work and even e-mail consultations.

**Classification of Telemedicine Centers**

 The telemedicine centers could be broadly classified into the following classes:

* Primary Telemedicine Center (PTC)
* Secondary Telemedicine Center (STC)
* Tertiary Telemedicine Center (TTC)

 PTCs would be based in Primary Health care centers, STCs in Secondary care Medical Centers and TTCs in Tertiary care Medical Centers.

**Applications of Telemedicine in Health care System**

**Epidemiological surveillance**

Telemedicine applications for epidemiological surveillance are gradually reaching new heights with the development of technology such as geographic information systems (GISs). It can give new insight into geographical distribution and gradients in disease prevalence and incidence and valuable insight into population health assessment.

* It also provides valuable information of differential populations at risk based on risk factor profiles.
* It helps in differentiating and delineating the risk factors in the population.
* It also helps in interventional planning, assessment of various interventional strategies and their effectiveness.
* It can play a pivotal role in anticipating epidemics.
* It is an essential tool in real-time monitoring of diseases, locally and globally.
* GIS provides the basic architecture and analytical tools to perform spatial-temporal modeling of climate, environment and disease transmission helpful in understanding the spread of vector-borne diseases. Remote sensing techniques have been recently been used in this regard.
* It can relay information to individuals as well as to the population as a whole. It can A GIS-based method for acquiring, retrieving, analyzing and managing data differs from traditional modes of disease surveillance and reporting. It facilitates aggregation and integration of disparate data from diverse sources so it can guide the formulation of public health programs and policy decisions.

**Interactive health communication and disease prevention**

Information technology and telemedicine can be used to inform, influence and motivate individuals and population organizations on health, health-related issues and adoption of healthy lifestyles. The various approaches and applications can advance and support primary, secondary and tertiary health promotion and disease prevention agendas.

* Provide an easy access to those living in remote areas.
* It enables informed decision-making. It also simplifies the health decision-making process / or communication between healthcare providers and individuals regarding prevention, diagnosis or management of a health condition. As a result, the users are exposed to a broader choice base.
* It can go a long way to promote and maintain healthy behaviours in the community.
* It can also help in peer information exchange and emotional support. Examples include online Internet applications that enable individuals with specific health conditions, needs or issues to communicate with each other, share information and provide / receive emotional support.
* It promotes self-care and domiciliary care practices. Many living in the remote areas can be benefited by self-management of health problems which will supplement existing health care services.
* It can be a very important tool for the evaluation and monitoring of healthcare services.

**Conclusions**

Telemedicine has brought new dimension to health care and has been gaining popularity World wide. However, the medo-legal aspects of telemedicine in India remain ambiguous to most doctors and administrators. There is a need to conduct awareness about legal aspects and significance of telemedicine services in rural and urban areas so that the health care team members can able to provide better and effective telemedicine services to needy people. Telemedicine can provide and improve access to health care in previously un-served or under –served areas. Remote monitoring has the potential to make every minute count by gathering clinical data from many patients simultaneously. However, information may be lost due to a software glitch or hardware meltdown. Therefore, relying too heavily on a computer system to prevent errors in healthcare data may be problematic. There has to be a smart balance between total dependence on computer solutions and the use of human intelligence. Time alone will tell that Telemedicine is a “forward step in a backward direction” or to paraphrase Neil Armstrong “one small step for IT but one giant leap for Healthcare”.

**References**

Allen A, Allen D. Telemedicine programs: 2nd annual review reveals doubling of programs in a year. *Telemedicine Today.*1995;3(1):10–4. [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Telemedicine+Today&title=Telemedicine+programs:+2nd+annual+review+reveals+doubling+of+programs+in+a+year&author=A+Allen&author=D+Allen&volume=3&issue=1&publication_year=1995&pages=10-4&)]

Aparajita Dasgupta and Sowmya Deb. Telemedicine: A New Horizon in Public Health in India. *Indian J.Community.Med*. 2008;33(1):3-8.

Balas EA, Jaffery F, Pinciroli F. Patient care from a distance: Analysis of evidence. *Annu Meet Int Soc Technol Assess Health Care.*1996;12:17. [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Annu+Meet+Int+Soc+Technol+Assess+Health+Care&title=Patient+care+from+a+distance:+Analysis+of+evidence&author=EA+Balas&author=F+Jaffery&author=F+Pinciroli&volume=12&publication_year=1996&pages=17&)]

  Bashshur RL, Armstrong PA, Youssef ZI. *Telemedicine: Explorations in the use of telecommunications in health care.* Springfield, IL: Charles C Thomas; 1975. [[Google Scholar](https://scholar.google.com/scholar_lookup?title=Telemedicine:+Explorations+in+the+use+of+telecommunications+in+health+care&author=RL+Bashshur&author=PA+Armstrong&author=ZI+Youssef&publication_year=1975&)]

Bashshur R, Lovett J. Assessment of telemedicine: Results of the initial experience. *Aviation Space Environ Med.*1977;48:65–70. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/831717)] [[Google Scholar]](https://scholar.google.com/scholar_lookup?journal=Aviation+Space+Environ+Med&title=Assessment+of+telemedicine:+Results+of+the+initial+experience&author=R+Bashshur&author=J+Lovett&volume=48&publication_year=1977&pages=65-70&" \t "_blank)

 [Bashshur R.](https://scholar.google.com/scholar_lookup?journal=Aviation+Space+Environ+Med&title=Assessment+of+telemedicine:+Results+of+the+initial+experience&author=R+Bashshur&author=J+Lovett&volume=48&publication_year=1977&pages=65-70&" \t "_blank)*[Superintendent of Documents.](https://scholar.google.com/scholar_lookup?journal=Aviation+Space+Environ+Med&title=Assessment+of+telemedicine:+Results+of+the+initial+experience&author=R+Bashshur&author=J+Lovett&volume=48&publication_year=1977&pages=65-70&" \t "_blank)*[Washington DC: US Government Printing Office; 1980. Technology serves the people: The story of a cooperative telemedicine project by NASA, the Indian Health Service and the Papago people. [](https://scholar.google.com/scholar_lookup?journal=Aviation+Space+Environ+Med&title=Assessment+of+telemedicine:+Results+of+the+initial+experience&author=R+Bashshur&author=J+Lovett&volume=48&publication_year=1977&pages=65-70&" \t "_blank)[[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Aviation+Space+Environ+Med&title=Assessment+of+telemedicine:+Results+of+the+initial+experience&author=R+Bashshur&author=J+Lovett&volume=48&publication_year=1977&pages=65-70&" \t "_blank)](https://scholar.google.com/scholar_lookup?title=Superintendent+of+Documents&author=R+Bashshur&publication_year=1980&)[]](https://scholar.google.com/scholar_lookup?journal=Aviation+Space+Environ+Med&title=Assessment+of+telemedicine:+Results+of+the+initial+experience&author=R+Bashshur&author=J+Lovett&volume=48&publication_year=1977&pages=65-70&" \t "_blank)

[Bedi BS.](https://scholar.google.com/scholar_lookup?journal=Aviation+Space+Environ+Med&title=Assessment+of+telemedicine:+Results+of+the+initial+experience&author=R+Bashshur&author=J+Lovett&volume=48&publication_year=1977&pages=65-70&" \t "_blank)*[Telemedicine in India: Initiatives and Perspective, eHealth 2003: Addressing the Digital Divide-17th Oct.](https://scholar.google.com/scholar_lookup?journal=Aviation+Space+Environ+Med&title=Assessment+of+telemedicine:+Results+of+the+initial+experience&author=R+Bashshur&author=J+Lovett&volume=48&publication_year=1977&pages=65-70&" \t "_blank)*[2003.](https://scholar.google.com/scholar_lookup?journal=Aviation+Space+Environ+Med&title=Assessment+of+telemedicine:+Results+of+the+initial+experience&author=R+Bashshur&author=J+Lovett&volume=48&publication_year=1977&pages=65-70&" \t "_blank)

 Brown N. A brief history of telemedicine. *Telemedicine Information Exchange.*1995;105:833–5. [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Telemedicine+Information+Exchange&title=A+brief+history+of+telemedicine&author=N+Brown&volume=105&publication_year=1995&pages=833-5&)]

 Brown N. *Telemedicine coming of age. TIE.*1996 Sep 28; [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Telemedicine+coming+of+age.+TIE&author=N+Brown&publication_year=1996&)]

Foote D, Hudson H, Parker EB. *National Technical Information Service (NTIS)* Springfield, VA: US Department of Commerce; 1976. Telemedicine in Alaska: The ATS-6 satellite biomedical demonstration. [[Google Scholar](https://scholar.google.com/scholar_lookup?title=National+Technical+Information+Service+(NTIS)&author=D+Foote&author=H+Hudson&author=EB+Parker&publication_year=1976&)]

Ganapathy K. *Neurosurgeon, Apollo Hospitals, Chennai, Telemedicine in India-the Apollo experience, Neurosurgery on the Web.* 2001.

Grigsby B, Brown N. *ATSP Report on US Telemedicine Activity: Portland; 1999 or Association of Telehealth Service Providers.*

 Grigsby J, Schlenker RE, Kaehny MM, et al. Analytic framework for evaluation of telemedicine. *Telemedicine J.*1995;1(1):31–39. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/10165320)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Telemedicine+J&title=Analytic+framework+for+evaluation+of+telemedicine&author=J+Grigsby&author=RE+Schlenker&author=MM+Kaehny&volume=1&issue=1&publication_year=1995&pages=31-39&)]

  Houtchens BA, Allen A, Clemmer TP, Lindberg DA, Pedersen S. Telemedicine protocols and standards: Development and implementation. *J Med Sys.*1995;9(2):93–119. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/7602256)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=J+Med+Sys&title=Telemedicine+protocols+and+standards:+Development+and+implementation&author=BA+Houtchens&author=A+Allen&author=TP+Clemmer&author=DA+Lindberg&author=S+Pedersen&volume=9&issue=2&publication_year=1995&pages=93-119&)]

Ibef.org/industry/health care-india

Kopp S, Schuchman R, Stretcher V, Gueye M, Ledlow J, Philip T, et al. Telemedicine. *Telemedicine J E-health.*2002;8:18. [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Telemedicine+J+E-health&title=Telemedicine&author=S+Kopp&author=R+Schuchman&author=V+Stretcher&author=M+Gueye&author=J+Ledlow&volume=8&publication_year=2002&pages=18&)]

Mexrich RS, DeMarco JK, Negin S, et al. Radiology on the information superhighway. *Radiology.*1995;195(1):73–81. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/7892498)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Radiology&title=Radiology+on+the+information+superhighway&author=RS+Mexrich&author=JK+DeMarco&author=S+Negin&volume=195&issue=1&publication_year=1995&pages=73-81&pmid=7892498&)]

   Report of the Technical Working Group on Telemedicine Standardization, Technical working group for Telemedicine Standardization Department of Information Technology (DIT), Ministry of Communications and Information Technology (MCIT), May 2003.

Satvki N Pai, Madhan Jayaraman, Naveen Jayaraman and Sankalp Yadav. Understanding the Medic-Legal Aspects of Telemedicine in India. Journal of Medical Science,2023,July 25, doi 10.7759/cureus.42431.

 Saxena G, Singh JP. *E-medicine in India: Hurdles and future prospects, paper presentation at an International seminar organized at The International Institute of Professional Studies.* Devi Ahilya University; [[Google Scholar](https://scholar.google.com/scholar_lookup?title=E-medicine+in+India:+Hurdles+and+future+prospects,+paper+presentation+at+an+International+seminar+organized+at+The+International+Institute+of+Professional+Studies&author=G+Saxena&author=JP+Singh&)]

 Stamm BH. Clinical applications of telehealth in mental health care. *J Am Psychol Assoc.*1998;29:536–42. [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=J+Am+Psychol+Assoc&title=Clinical+applications+of+telehealth+in+mental+health+care&author=BH+Stamm&volume=29&publication_year=1998&pages=536-42&)]

  Wachter GW. Telecommunication, linking providers and patients. *Telemedicine Information Exchange.*2000 Jun 30; [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Telemedicine+Information+Exchange&title=Telecommunication,+linking+providers+and+patients&author=GW+Wachter&publication_year=2000&)]

Watson DS. Telemedicine. *Med J Aust.*1989;151:62–66. 8,71. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/2739609)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Med+J+Aust&title=Telemedicine&author=DS+Watson&volume=151&publication_year=1989&pages=62-66&pmid=2739609&)]