REVIEW ARTICLE

AN UPDATE ON GROWTH AND DEVELOPMENT OF TELEMEDICINE WITH PHARMACOLOGICAL IMPLICATIONS

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ABSTRACT
Telemedicine is an application of information technology in relation to patient health care, treatment, education, research, administration and the public health. It forms a potential bridge between the patient and doctor which ages a century with a good development in its growth. In developing countries like India with more than 60% of population living in rural areas with poor medical facilities, telemedicine can fill the gap and provide the timely care, appropriate treatment and medical assistance with less expense in relation to time and money. Telemedicine also helps in maintenance of electronic health records, remote monitoring of the cases, recording and reporting of adverse drug reactions, continued medical education programs and training programs to health care providers. Telemedicine can be practiced by store and forward method, interactive services, remote monitoring and by telepharmacy practises with the help of internet. The telemedicine system practice adapted more rampantly would help in easy flow and better health care delivery system to the remotest places in rural setups to save the lives, time and cost of the suffering. Perhaps the slogan "Health for all by 2000" which was forgotten towards the end of last century, can still be achieved by the year 2020 by making the telemedicine revolution happen in India.

Key Words: Continued Medical Education; Remote Health Care; Telemedicine; Telepharmacy

Introduction

In developing country like India where one out of every six person is a consumer of health service it has compulsified to improve and standardize the health services.[1] With the development of science and technology telemedicine has evolved which often refers to provide clinical services such as diagnosis, treatment, medical education, administration and research.

India is a developing country with a paradox in some respects as there has been unexpected growth and development in information technology, satellite transmission, broadband connectivity and mobile telephony across the country which placed a major solution in a form of telemedicine to fulfil the huge gap that exists between the demand and supply of health care facilities more so in rural areas.[2]

Telemedicine (TM) is the use of electronic information and communication technologies to provide and support the health care system. Telehealth is a remote health care that includes video conferencing, monitoring of cases, maintenance of electronic health records, recording and reporting of adverse drug reactions (ADRs), continued medical education programs and training programs for health care providers.[3]

The World Health Organization (WHO) defines telemedicine as "the delivery of health care services, where distance is the critical factor by all the health care 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 continued education of the health care providers, all in the interests of advancing the health of individuals and their communities".[4] (Figure-1)

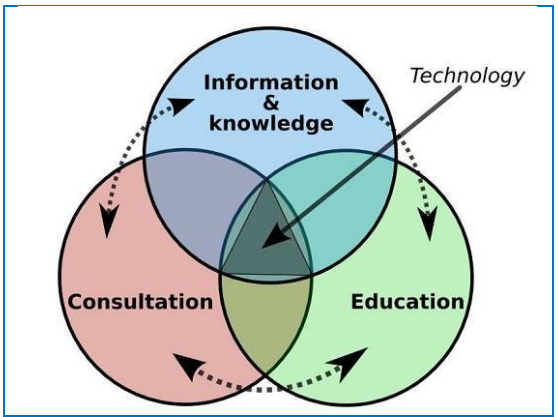

Figure-1: A link between telemedicine and telehealth

As derived from these definitions, telemedicine helps patients who are unable to access specialized healthcare facilities such as in rural areas or from distant areas to avail timely consultation without having to travel long distances. The telemedicine facility provides facilities to transmit patient's medical records, images, output from medical devices and sound files, videos etc. with the help of telecommunication technologies.

Milestones in Growth & Development of Telemedicine

Health care in the home-based setting has a long history and has also been used for decades in clinical settings. For example, an 1879 article in the *Lancet* talked about using the telephone to reduce unnecessary visits to clinics. Similarly in 1920s, the radio has been used to give medical advice to clinics on ships and in 1925, a cover of *Science and Invention* magazine showed a doctor diagnosing a patient by radio.[5]

In 1960, National Aeronautics and Space Administration (NASA) implemented telemedicine system to monitor physiological parameters of astronauts, that began the era of modern telemedicine which proposed the first ever pioneer project by NASA to provide health services in rural area (Space Technology Applied to Rural Papago Advanced Health Care).[6,7]

In 1980s, there were the revolution for telecommunication and internet services which also supported faster growth of telemedicine mostly focused on diagnostic services like, tele-radiology, tele-dermatology and tele-pathology.

The first ever telemedicine unit started functioning in Aragonda, Andhra Pradesh by former President of United States Mr. Bill Clinton, in 2001 which pioneered in the development of telemedicine in India with more than 400 such centres existing at present.[8]

Objectives of Telemedicine

- **To make high quality healthcare available to traditionally under privileged population:** In India, there is a large rural based population separated by large distances which need access to regular quality medical care. Telemedicine can enhance availability of various medical services and clinical health care, despite these economic and geographic barriers.
- **Save the time** wasted by both the health care providers and patients in travelling from one geographic location to another to avail services on time.
- **Case monitoring, home care and remote critical care:** Telemedicine can help monitor a patient from distance by specialist. Furthermore it makes remote critical care and home care possible.
- **Reduce costs of medical care:** The ever- rising cost of healthcare is becoming a prime concern. The incidental expenses related to patient care, i.e. the cost associated with factors other than the actual medical care such as travel, accommodation for relatives, food etc. also contribute substantially to the overall cost of treatment for which TM seems to be the answer.
- **Survey and track diseases:** Telemedicine application can help in better survey and tracking of epidemics and endemics and will add to the efficient management of diseases in the community also helping to abet the disaster management programs.[9]
- **Continued Medical Education (CME) and training programs:** Medical science is evolving every day thus, in order to keep practitioners updated with the latest information so as to provide safe and effective health care to the stakeholders, CME for health care professionals, training programs for health workers and public education programs can be effectively delivered with the help of telemedicine.

Telemedicine acts as a major link between nodal and referral hospitals to provide health care for patients at remote areas with less expenditure of time and money. (Figure-2)

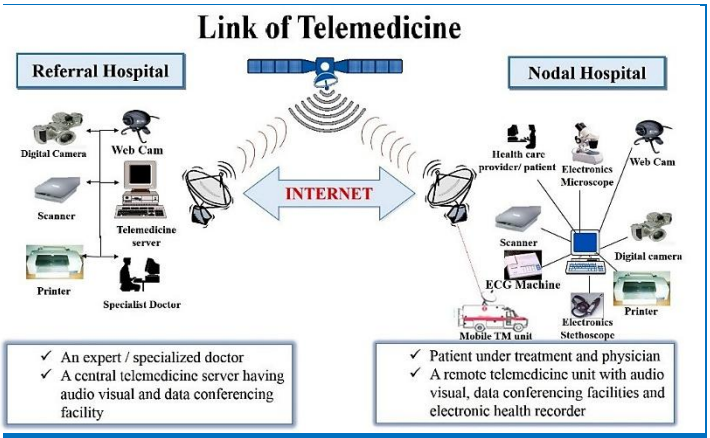

Figure-2: Link of telemedicine

Types of Telemedicine

Telemedicine services are of several types that includes;[10]

1. **Store and forward:** This type of services are practised where live contact with the remote centre cannot be practised or where immediate transmission of message is not possible due to connectivity problems. In such cases, patients interview is recorded, his/her examination and investigations are carried out and these data are later on forwarded to remote speciality centre for further evaluation and expert opinion. This is mainly practised for non-emergent cases. For example, tele-radiology, telepathology, teledermatology, etc.
2. **Interactive services:** With the availability of improved telecommunication services, direct contact with referral centre can be made in real time. Patient who visits remote centre can have direct face to face interactive session with the specialist present on the other side at referral centre. This type of service requires high speed

connectivity on both the centres. Not with just patients, but such video conference sessions can be practised among professionals also for continued education and other collaborative work to provide better health care. This also increases patient's confidence being under supervision of multiple experts.

3. **Remote monitoring:** It is defined as the process of using audio, video, and other telecommunications and electronic information processing technologies to monitor the health status of a patience from a distance. Remote monitoring, also known as self-monitoring/ testing, enables medical professionals to monitor a patient remotely using various technological devices. Telemedicine can be used to monitor patient's interviews, physical examination records and investigational data along with other electronic health records from remote place by specialist. With availability of telemedicine equipped devices for blood pressure, blood sugar measurement, and patient can send their records directly to his physician who can guide them accordingly.
4. **Mobile telemedicine:** The telemedicine facilities come extremely in use in natural disasters such as earthquakes, floods etc. where medical facilities cannot be quickly set-up. Telemedicine equipment installed in the ambulance with satellite connectivity would let us provide medical care at remote places such as during transit, camps, public gatherings (Maha-kumbhmela) or during unfortunate disasters.[11] This also reduces the time and cost of transportation of medical facilities and does not require the specialist to reach the disaster struck areas.

There are about ten active mobile telemedicine units in India today that go to different villages every day. A villager gets into an air-conditioned mobile truck with ultrasound, X-ray, echocardiogram, electrocardiogram, biochemistry laboratory, ophthalmic equipment etc. A paramedical technician examines and performs the required tests and same is evaluated by the specialist in the tertiary care center. A direct satellite link for internet on the vehicle transmits the data and images. Though many of the existing vans are dedicated to ophthalmology, multipurpose vans are also now available.

Benefits of Telemedicine

It improves access of health services to previously unserved or underserved areas. Improved quality of care with enhanced decision making through collaborative efforts becomes possible. Reduced isolation of healthcare professionals aided with telemedicine will allow peer and professional contacts for patient consultations thus, facilitating continuing education. It also decreases the necessity for travel thus, optimum use of telemedicine resources will save time and cost with improved health care provision.

Telemedicine has several advantages for patients and health care providers which is shown in figure-3.[12]

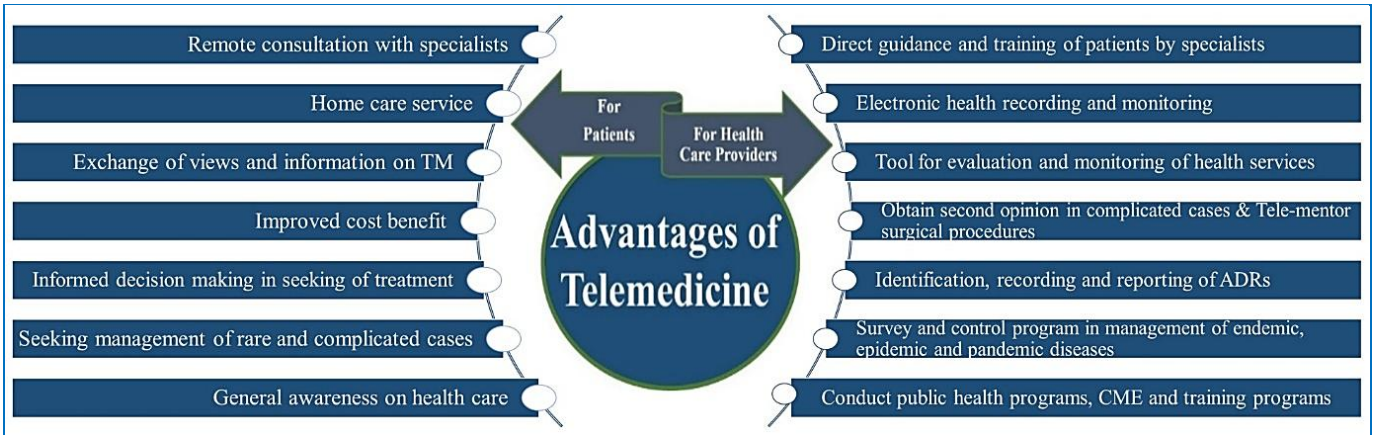

Figure-3: Advantages of telemedicine for patients and the health care providers

Current Status of Telemedicine in India

India's healthcare infrastructure is currently unable to meet the needs of the rising demands. Although India has several state of the art centers for healthcare delivery, these are small in number. Furthermore, most of them have shortage of resources, doctors, staffs or equipment. In India, 68 % of the population stays in rural area while 92 % of the secondary and tertiary care facilities are situated in urban areas.[13] Diagnostic measures, consultants and specialists who cannot be planted in peripheral and rural areas, their services can be availed through telemedicine. Although more than 400 stations are already established with services rendered through various implementing agencies, further growth in this field would help to provide

better health services with less expense and assured quality.[14]

Telepharmacy and Telemedicine

Telepharmacy is defined as a long distance supervision of pharmacy technicians by a senior pharmacist at another site. Telepharmacy is facilitated by computerized physician order entry, remote review and dispensing.[15] The senior pharmacist would screen the prescriptions from the distant referral centre which helps to reduce the prescription errors happening at the remote centres thus, benefiting remote centre pharmacist and improving patient safety.[16] The vast majority of hospitals reported that they track medication error rates internally and some hospitals indicated that they have seen improvements in their medication error rates since implementing telepharmacy activities.[17] Another study including six rural hospitals showed that remote pharmacists picked up about 19 % of patients who had one or more medication errors.[18]

Telepharmacy practice also provides the rural practitioners with new and updated information of medication use and related issues such as ADRs. It helps in recording and reporting of ADRs from the periphery. It also adds to the awareness of the pharmacoeconomics among the rural practitioners. Thus it is useful to conduct telepharmacy training programs for pharmacy students.

Challenges for Implementation of Telemedicine in India

- **Acceptance of this modality by society, patients, family physicians, specialists, administrators and the government:** Patients feels for the lack of emotional relations with the treating physician. At the same time the untrained doctors find it difficult and are not totally convinced in managing the cases through telemedicine due to their poor knowledge of gadgets.[19,20]
- **Financial unavailability:** The technology and communication costs being too high, make it financially unfeasible for various organizations and hospitals for the implementation of telemedicine projects.
- **Literacy rate and diversity in languages:** Only 65.38 % of India's population is literate with very wide diversity in languages spoken by different population. Hence it interferes with the implementing the advanced technological skills.
- **Technical constraints:** Telemedicine supported by various software and hardware, still needs to upgrade with efficient designing and advances in biological sensors and better connectivity solutions.
- **Quality aspect:** Standardizing, certifying, authenticating, and registering telemedicine units so that minimum safe standards are uniformly adopted. Drafting and passing a telehealth act for India is required that ensures quality health care and support the Pharmacovigilance programme.
- **Government support:** Telemedicine is at primary stage and government has resources and power to support it for better health care delivery.

What can be Done for Successful Telemedicine Application?

- Provide basic medical facility such as, primary health care (PHC) centers, supply of essential medicines, transportations, electricity are to be made available at periphery.
- Introducing telemedicine training programs for medical/information and technology students as a part of their undergraduate learning.
- Make more user friendly and flexible telemedicine software so that person with minimum knowledge and skills can make use of the same.
- Payment to teleconsultants to make the scheme attractive and acceptable by the providers.
- Getting Indian telemedicine units recognized by other countries so that we can provide overseas teleconsultations for revenue generation which can be used to subsidize rural telemedicine.
- Mobile telemedicine units fully equipped with all the equipment of telemedicine, can take frequent rounds in urban and rural areas to spread awareness.
- Providing continuous medical education and training programs on telemedicine for professionals, patients and users.[21]

The Indian Space Research Organization (ISRO) has announced a launch of HealthSat, satellite exclusively for telemedicine purposes. ISRO hopes that, one day, there will be almost a million tele-consultations a day in India; eventually, no Indian will be deprived of a specialist consultation wherever he/she is placed as, this is not impossible. Telemedicine will soon be an integral part of mainstream medical practice in India.

Conclusion

Telemedicine and information technologies are mere vehicles that permit the delivery of health care services. We should understand that it is the content of the vehicle

that permits effective health care, not the vehicle. The telemedicine system practice adapted more rampantly would help in easy flow and better health care delivery to the remotest places in rural setups to save the lives, time and cost of the suffering. Perhaps the slogan "Health for all by 2000" which was forgotten towards the end of last century, can still be achieved by the year 2020 by making the telemedicine revolution happen in India.

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