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TELEDENTISTRY: A NEW FRONTIER

Mathews MA, * Kathavate RN, ** Tewary S, *** Pawashe K †

* BDS, 874, Sadashiv Peth, Near Chattrapati Rajaram Mandal, Pune, Maharashtra, India
** BDS, 892, Sevanand Appartment, Near Hotel Lajjat, Sadashiv Peth, Pune, Maharashtra, India
*** Senior Lecturer; Department of Prosthodontics, School of Dental Sciences, Krishna Institute of Medical Sciences Deemed University, Satara, Maharashtra, India
† Senior Lecturer; Department of Prosthodontics, School of Dental Sciences, Krishna Institute of Medical Sciences Deemed University, Satara, Maharashtra, India

ABSTRACT

Teledentistry is an emerging mode of practice which promises immense potential in fields of clinical practice as well as public health delivery. Even though considered new, teledentistry has been around since the 1990's. Like many other health providers dentists are literally tied down to their chairs when it comes to the matter of distance. Teledentistry eliminates that barrier and provides for an even smoother practice environment. Technology is making things possible that were unimaginable a decade ago. Teledentistry has the potential to meet the care needs of the underserved and under reached people of our country and can also contribute towards increasing the quality of our present education system. There also remains a large reservoir of untapped potential with teledentistry in the field of clinical practice. But are we utilizing this opportunity to the fullest? This paper analyses the present state of teledentistry and tries to draw a comparison with the state of telemedicine in India.

KEYWORDS: Teledentistry; telemedicine; telecommunication; education; public health; community dentistry; data security; tele-healthcare

INTRODUCTION

Teledentistry is a relatively new field which has emerged with the dawn of information technology and more importantly, with the universalisation of it. The roots of teledentistry lie in telemedicine and provide a new horizon for the progress of dentistry as well as offer new challenges. The changes that came into the fields of healthcare research and care delivery with the introduction of telecommunication technology were astounding and it has improved the quality and speed of health care delivery manifold. The terms that we use to describe health care services at a distance, such as telehealth and e-health are currently used as umbrella terms.[1,2] The term *teledentistry* came into usage in 1997 and is defined by cook as "The practice of using video conferencing technologies to diagnose and to provide advice about the treatment over a distance".[3] It is also defined as "The segment of the science of telemedicine concerned with dentistry which deals with the entire process of networking, sharing digital information, distant consultations, workup and analysis".[4] Teledentistry has been in the picture for almost three decades now and the relevance of it is far from declining. Even though teledentistry in India was not able to produce its indented impetus initially, it has been gathering momentum through the decades and coupled with the changes in demography, society, families, economy etc has made it a new frontier worth exploring.

TYPES OF TELEDENTISTRY

There exists, at present, two different forms of teledentistry:[5]

1) Two Way Interactive/ Real-Time
2) Store and Forward

1) Two Way Interactive/ Real-Time

This type of teledentistry is a derivative of synchronous type of telemedicine[6] and can be as simple as a telephone call of a general practitioner to a specialist/peer for confirmation of a diagnosis or something as complex a robot assisted remote surgery. Basically in this type there is no storage of the data and it is streamed in real time between the two parties involved. The requirements of this type on real time connections are more compared to the store and forward type as the basic requirement in many cases is a fast internet/intranet connection which demands for

adequate infrastructural support. Video conferencing equipment is one of the most common forms of technology used in this type of communication.[6] Long distance specialist consultation can made possible via this method helping in healthcare delivery in resource constrained settings.

2) Store and Forward

It is derived from the asynchronous type of telemedicine[6] and involves the gathering and forwarding of data in stored form to different locations. These data packets can be patient files, X-Rays, digital photographs, CT Scans, MRIs, EEG data etc.[7-9]

ADVANTAGES OF TELEDENTISTRY[10]

- Reduced cost of service and improved quality of care.
- Reduction in peer isolation and increased specialist support as well as education.
- General dentists will send multimedia patient records to dental specialists, often enabling the specialist to make a diagnosis and develop a treatment plan without having to see the patient in person.
- Improvement in diagnostic services.
- Improved integration of Dentistry into the larger health care delivery system.
- Improvement in communication with the Insurance industry with respect to requirements.
- Improvement in communication with dental laboratories.[8,11]

ROLE OF TELEDENTISTRY

1) Role in Education

The role of teledentistry in education can be categorized broadly in to two. Self instruction and interactive video conferencing.[12] The present days Massive Open Online Courses (MOOCs) are an example of the self instruction method. The web based self instruction educational system contains information that has been developed and stored before the user accesses the program.[13] The advantage of these systems is that the user can access the data multiple times and can control the pace of learning. But the lack of face to face communication may result in dissatisfaction.[14] Interactive video conferencing can be conducted over telephone, satellite, internet or intranet. It includes both video setup and supportive information such as patient's data, radiographs, and case files etc.[12] The advantage is that the user can receive immediate feedback but this system is heavily dependent on a live infrastructural support.

2) Role in Clinical Practice

Teledentistry has within it the potential to revolutionize the clinical care delivery as well as the patient care platforms. The incorporation of teledentistry has the potential to lower the clinical costs as specialty care can be delivered with the supervision of a specialist even in their physical absence. Care and opinion can be gathered even from across borders. The initial investment costs can be thus justified. These systems can also be used to provide care in schools and community care centers and can be used for the following purposes:

- Preventive screening of children[12,15]
- Helping to manage chronic illnesses in geriatric patients and other needy
- Connecting children and their families to the needed health and social services[12]
- Monitoring for gender based violence or molestation and effective working with authorities
- Providing urgent care via nurses / trained personal whenever necessary

3) Role in Research

Handwritten paper medical records may be poorly legible, which can contribute to medical errors.[16] Pre-printed forms, standardization of abbreviations and standards for penmanship were encouraged to improve reliability of paper medical records. Electronic records may help with the standardization of forms, terminology and data input. Digitization of forms facilitates the collection of data for epidemiology and clinical studies.[17]

4) Role in Dentist – Laboratory Communication

In cases of unfortunate complications, errors or esthetic nuances in submitted dental records to the laboratory, it is imperative that a communication is necessary between the technician and the dentist to avoid further complications. In such cases the ability to communicate with the technician directly from the operatory and to provide him/her with additional data such as color photographs or shade data can help to prevent fabrication of improper prosthesis or appliance whereby saving time and money.[18-20]

Table

NAME OF THE STATE GOVERNMENT	FUNDING AGENCY	NO. OF TELEMEDICINE NODES	SPECIALTY HOSPITAL
Jammu and Kashmir	ISRO	12 District hospitals	Sher-e-Kashmir Institute of Medical Sciences Hospital, Srinagar
Himachal Pradesh	DIT	19 Health centers at district, block, and tehsil headquarters	IGMC Shimla and PGIMER Chandigarh
Punjab	DIT	20 District hospitals	Government medical college and hospital and five polyclinics of the state
Uttarakhand	State	2 District hospitals	SGPGIMS, Lucknow
North Eastern States	DIT	District hospitals each of seven North eastern states	Narayana Hrudayalaya, Bangalore
Jharkhand	ISRO	22 District hospitals	3 Medical colleges & hospitals
West Bengal	DIT	12 District hospitals	School of Tropical Medicine, NRS Medical College & Hospital,Kolkata, Burdwan Medical College & Hospital, Burdwan
Rajasthan	ISRO	32 District hospitals	6 State medical colleges
Chhattisgarh	ISRO	Two at medical colleges	Government medical colleges at Raipur & Bilaspur that further link to premier hospitals of the country
Orissa	ISRO, C-DAC	5 District Hospitals	3 Medical colleges that further linked with SGPGIMS
Karnataka	ISRO	26 District hospitals	Narayana Hrudayalaya, Bangalore
Tamil Nadu		6 District hospitals	Government General Hospital, Royapettah Hospital, Adiyar Cancer Center
Kerala	ISRO, C-DAC	14 District hospitals and two taluk hospitals	AIIMS, New Delhi, Amrita Institute of Medical Sciences (AIMS), Kochi, and Sri Chithira Tirunal Institute of Medical Science and Technology, Thiruvananthapuram

ISRO, Indian Space Research Organization; DIT, Department of Information Technology; PGIMER, Post Graduate Institute of Medical Sciences; SGPGIMS, Sanjay Ghandi Postgraduate Institute of Medical Sciences.

5) Role in Public Health Systems

One of the most promising fields for implementation of teledentistry is that of public health and public health delivery. Especially India being a developing country and primarily consisting of remote villages where conventional mode of care delivery is still not universal, frugal solutions such as teledentistry should be of great value. The implementation of teledentistry in Aids affected children in Africa[21] can be a great example. General dental surgeon and dental hygienists can be appointed at the sub-centers, who can provide cost-effective dental care when supported through teledentistry by specialists. Similarly, graduate dentists with knowledge in teledentistry can be appointed at the primary health centers and community health centers for discussing about the diagnosis and treatment plan of the difficult cases with the specialists.[22,18] The low cost solution for mass delivery of healthcare can become a boon to the resource constrained economy of the villages of India. The techno savvy new generation of India can be adequately trained to make the most of this rare opportunity.

GOVERNMENT INITIATIVES FOR TELEMEDICINE AND TELEDENTISTRY[23]

1. *Department of Information Technology (DIT), Ministry of Communication, and IT (MCIT), Government of* India [23,24]

DIT has established more than 100 nodes all over India, mostly in collaboration with the state

governments. These include the telemedicine network in West Bengal for diagnosis and monitoring of tropical diseases, the Kerala and Tamil Nadu Oncology Network for facilitating cancer care, and the Northeastern and Himachal Pradesh hilly states for specialty health care access. Based on the highly encouraging results from the Kerala Oncology Telemedicine Network, the Ministry of Health & Family Welfare has taken up the ONCONET India program to cover all states in India.

2. *Indian Space Research Organization (ISRO)*[23,25]

For promoting the societal benefit of indigenously developed space technology, Indian Satellite System (INSAT), ISRO is deploying telemedicine nodes under a GRAMSAT (rural satellite) program. In collaboration with state governments, ISRO has established a telemedicine network for 300 hospitals. A total 257 remote/rural district hospitals and health centers have been connected to 43 super specialty hospitals located in major states. Ten mobile tele-ophthalmology units are part of this network. Andaman and Nicobar Islands are now linked to mainland specialty hospitals through satellite connectivity.

3. *Ministry of Health and Family Welfare (MoH&FW),Government of India*[23,26]

MoH&FW is currently implementing its Integrated Disease Surveillance Program Network, which will connect all district hospitals with medical colleges of the state to facilitate teleconsultation, tele-education, training of health professionals, and monitoring disease trends. It has funded few pilot national level teleophthalmology and rural telemedicine projects. The OncoNET India Project is under implementation, and this will network 27 regional cancer centers (RCCs) with 100 peripheral cancer centers (PCCs) hospitals to facilitate a national cancer-control program.

4. *State Governments*[23-26]

As it can be inferred from the above data, there is comparatively very less standalone establishments for teledentistry. As of now, these services operate under the umbrella of telemedicine services in India. The private sector has also played an important role in the nurturing of telemedicine and teledentistry in India. Various key players in the private sector are as follows:[23]

The Apollo Hospitals Group (104 nodes) the Amrita Institute of Medical Sciences (AIMS) (34 nodes), the Asia Heart Foundation (2 nodes), Fortis Hospital (13 nodes), Narayana Hrudayalaya (26 nodes), and Escorts Heart Institute and Research Center (8 nodes).

ETHICAL AND LEGAL CONCERNS

As it is with any information technology system, there are concerns about the safety of the data which is transmitted via the teledentistry data such as copyright and ownership issues. Similar to all online systems, these systems are also susceptible to hacking and data theft issues. The most prominent concern from the patient perspective is that of confidentiality of the data.[27,28] Patients should be informed about the chances of loss of data despite maximum efforts and should also be briefed about the chances of improper diagnosis or treatment failure due to technology errors or failure.[28-30] The copyright and data ownership issues are primarily due to the lack of a proper legal framework regulating the teledentistry as well as telemedicine domains. There is an acute lack of regulations over matters such as privacy, security, remuneration, taxation, jurisdiction, definition and regulation of malpractice and issues associated with e-commerce.[28] The United States has made it mandatory from the year 2000 that teledentistry practitioners must obtain full license to practice across state lines.[28,30] Literature about the legal issues concerning teledentistry is scarce and is non - comprehensive.

FUTURE PROSPECTIVE

The various ethical and legal issues addressed above needs to be solved; Even so, teledentistry has the potential to promise many exiting changes in the coming years.[31] The various measures that can be adopted for the effective implementation of teledentistry are:

- National level training program for teledentistry or even inclusion of the same to the curriculum of dental studies
- Proper licensure protocols[32]
- Practitioners should make sure about the security of their systems and data. Adjuncts such as data encryption, Password protection and User access logs should be maintained and periodically monitored.[30]

CONCLUSION

Even though teledentistry is not new to India, it is hard to say that it has passed its infant stage in India. Teledentistry is still nested under the wings of telemedicine and is yet to be recognized in its own right. Dentistry combined with information technology has the potential to revolutionize the way in which clinical and primary health care is delivered in our country. In spite of the issues which need to be addressed, this new method promises better days to come for both patients as well as practitioners. When the primary focus of our society shifts from treatment to prevention, teledentistry would be an invaluable asset in our arsenal.

CONFLICT OF INTEREST & SOURCE OF FUNDING

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