Tele-dentistry: An Alternative Dental Care Access

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Abstract

In the practice of tele-dentistry, online consultation is done and the basic oral care advice and service is provided via a virtual platform. Tele-dentistry increases the efficiency and impact of dentistry by promoting collaboration and connecting dental care providers to patients in need. This article review and discuss the applications and scope of tele-dentistry as a part of health care services to both urban and rural population. Articles on tele-dentistry were searched and reviewed from various databases like PubMed, Science Direct, Google Scholar, and Cochrane database. Tele-dentistry assisted healthcare delivery can be an ideal set up in India. It can create prospect for all kind of healthcare specialist along with dental specialist to work out together. Tele-dentistry will be just an alternative way of accessibility to medical facilities. The prospective of tele-dentistry will definitely be a remarkable in the future in India.

Keywords: Tele-dentistry, Tele-dentistry Apps, Services of Tele-dentistry, Utilization in India.

Introduction

Tele-dentistry is one of the similar varieties of telemedicine, where the use of telecommunications along with various software technologies are done to provide medical services to the needy people. During the practice of tele-dentistry, online consultation is done and the basic oral care advice and service is provided via a virtual platform. Tele-dentistry increases the efficiency and impact of dentistry by promoting collaboration and connecting dental care providers to patients in need (1). The concept of tele-dentistry is associated with the start of telemedicine facilities in health care system which involves the use of telecommunications and the technology of digital medium. By the means of this exchange of telecommunication between a patient and a doctor, which enables to provide required clinical information to the patient and also supports dental health care from a long distance (2). Tele-dentistry is described as "the establishment of real-time as well as offline dental care such as diagnosis, consultation, treatment and follow-up through telephonic networking with the help of electronic transmission from different sites" (3). In this modern era of artificial intelligence and digital health care system, we are still way behind the era to provide accessible and affordable health care services to the rural and urban population. Tele-health services like telemedicine and tele-dentistry should be a compulsory part of health care system to provide maximum benefit to the patients during the required time. The review article is here to discuss about the applications and opportunity of tele-dentistry as a part of health care services to both urban and rural population.

Revolution of tele-dentistry

In the year 1999, the ISRO (Indian Space Research Organisation) came up with a pilot project of telemedicine in collaboration with the IT (Information Technology) department and the Ministry of Communications. During the initial days, 60 multi-speciality hospitals were linked with the telemedicine network. With a positive intention, the reinforcement of national healthcare delivery system in India was established jointly by the government, private and several charitable trust agencies. Among them a foundation named ATN (Apollo Telemedicine Networking) has contributed five hundred active centres which includes 164 electronic urban primary health centre and 115 Tele-ophthalmology centres having about more than 150 franchises all over the country (4).

At SGPGI (Sanjay Gandhi Post Graduate Institute of Medical Sciences) in Lucknow, a national telemedicine resource nodal centre was

established in the year 2001. The formation of Telemedicine Society of India occurred during the conference on Telemedicine at national level held at Lucknow in April 2001. The members committed to hosts an annual conference to be hosted by the scientific society devoted to telemedicine. With reference to this an International Conference on Telemedicine (INTELMED 2005) in the year 2005 at Bangalore was organised by the ISRO (Indian Space Research Organisation). Apart from telemedicine accesses, the NTM (national telemedicine) centre keep on organising camps providing health services in rural places. They projected telemedicine network by providing medical facilities through mobile network of telemedicine units in mass gathering at 'Maha-Kumbh Mela' (Allahabad) in 2001 and in the year 2009 at 'Puri-Rath Yatra' (Odisha) (4-5). Table 1 gives us the Telemedicine and Tele-dentistry projects and practices in India.

Telemedicine / tele-dentistry unit networks in India

From the government there is no well documented Telemedicine or Tele-dentistry network setup across the states (10) but very few have taken up the initiatives as shown in Table 2.

At present scenario, the current active networks In India (11, 12) are as follows:

1. NIC (National Knowledge Network by National Informatics Centre)
2. ISDN (Integrated Services Digital Network)
3. V – SAT (Very Small Aperture Terminal) by Indian Space Research Organisation (ISRO)
4. SWAN (State Wide Area Network)
5. NOFN (National Optic Fibre Network) is a very successful system that aids in data broadcast with a100 Mbps, very high speed which is followed by ISDN (1-10Mbps) and V-SAT (128-756 Kbps) providing a very fast network through 10 IP (Internet protocol) addresses to all connected institutes simultaneously.
6. There are also various private service that provides internet in India like Jio, Airtel, Tata Teleservices and ACT (Atria convergence technology) etc which also helps in establishing a network in telemedicine / tele-dentistry health care system.

Mechanism of tele-dentistry services

Tele-dentistry in its budding stage needs scientific as well as technical innovations and high-speed internet network to reach the people. There are various health services (Figure 1) provided through Tele-dentistry and it can reach people in two forms, a) real-time consultation b) store and forward consultation (13) as explained in Table 3.

Advantages and possibilities of tele-dentistry

There are many reasons to choose Tele-dentistry as mentioned below:

1. Accessible for elderly people as well as undertreated population where the patient can avoid expensive transport and unusual hospital based anxiety (14).
2. It provides cost effective services to the people where the patient can reach the doctor without wasting of time and money (15).
3. Tele-dentistry helps in early diagnosis and preventive treatment to the people (16, 17).
4. By the help of e-prescription, medicinal treatment can be received without travelling to far areas (18).
5. Enhanced communication through clinical images digitally between the dentist and other colleagues as well as peer consultation can result in better prognosis (19, 20).
6. Information related to the patient along with the clinical images can be stored digitally.
7. Tele-dentistry can helps in training of the dental personnel at remote sites (21).
8. Tele-dentistry in remote areas can actually act as a boon for the patients. Remote areas like village areas in mountain or hilly region, island like region or any area where road communication is not possible in a specific period of time. People out there can get the minimum basic medicine being prescribed and patient health education can be done which can save any untimely demise or disease.
9. Tele-dentistry can be a major pathway to provide health education towards prevention from various disease as these can reach very easily to the patient.
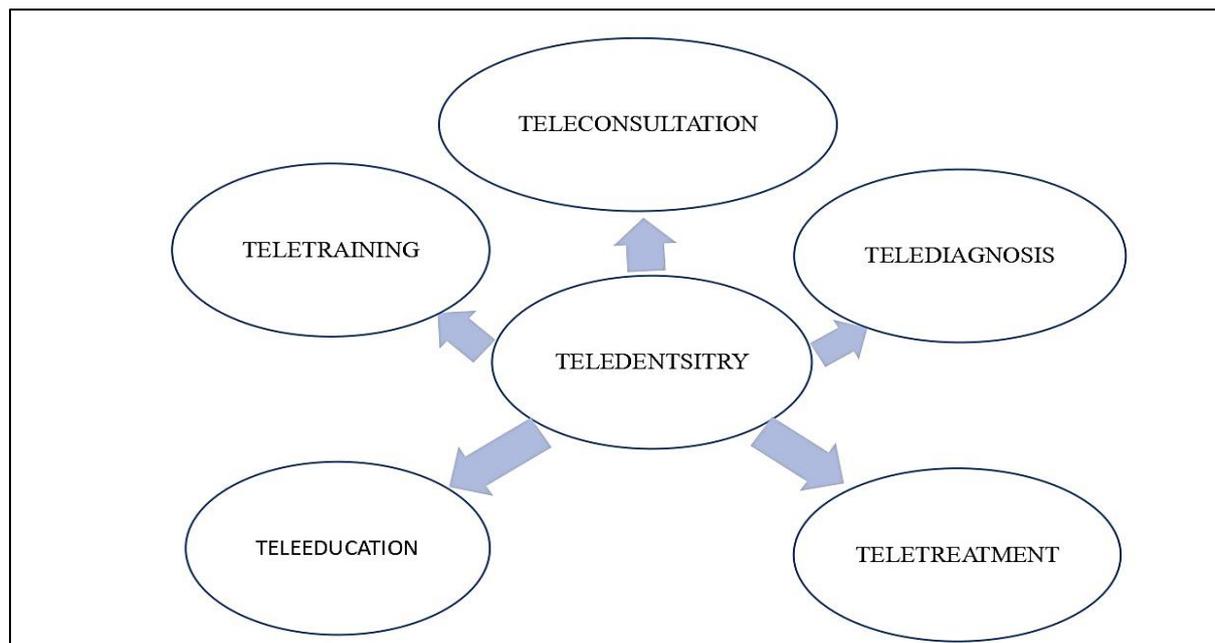
Figure 1: Health services provided by Tele- dentistry

Table 1: Telemedicine/Tele-dentistry projects and practices in India

PROJECTS	SIGNIFICANCE
Pan African e-Network Project (2009- 2017) for global healthcare	Creates link between Tele-education, telemedicine, Internet, video conferencing as well as voice over Internet protocol (VoIP) services. Provides facilities for super speciality hospitals in India from 48 countries of Africa through Tele-health services (5).
Initiatives through AIIMS, New Delhi	Since 2014, AIIMS has been a regional resource centre for telemedicine networking. They provide Tele-health services like Tele-consultation, Tele-education. Tele-diagnosis and Tele-referral to 9 medical colleges and hospitals across several states (Delhi, Chhattisgarh, Rajasthan, Madhya Pradesh, and Uttarakhand) (6).
ECHO (Extension for Community Healthcare Outcomes)	A combined model of medical education and care management started in the year 2008 that endows clinicians all over the place to deliver better care to more people, right where they live. Presently there are 15 hubs of Tele-ECHO clinics in India. It is a model of weekly or fortnightly virtual clinics that use teleconferencing, combined with mentoring and patient case presentations to bridge the gap in healthcare resources by using best specialists to reach out to underserved areas. National Institute of Cancer Prevention and Research (NICPR) being a partner with project ECHO, conducts 14 weeks virtual advanced cancer screening training programme for dentists and community health specialists interested in oral cancer, screening. The purpose of the training programme is to empower screening for oral potentially malignant lesions and oral cancer and learn to promote counselling the community in hazards of tobacco and tobacco cessation (7).

Tele-CME Programme	Case discussions among various departments across the states along with case presentations on weekly basis benefits the clinicians to update the knowledge and better diagnosis (8).
Tele-Evidence Programme	Court visits for medico-legal advice and documents can be minimised through the Tele-evidence networking system. Tele-Evidence services are provided at the Postgraduate Institute of Medical Education and Research at Chandigarh and AIIMS New Delhi (9).

Table 2: Telemedicine/ Tele-dentistry networks in the states

STATE	NETWORKING
ODISHA	1. "Odi –Tele con" has more than 20,000 Tele-consultations and Tele-follow-ups since 2001. 2. Around 490 training courses were given to doctors and other para medical staffs till May 2017. 3. Many postgraduate students of 3 government medical colleges were benefitted through online teaching of medical topics.
KERALA	1. "ONCONET-Kerala" launched in the year 2001 completed by the Regional Cancer Centre in Trivandrum and the Centre for Development of Advanced Computing (CDAC). 2. Web-enabled hospital information system named "TEJHAS" ((Telemedicine enabled Java-based Hospital Automation System) was also developed that maintains patients medical records in an electronic database which can be easily accessible to all the regional medical centres. 3. "Tele-Oncology Network" provide services for early detection, pain – relief and follow-ups of cancer patients from rural areas.
MAHARASHTRA	1. Telemedicine and Tele-dentistry consultation since 2014-15. 2. Telemedicine facilities to 23 district hospitals and 39 sub-district or rural hospitals. 3. Telemedicine networking system controlled at Sir J.J. Hospital, Mumbai and is also connected to 6 speciality hospitals. 4. Provide advanced education to doctors and paramedical staff at district or sub-district or rural hospitals.

Table 3: Real-time consultation and Store & Forward consultation

REAL-TIME CONSULTATION	STORE AND FORWARD CONSULTATION
Involves a video-conferencing using advanced communication technology between the dentist and the patient where exchange of conversations can be done between them along with advanced with intraoral oral camera with high resolutions.	Involves the exchange of static images and information including intraoral as well as extra-oral images along with digital or scanned radiographs stored in the telecommunication equipment. The dentist then evaluates and forward the treatment planning through established networks. This type of treatment is far more timely and cost effective.

Table 4: Dental Apps and its uses

APPS FOR TELEDENTISTRY	USES
Live Dentist Site	Live Dentist is a robust Tele-dentistry platform that gives users access to affordable, quality dental care for general questions and emergencies, regardless of users' location or the time of day.
Dental Chat App	With its low fees, including the ability to ask general questions for free, as well as its acceptance of many major dental insurance plans, Dental Chat is an affordable Tele-dentistry option.
Denter active App	Denter active's platform allows users to see available dentists virtually on a "walk-in" basis, regardless of the day or time, making this a convenient option for urgent dental needs.
Virtudent, Inc. App	Virtudent, Inc. can save employers and their employee, time and money by bringing dental care directly to companies, through virtual consultations and on-site exams.
Aspen Dental App	If customers have dental insurance, a Health Savings Account, or a Flexible Spending Account, Aspen Dental is an optimal Tele-dentistry option, as they accept all these forms of payment.
Tooth Pic App	For patients who want to learn more about proper oral care, dental procedures, and common conditions, Toothpic has a large variety of educational resources.
The Tele-Dentists App	In addition to helping patients virtually, The Tele-Dentists can also assist patients connect with a local in-person dentist to ensure that they receive comprehensive care.
Dentulu App	For patients seeking the ultimate convenient dental care, Dentulu can do a virtual consultation, or send a dentist to a patient's home, office, or whatever location works best for them.
Smile Virtual App	Smile Virtual is a premier Tele-dentistry platform that helps patients by providing consultations for a number of cosmetic dentistry procedures, including veneers, whitening, restorations, and more.
Alpha Dental Excellence App	Alpha Dental Excellence's free virtual consultations make it easy and affordable to get an expert second opinion on dental conditions and procedures without having to visit an office in-person.

There are many Apps (as given in the Table 4) now available in the market where the patients can easily avail the facilities of Tele-dentistry (22, 23).

Pitfalls in tele-dentistry

- Tele-dentistry can be useful in the diagnostic plus preventive procedures but for the surgical procedures, the patient needs to visit the clinic (24).
- Processing of digital images of any oral lesion and then disseminating the diagnosis and required treatment to the patient through Tele-dentistry may sometimes consume time and technique sensitive issues might occur if poor network persists (25, 26).
- Initial cost investment for all the required equipment for Tele-dentistry including high speed internet network is high (27).
- On virtual examination of any oral lesion, added diagnostic assistances like percussion and palpation cannot be done (28).
- The services provided through Tele-dentistry should be well known to patients so that they should know and be aware of the risk of wrong diagnosis or management because of disturbances of high speed internet networking technology (29).

- Language barrier can be an issue that are dealt with by many patients from rural areas receiving services of Tele-dentistry as English (across the globe) and Hindi (official language of India) are the languages that are well communicated (30).

Understanding challenges of tele-dentistry

Tele-dentistry faces day to day technical challenges during its services such as:

1. Due to electric interruption, there will be frequent unwanted disturbances of sessions between remote site and the centre hub resulting in issues in hardware, software and internet network connections (31).
2. Due to low speed internet connection, dentist deals with 'Packet loss' that is with poor image quality of the oral lesions (32).
3. The knowledge gaps of Tele – dentistry suggests the need for various awareness programmes to install positive attitudes (33).
4. Linguistic diversity in India could be an obstruction for patients talking to a doctor in another language so local doctors or health care staffs could also be an option (34).

Future of tele-dentistry in India

Tele-dentistry assisted healthcare delivery can be an ideal set up in India. It can create prospectous for all kind of healthcare specialist along with dental specialist to work out together (35, 36). We can think of making the various dental colleges in India as a "hub" for providing Tele-dentistry meetings to remote primary health centres (PHC) or community health centres (CHCs) which can be digitally connected to a designated nearby dental college (37). The required equipments for Tele-dentistry infrastructure at PHCs and CHCs can be set up to extend the reach of health care services and training so as to provide better services to the society.

Tele-dentistry as boon during COVID 19 pandemic

During this COVID-19 pandemic time, every person is worried about their life because of the physical unavailability of resources to the patients. Patients who suffered a lot during this pandemic time were in dilemma over available options to address their unbearable toothache, bleeding disorders and other serious oral health issues (38).

They were not able to meet and visit any health care professionals or dentist feasibility due to the prevailing lockdown situation. That's when the Tele-dentistry comes into picture. Without exposing to unnecessary risks as well as expenses, healthcare professionals can use every option to provide dental care to those in need. The use of Tele-dentistry services has been on the rise in recent years. By using the combination of Tele-communications technology with the internet facilities with tools like smartphones and computer webcams, dentist are accessible by any needy patient safely in their homes along with eradicating their risk of infections (39).

Recommendations for improving tele-dentistry in health care setup

The following are the recommendations suggested to improve the facilities of tele-dentistry in health care set-up (2):

1. Every district should have a mandatory tele-dentistry setup in the hospital campus.
2. The doctors need to be trained to use the setup of tele-health services
3. There should be mandatory Information Technology dept. in the hospital campus to support such initiative.
4. The government should partner with the internet provider company to provide good internet services for such operations in all the district hospitals including al the remote areas.
5. The remote areas of villages should also be well connected with the proper internet data server.

Conclusion

Currently, Tele-dentistry is not yet a compulsory or integral part of the health care system. The government should develop a missionary administrative vision towards the Telemedicine / Tele-dentistry network which is somehow due to lack of financial support. There is an urgent need of public awareness enhancement regarding the benefits of Tele-health for educating people, consultations as well as post-operative follow-ups. Tele-dentistry will be the smartest alternative way to access an oral healthcare system. Despite of some uncertainty, the prospective of Tele-dentistry will be remarkable in the future in India.

Abbreviation

Nil

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Author Contributions

Debasruti Naik conceived the idea, analysed the material, and prepared the original draft. Motirmoy Giri, Nikita Sahu, Utkalika Das have structured and edited the manuscript.

Conflict of Interest

There is no conflict of interest among the listed authors.

Ethics Approval

Not Applicable.

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References

1. Peng X, Xu X, Li Y, Cheng L, Zhou X, Ren B. Transmission routes of 2019-nCoV and controls in dental practice. Int J Oral Sci. 2020; 12:9.
2. Gopi VV, Daryani D, Uthkal MP, Zehra F. Teledentistry – The Indian perspective. Int J Oral Health Dent 2019; 5(2):59-62.
1. Khan SA, Omar H. Teledentistry in practice: literature review. Telemed J e Health. 2013; 19:565–567.
2. Rocca MA, Kudryk VL, Pajak JC, Morris T. The evolution of a teledentistry system within the Department of Defense. Proc AMIA Symp. 1999; 921–4.
3. Alabdullah JH, Daniel SJ. A systematic review on the validity of teledentistry. Telemed J e Health. 2018; 24:639–648.
4. Estai M, Kanagasingam Y, Tennant M, Bunt S. A systematic review of the research evidence for the benefits of teledentistry. J Telemed Telecare. 2018; 24:147–156.
5. Mariño R, Ghanim A. Teledentistry: a systematic review of the literature. J Telemed Telecare. 2013; 19:179–183.
6. Spivack E. Teledentistry: remote observation of patients with special needs. Gen Dent. 2020; 68:66–70.
7. Tynan A, Deeth L, McKenzie D. An integrated oral health program for rural residential aged care facilities: a mixed methods comparative study. BMC Health Serv Res. 2018; 18:515.
8. Tynan A, Deeth L, McKenzie D, Bourke C, Stenhouse S, Pitt J. Integrated approach to oral health in aged care facilities using oral health practitioners and teledentistry in rural Queensland. Aust J Rural Health. 2018.
9. Bavaresco CS, Hauser L, Haddad AE, Harzheim E. Impact of teleconsultations on the conduct of oral health teams in the Telehealth Brazil Networks Programme. Braz Oral Res. 2020; 34:e011.
10. Kaliyadan F, Ramsey ML. StatPearls Publishing; 2020. Teledermatology. StatPearls, Treasure Island (FL).
11. Lee JJ, English JC. Teledermatology: a review and update. Am J Clin Dermatol. 2018; 19:253–260.
12. Carrard VC, Roxo Gonçalves M, Rodriguez Strey J, Pilz C, Martins M, Martins MD. Telediagnosis of oral lesions in primary care: the Estomato Net Program. Oral Dis. 2018 Sep; 24(6):1012-1019.
13. AlShaya MS, Assery MK, Pani SC. Reliability of mobile phone teledentistry in dental diagnosis and treatment planning in mixed dentition. J Telemed Telecare. 2020; 26:45–52.
14. Kohara EK, Abdala CG, Novaes TF, Braga MM, Haddad AE, Mendes FM. Is it feasible to use smartphone images to perform telediagnosis of different stages of occlusal caries lesions? PloS One. 2018; 13.
15. Vinayagamoorthy K, Acharya S, Kumar M, Pentapati KC, Acharya S. Efficacy of a remote screening model for oral potentially malignant disorders using a free messaging application: a diagnostic test for accuracy study. Aust J Rural Health. 2019; 27:170–176.
16. Sunny S, Baby A, James BL, Balaji D, N. V. A, Rana MH, et al. (2019) A smart tele-cytology point-of-care platform for oral cancer screening. PLoS ONE 14(11): e0224885.
17. Haron N, Zain RB, Ramanathan A, Abraham MT, Liew CS, Ng KG. m-Health for early detection of oral cancer in low- and middle-income countries. Telemed J e Health. 2020; 26:278–285.
18. Skandarajah A, Sunny SP, Gurpur P, Reber CD, D'Ambrosio MV, Raghavan N, James BL, Ramanjinappa RD, Suresh A, Kandasarma U, Birur P, Kumar VV, Galmeanu HC, Itu AM, Modiga-Arsu M, Rausch S, Sramek M, Kollegal M, Paladini G, Kuriakose M, Ladic L, Koch F, Fletcher D. Mobile microscopy as a screening tool for oral cancer in India: A pilot study. PLoS One. 2017 Nov 27; 12(11):e0188440.
19. Machado RA, de Souza NL, Oliveira RM, Martelli Júnior H, Bonan PRF. Social media and telemedicine for oral diagnosis and counselling in the COVID-19 era. Oral Oncol. 2020; 105:104685.
20. Maret D, Peters OA, Vaysse F, Vigarios E. Integration of telemedicine into the public health response to COVID-19 must include dentists. Int Endod J. 2020; 53:880–881.
21. Estai M, Kanagasingam Y, Mehdizadeh M, Vignarajan J, Norman R, Huang B. Teledentistry as a novel pathway to improve dental health in school children: a research protocol for a randomised controlled trial. BMC Oral Health. 2020; 20:11.
22. Kopycka-Kedzierawski DT, McLaren SW, Billings RJ. Advancement of Teledentistry at the University of Rochester's Eastman institute for oral health. Health Aff (Millwood) 2018; 37:1960–1966.
23. Brucoli M, Boffano P, Franchi S, Pezzana A, Baragiotta N, Benech A. The use of teleradiology for triaging of maxillofacial trauma. J Cranio-Maxillo-Fac Surg. 2019; 47:1535–1541.
24. Giudice A, Barone S, Muraca D, Averta F, Diodati F, Antonelli A. Can teledentistry improve the monitoring of patients during the covid-19 dissemination? A descriptive pilot study. Int J Environ Res Publ Health. 2020 May 13; 17(10):3399.

25. Smith AC, Thomas E, Snoswell CL, Haydon H, Mehrotra A, Clemensen J. Telehealth for global emergencies: implications for coronavirus disease 2019 (COVID-19) J Telemed Telecare. 2020 Jun; 26(5):309-313.
26. Estai M, Kruger E, Tennant M, Bunt S, Kanagasingam Y. Challenges in the uptake of telemedicine in dentistry. Rural Rem Health. 2016; 16:3915.
27. Ghai S. Are dental schools adequately preparing dental students to face outbreaks of infectious diseases such as COVID-19? J Dent Educ. 2020 Jun; 84(6):631-633.
28. Petcu R, Kimble C, Ologeanu-Taddei R, Bourdon I, Giraudeau N. Assessing patient's perception of oral teleconsultation. Int J Technol Assess Health Care. 2017; 33:147–154.
29. Estai M, Kanagasingam Y, Xiao D, Vignarajan J, Bunt S, Kruger E. End-user acceptance of a cloud-based teledentistry system and Android phone app for remote screening for oral diseases. J Telemed Telecare. 2017; 23:44–52.
30. Legal aspects of Telemedicine. JPAFMAT, 2005; 5.
31. Golder DT, Brennan KA. Practicing dentistry in the age of telemedicine. J Am Dent Assoc 2000; 131(6):734-744.
32. Mathur P, Srivastava S, Lalchandani A, Mehta JL. Evolving role of telemedicine in health care delivery in India. Prim Health Care 2017; 7(260):2167-1079.
33. The Information Technology Act 2000. Available: https://www.indiacode.nic.in/bitstream/123456789/13116/1/it_act_2000_updated.pdf.
34. Dasgupta A, Deb S. Telemedicine: A new horizon in public health in India. Indian J Community Med 2008; 33(1):3-8.
35. Shirolkar R, RuparellaKP, More C, Ruparella P. Teledentistry: An art and science of healing. J Indian Acad Oral Med Radiol 2011; 23(2):108-111.
36. Chandra G, Rao J, Singh K, Gupta K. Teledentistry in India: Time to deliver. J Educ Ethics Dent 2012; 2:61-64.
37. Mathews MA, Kathavate RN, Tewari S, Pawashe K. Teledentistry: A new frontier. Int J Oral Care Res 2015; 3(4):52-57.