



## **Tele Dentistry and Its Applications**

<sup>1</sup>Dr. Sai Vyshnavi, <sup>2</sup>Dr. Sindhura Ravi

<sup>1,2</sup>Randolph Dental Care, Charlotte, North Carolina, USA

**Corresponding Author:** Dr. Sai Vyshnavi, Randolph Dental Care, Charlotte, North Carolina, USA

**Citation this Article:** Dr. Sai Vyshnavi, Dr. Sindhura Ravi, “Tele Dentistry and Its Applications”, IJMSIR - May - 2024, Vol – 9, Issue - 3, P. No. 33 – 42.

**Type of Publication:** Review Article

**Conflicts of Interest:** Nil

### **Abstract**

Teledentistry is a combination of telecommunication and dentistry which involves exchange of images and information for remote people for treatment planning. It has access to improve healthcare that is being provided to the individuals as well as cost effective. It eliminates the difference between the healthcare being provided in the rural as well as in the urban areas. The application of tele dentistry has come into its play during the COVID 19 pandemic where the flow of the patients to the dental clinics has declined to a great level while the dentists even were not willing to do in person patient consultation due to the restrictions imposed by various governments and also to decrease the risk that is being imposed to them since the virus spreads mainly through the aerosols (droplet spread). Tele dentistry has come along a long way and even today some dentists are already using tele dentistry has a day to day practice in their clinics.

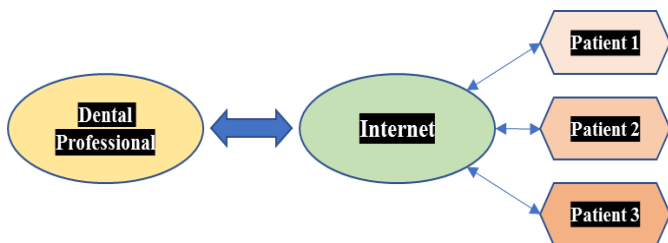
**Keywords:** Tele Dentistry    Tele Diagnosis    Tele Consultation.

### **Introduction**

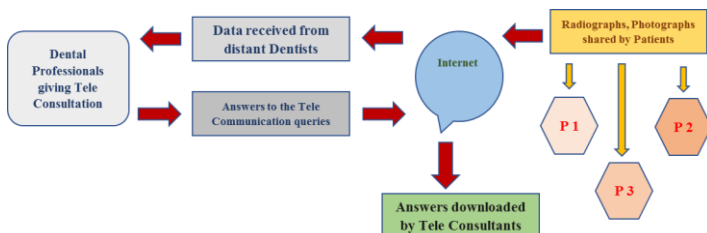
Before tele dentistry, telemedicine came to the existence where telemedicine utilizes the information based technology and communication system across various geographical distances. It utilizes the combination of

communication technology to support healthcare system. It is a wide part of healthcare chain system. It can enhance the quality and efficiency of healthcare. It bridges the gap between the healthcare being provided in the rural and urban areas. The people living in the rural areas can get the advantage of all the facilities and doctors and even specialists living in the urban areas. By doing so it can create a decrease in the travel time where people living in the rural areas have to travel miles together to get access to their resources. Telemedicine is now used in healthcare and in various medical centers, community hospitals so as to link the care being provided in the developed countries. In recent times, there is an extensive technology in the field of dentistry and it is developing faster. The advances of usage of computers, telecommunication, diagnostic services, software, imaging services has shown a great trend in the recent times. This telecommunication has formed a bridge between the patients and doctors where they are being able to provide healthcare needs. The combination of technology, networking, sharing digital information, distant communication, analysis, treatment planning, diagnosis, a segment of telemedicine together are helpful in tele dentistry. Tele dentistry has come a long way

where initially it was used in 1924, where a physician for seeing his patient over radio used a television screen.



Initially it was developed as a part of blueprint for a conference at 1989 which was funded by Westing house Electronics System Group in Baltimore. The main focus of the conference was to bring up informatics into dentistry to provide healthcare. The start of teledentistry was linked to as a subspecialty of telemedicine in 1994, a military project of United States Army whose main concerns was about patientcare, dental education. The term was first used by Crook in 1997 who defines it as the practice of using video conferencing technology to diagnose and provide treatment needs over a wide range of distances. Tele pediatric dentistry , the term was coined by Kumar Mallineni et al. As a part of rising technology new opportunities are created for the delivery of healthcare. Nainar SMH et al conducted a study which portrayed that pediatric dental practices in Connecticut are mostly performed through tele dentistry. Leao JC and Porter SC suggested that tele diagnosis is possible for the various common orofacial diseases via internet. Coorea L et al evaluated a web based practical courses with practical modules are considered as a special type of educational modalities. Ignatius E et al investigated tele dentistry and suggested video conferencing which is suitable for long distance learning.



<b>1997</b>	<b>2004</b>	<b>2005-2019</b>	<b>2020</b>
The term Tele Dentistry was used by Federal Government and Cook and defined it.	A Tele Dentistry network was introduced by the University of Minnesota School of Dentistry specialists with dentists and patients in remote rural areas.	Dentistry has been slower than other healthcare areas in terms of communication technologies.	In Covid-19 pandemic, it became very popular in the field of Dentistry so as to prevent patient contact

### Methods of Consultation

The consultation for the dental appointments through video calls can be done through various ways. Those include:

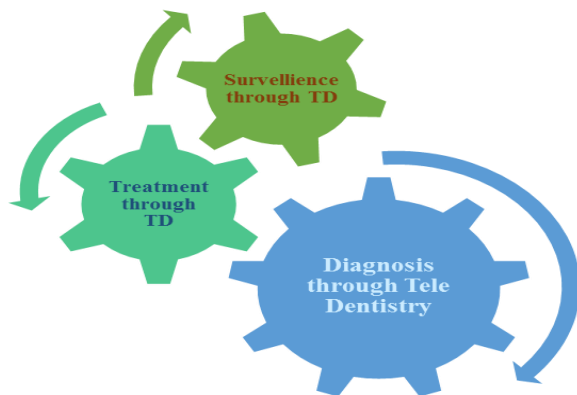
- 1. Real time consultation:** In this the consultation mainly occurs through video calls where the consulting dentist and the patient can talk through video call by using any suitable application.
- 2. Store and forward:** The consulting dentist here receives all the information from the various other previous dentists where the information to them is generally shared by the patients and the consulting dentist uses such information during the consultations. The information is stored such that to be used during consultation. Generally, the patient is not present during the consultation.
- 3. Remote monitoring method:** In this procedure the patients are being monitored from a distance.
- 4. Near real time consultation:** In this process a low resolution, low frame rate product that looks exactly like a jittery television is used during the consultation so that the dentists can visually see the patient.

### Scope of Tele Dentistry

A pilot study was conducted in China Shah Group and National Jaiwan University in over 17,000 people and showed that tele dentistry is effective in providing dental care.

1. The application of tele dentistry mainly helps in improving the healthcare being delivered.

2. It reduces the cost effectiveness
3. It forms a bridge between the patients living in distant locations and the dentists.
4. It reduces the disparities of healthcare system in rural and urban areas.
5. Linert N et al in a Swiss Centre found that tele medicine services are being widely used for the treatment of dental trauma cases.
6. Snow M et al noticed that tele dentistry permitted distant consultations and was cost effective for rural Australians.
7. In case of shortage of dentists, this tele communication acts as a scope for rural and urban as well as sub urban populations.
8. Tele dentistry is as scope where all the specialists can share their knowledge during consultations and its even easy for second opinions, it helps in the usage of real images of tooth that can be easily available online.



### Requirements of Tele Dentistry

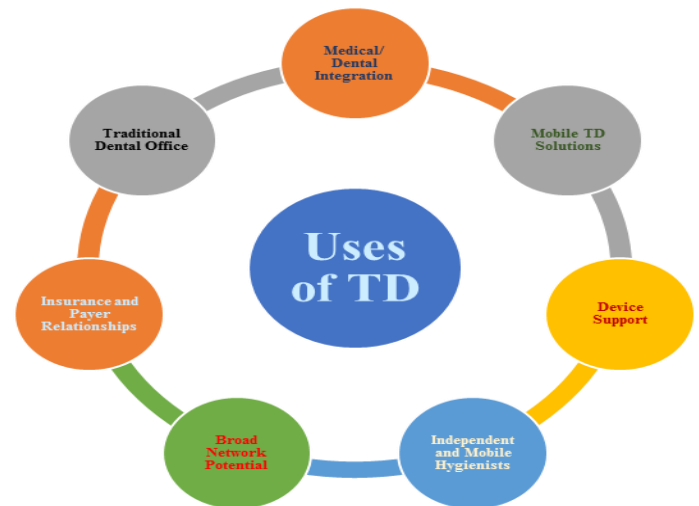
The main requirements for the use of tele dentistry mainly include:

1. Computer with hard drive memory
2. Random Access Memory (RAM)
3. Processor
4. Intra oral video camera
5. Fax Machine

6. Internet connection
7. Scanner
8. Printer
9. Application that support live video conferencing with good audio and video facility like PCI, Codec board.

### Applications of tele dentistry in various fields of dentistry

Tele dentistry is not a specialty, it is an alternative for the delivery of healthcare needs. The following are the various applications of tele dentistry in various fields.



### Oral Medicine

The usage of tele dentistry which is a sub type of tele medicine is used for detection of various oral lesions, preliminary diagnosis, pre malignant lesions, mild pain cases, providing suitable treatment plan such that if they are really small they can be reduced by the prescription drugs and there would be no need for face to face consultation if they can be determined by the video consultations. Bradley M et al used tele dentistry first in oral medicine. Torres Pereira C et al used tele dentistry for distant diagnosis and it acted as an effective way for the diagnosis. Summerfelt FF reported that tele dentistry in dental hygiene model allowed hygienists who provide healthcare, linked the population with distant oral health

team. It decreases the waiting times, better communication, helps in better communication.

### **Oral Surgery**

Duka M et al used tele dentistry for assessment of the impacted third molar. Rollert MK et al used tele dentistry during the dento alveolar surgery. Brickley M et al used tele dentistry for oral specialty care. Aziz SR et al and Ziccardia UB used smart phones for electronically mailing all the digital images. Tele dentistry in the field of Oral Surgery mainly helps in the diagnosis of various trauma cases, head and neck injuries, impacted tooth, fractures of the jaw, odontogenic infections, medications can be provided for the causes of any pain due to the infections. It is accepted with the patient by trauma, temporomandibular disorders, salivary gland disorders, head and neck cancers, used in the further evaluation for orthognathic surgery. Lienert et al found tele medicine services that were helpful for trauma cases in Swiss tele Medical Centre and provided valuable support in the absence of a specialty dentist.

### **Endodontics**

Brullmann D et al identified orifices for a endo accessed tooth using tele communications. Zivkovic D et al diagnosed various periapical lesions for the front teeth. Baker WP 3<sup>rd</sup> et al used tele dentistry to identify various periapical bone lesions. Tele dentistry in the field of endodontics helped dentists in cases of identification of various periapical lesions, endodontically treated tooth.

### **Orthodontics**

Berndt f et al used tele dentistry and he decreased the severity of malocclusion . A study was conducted by Stephens CD and Cook j and he showed the concepts of tele dentistry to dentists and patients. A survey was performed by Bradley SM et al that showed that a positive influence and attitude of patients towards the advices of ortho consultation. Favero L et al used tele

communication for minor emergencies like irritation due to bracket placement, ligature displacement, braces discomfort all these can be solved without face to face appointments. Mandall NA carried out a trial for the assessment of screening for orthodontic referrals, where he found out that patients referred through store and forward tele dentistry were later evaluated clinically. It was seen that clinician agreement for screening and accepting referrals were comparable to that for clinical decision making. During initial orthodontic consultation that is during diagnosis, treatment plans, removable and functional consultation. Both pedodontics and orthodontic appointments have advantage with tele dentistry since they have to wait for the shedding of deciduous dentition which can be assessed by video calls and it reduces the travel time for the kids and parents who have to leave their workplace for appointments.

### **Prosthodontics**

Ignatius E et al used video conferencing for the diagnosis and treatment planning and this had an increase in the potential to the increase in the number of dental specialist services. All the basic simple dental procedures can be evaluated by the process of screening.

### **Periodontics**

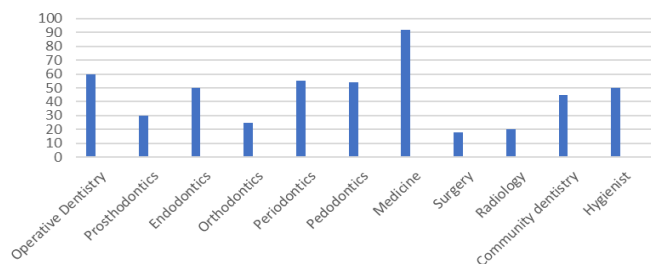
A study was conducted where 15 patients underwent periodontal surgery at Georgia and a week later sutures were removed 150 miles away under the tele communication in the presence of a periodontist who was available through video consultation and only one patient showed return for a follow up procedure. This study shows the usage of tele dentistry and communication for minor procedures.

### **Pedodontics**

Kopycka- Kedzierawski DT and Billings RJ showed tele dentistry as good for visual or tactile examination for dental caries screening in children. They also developed

an intra oral camera for caries screening. They also said that tele dentistry can be used for assessing ECC ( early childhood caries).Tele dentistry is used for preventive counselling, usage of fluoride toothpastes, tooth eruption times, exfoliation times can be visualized by the video consultations.

### Tele Dentistry Applications in Dentistry



#### Advantages of Tele dentistry

1. It provides an effective oral care
2. Exchange of information is easy through the internet
3. Ability to easily contact consultants
4. Dentist have to be well educated such that they can share their knowledge about the usage of technology.
5. The payments generally don't differ since the appointments are made face to face.

#### 1. ORAL LESIONS

Dental caries  
 Mucocele  
 Fibrous hyperplasia  
 Leukoplakia  
 Candida  
 Tongue lesions  
 Amalgam tattoos  
 Aphthous ulcer  
 Pyogenic Granuloma  
 Sialosis  
 Ulcerations

#### 2. MALOCLUSION

Open bite  
 Overjet  
 Crossbite  
 Maxillary Incisor irregularity  
 Bilateral Class 3  
 Malocclusion

#### 3. GINGIVITIS

Dental trauma

#### 4. FRACTURES

Root canal orifices

#### Benefits of Tele Dentistry

Patient benefits	Doctor benefits
In case of emergency	Reduces the chair side time
Evaluate the problem in detail and this helps the patient whether in person appointments is required or not	No requirement of follow up visits since tele dentistry is used
Saves time and money	Quick referral to specialist
Reduces the wait times	Communicate with patients who are remote

#### Responsibilities as a dentist

1. Dentists judge whether they get sufficient information from the patients to make a proper diagnosis.
2. Diagnosis, treatment plan, primary health care has to be accurate.
3. Preventive healthcare
4. Follow up treatment
5. Security measures
  - Patient records acquisition
  - Management
  - Maintenance
  - Technology to enable care

#### Limitations of Tele Dentistry

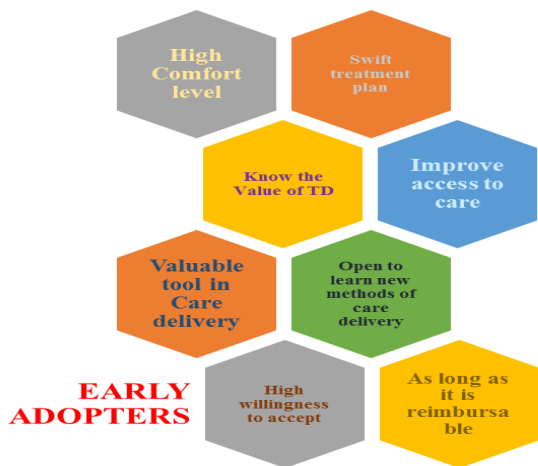
1. Difficulty in assessing dentition and soft tissues in the posterior region of oral cavity
2. Image quality that the patient send
3. Internet issues
4. Improper light during video consultation
5. Manual dexterity
6. Mobility of tooth cannot be evaluated accurately
7. During the case of emergencies
8. Direct patient contact is not possible
9. Tooth mobility and percussion cannot be evaluated

## Tele dentistry during COVID 19

Tele dentistry has gained popularity mainly during COVID 19 where it was helpful in providing consultations during emergencies, due to government restrictions it was difficult for the patient to witness dentists and it limited the patient contact, so this was helpful. It was helpful for the patients with extreme health conditions, physical disabilities and elderly. 23% of dentists approached their patients through tele dentistry. A study was performed on the usage of dentistry where the results obtained mainly include 28% of them responded to the survey out of which, 48% are whites, 14% are Asian, 11% are Hispanics, 7.6% are Blacks, 1% are American Indians. There included 2 groups of individuals

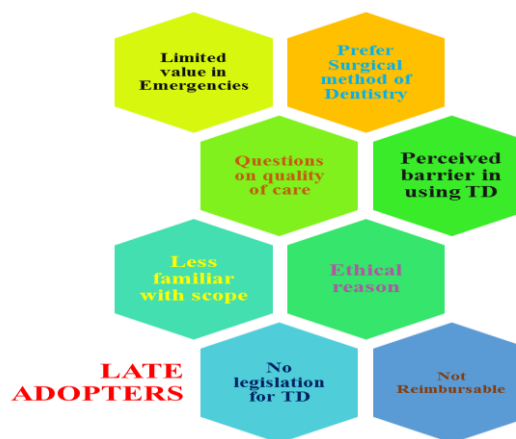
### 1. Early adopters

The group of early adopters basically included high comfort level patients, reimbursable group, willingness was present, improved access to care, open to learn new delivery care methods.



### 2. Late adopter

This group included people who believed on ethical reasons, questioned about the quality of care being provided, some say it has less scope and less familiarity.



18% of dentists claimed no need for tele dentists, 17% practices lacked technology, 16% are not comfortable using technology, 1% are not familiar with the HIPPA regulations. The application, policy, limitations of few countries regarding tele dentistry include:

### Europe

Bosnia and Herzegovina had no national tele dentistry or e policies, e records and E prescriptions are used. In Finland EU regional policy was not developed for electronic patient data, they also used E prescriptions, video meetings were conducted, Orthodontic care was delivered using tele dentistry, preventive care was rendered, 22% of dentists used mobile app for communication purposes. In France, medical doctors are reimbursed for using tele communications in their practices, e- dent project was developed for more than 10,000 procedures. In Italy, guidelines for orthodontic patients promoted the usage of photographic records, video calls for remote care., no laws are implemented during the regulation of practice. In United Kingdom, tele dentistry was occasionally used for orthodontic consultation, 75% had no experience, 63% had no resources, 16% had no confidence.

**Canada:** Recommends treatment of emergencies via tele dentistry. CDA identifies codes and fees for the services through tele dentistry.

**Chile:** Oral tele pathology, tele orthodontics, dental emergencies triage was proposed.

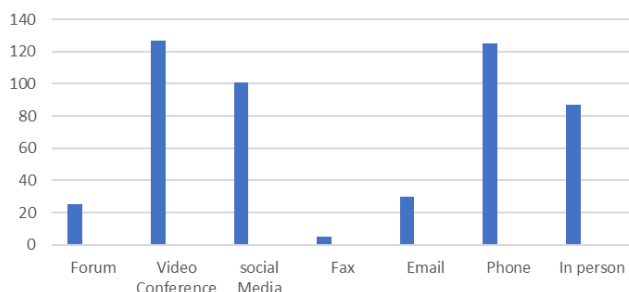
**Mexico:** Income inequality, low internet connection, low digital illiteracy, SMS messages, applications to care that do not include oral health.

**Egypt:** In September 2021, tele diagnosis was initiated in 150 medical units, where 300 collaborated with WHO, COVID 19 increased demand for the endodontics appointments through phone calls. Globe Med was the first tele health consultant service.

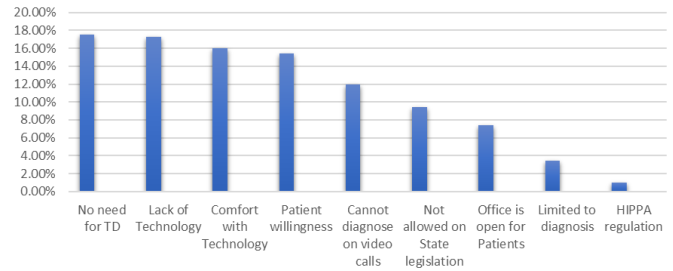
**China:** The first tele dentistry project was started in the year 2012. During COVID 19, ICT was adopted into healthcare for the diagnosis, treatment plan and during emergency care.

Jampeni et al recognized tele dentistry as a way to increase the consultation capabilities by sharing photos, xrays, improve communication between dentist and patient. Various applications that are used for orthodontic consultation include Go To Meeting, Blue Jeans, Microsoft Teams, Ready Talk, Dentulu,Toothpik. For Patient management applications used include tele Dent, car stack, tele Dentix. In UK, taylor described “Anywhere” as a virtual system supported by National Health Services. India used Tele dentistry to provide advices, prescribe analgesics, antibiotics. HIPPA non-compliant applications include WhatsApp, Facebook, Face time. HIPPA compliant applications include ZOOM, Skype, Google Meet.

### Preferred Communication Tool for TD



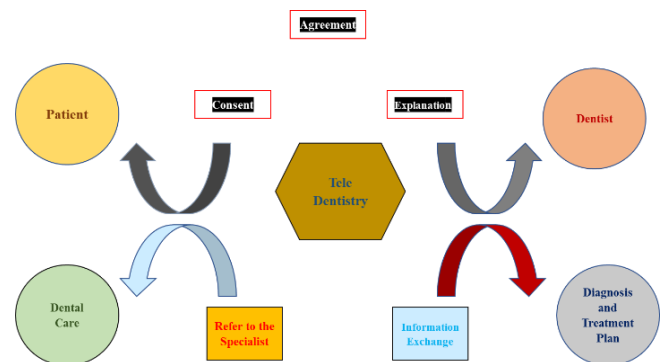
### Reasons for Dentists Not Using TD



### Advances in Tele dentistry

WHO defined tele medicine as a delivery system of healthcare services, where distance is a critical factor by all healthcare professionals using information and communicate technology for exchange of diagnosis, treatment plan, prevention of diseases, injuries and evaluation for continuing education of health care providers.

1. It was helpful for prescribing medicines
2. It is divided into separate groups those include consultation, diagnosis, treatment planning, monitoring
3. Various applications are being developed for video consultations



### Conclusion

Tele dentistry represents a groundbreaking fusion of telecommunications and dentistry, facilitating remote consultations, treatment planning, and information exchange. Its emergence has been particularly transformative during the COVID-19 pandemic, offering a crucial lifeline when traditional in-person dental visits were restricted. By harnessing the power of technology, tele dentistry brings forth numerous benefits, including

enhanced healthcare access, cost-effectiveness, and the bridging of rural-urban healthcare disparities. Moreover, it enables swift response during emergencies, bolstering overall healthcare resilience. Yet, alongside its promise, tele dentistry encounters challenges. Remote assessment of certain dental conditions, maintaining image fidelity, and ensuring dependable internet connectivity present significant hurdles. Despite these obstacles, the field is continuously evolving, leveraging technological advancements to elevate patient care and democratize access to dental services worldwide. It stands as a beacon of innovation, poised to revolutionize dental healthcare delivery, especially in underserved communities.

### References

1. Zimlichman E. Telemedicine: Why the Delay? *Isr Med Assoc J.* 2005;7:525–6.
2. Dasgupta A, Deb S. Telemedicine: A New Horizon in Public Health in India. *Indian J Community Med.* 2008;33:3–8.
3. Roine R, Ohinmaa A, Hailey D. Assessing Telemedicine: A Systematic Review of the Literature. *CMAJ.* 2001;165:765–71.
4. Dils ES, Lefebvre C, Abeyta K. Teledentistry in the United States: A New Horizon of Dental Care. *Int J Dent Hygiene.* 2004;2:161–4.
5. Clark GT. Teledentistry: What is it Now, and What Will it be Tomorrow? *J Calif Dent Assoc.* 2000;28:121–7.
6. Bhambal A, Saxena S, Balsaraf SV. Teledentistry: Potentials Unexplored. *J Int Oral Health.* 2010;2:1–6.
7. Mihailovic B, Miladinovic M, Vujicic B. Telemedicine in Dentistry (Teledentistry) In: Grasczew G, Roelofs TA, editors. *Advances in Telemedicine: Applications in Various Medical Disciplines and Geographical Areas 2011.* Rijeka (Croatia): InTech; 2011. pp. 215–30.
8. Bhambal A., Saxena S., Balsaraf S.V. Teledentistry: Potentials unexplored. *J. Int. Oral. Health.* 2010;2:1–6
9. Estai M., Kanagasingam Y., Tennant M., Bunt S. A systematic review of the research evidence for the benefits of teledentistry. *J.Teleded. Telecare.* 2018;24:147–156.
10. Khan S.A., Omar H. Teledentistry in practice: Literature review. *Teleded. E-Health.* 2013;19:565–567. doi: 10.1089/tmj.2012.0200.
11. Rocca M.A., Kudryk V.L., Pajak J.C., Morris T. The evolution of a teledentistry system within the Department of Defense. *Proc. AMIA Symp.* 1999:921–924.
12. Cook J., Austen G., Stephens C. Videoconferencing: What are the benefits for dental practice? *Br. Dent. J.* 2000;188:67–70. doi: 10.1038/sj.bdj.4800391.
13. Talla P.K., Levin L., Glogauer M., Cable C., Allison P.J. Delivering dental care as we emerge from the initial phase of the COVID-19 pandemic: Teledentistry and face-to-face consultations in a new clinical world. *Quintessence Int.* 2020;51:672–677.
14. Jain A., Bhaskar D.J., Gupta D., Agali C., Gupta V., Karim B. Teledentistry: Upcoming Trend in Dentistry. *J. Adv. Med. Dent. Sci.* 2013;1:112–115.
15. Daniel SJ, Kumar S. Teledentistry: a key component in access to care. *J Evid Based Dent Pract.* 2014;14(Suppl):201–8.
16. Morosini Ide A, de Oliveira DC, Ferreira Fde M, Fraiz FC, Torres-Pereira CC. Performance of distant diagnosis of dental caries by teledentistry in juvenile offenders. *Teleded J E Health.* 2014;20(6):584–9.
17. Elfrink MEC, Veerkamp JSJ, Aartman IHA, Moll HA, Ten Cate JM. Validity of scoring caries and primary molar hypomineralization (DMH) on

- intraoral photographs. *Eur Arch Paediatr Dent.* 2009;10(1):5–10.
18. Boye U, Willasey A, Walsh T, Tickle M, Pretty IA. Comparison of an intra-oral photographic caries assessment with an established visual caries assessment method for use in dental epidemiological studies of children. *Community Dentist Oral Epidemiol.* 2013;41(6):526–33.
19. Kopycka-Kedzierawski DT, Billings RJ. Comparative effectiveness study to assess two examination modalities used to detect dental caries in preschool urban children. *Telemed J E Health.* 2013;19(11):834–40.
20. Mandall NA, O'Brien KD, Brady J, Worthington HV, Harvey L. Teledentistry for screening new patient orthodontic referrals. Part 1: a randomised controlled trial. *Br Dent J.* 2005;199(10):659–62.
21. Kopycka-Kedzierawski DT, Billings RJ. Prevalence of dental caries and dental care utilisation in preschool urban children enrolled in a comparative-effectiveness study. *Eur Arch Paediatr Dent.* 2011;12(3):133–8.
22. World Health Organization. *Mobile technologies for oral health: an implementation guide.* Geneva (2021).
23. World Health Organization. *Global strategy on digital health 2020–2025* (2021).
24. European Observatory on Health Systems and Policies, Fahy N, Williams GA. *Use of digital health tools in Europe: before, during and after COVID-19* (2021).
25. World Health Organization. *Global diffusion of eHealth: making universal health coverage achievable: report of the third global survey on eHealth.* Geneva. (2016)
26. Eysenbach G. What is e-health? *J Med Internet Res.* (2001) 3(2):1–5. doi: 10.2196/jmir.3.1.e1
27. Oh H, Rizo C, Enkin M, Jadad A. What is eHealth (3): a systematic review of published definitions. *J Med Internet Res.* (2005) 7(1):e1. doi: 10.2196/jmir.7.1.e1
28. Eraso FE, Scarfe WC, Hayakawa Y, Goldsmith J, Farman AG. Teledentistry: protocols for the transmission of digitized radiographs of the temporomandibular joint. *J Telemed Telecare.* 1996;2(4):217–23.
29. A. Ather, B. Patel, N. B. Ruparel, A. Diogenes, and K. M. Hargreaves, “Coronavirus disease 19 (COVID-19): implications for clinical dental care,” *Journal of Endodontics*, vol. 46, no. 5, pp. 584–595, 2020.
30. D. Zivkovic, G. Tomic, B. Mihailovic, M. Miladinovic, and B. Vujicic, “Diagnosis of periapical lesions of the front teeth using the internet,” *PONS-medicinski časopis*, vol. 7, pp. 138–143, 2010.
31. J. Berndt, P. Leone, and G. King, “Using teledentistry to provide interceptive orthodontic services to disadvantaged children,” *American Journal of Orthodontics and Dentofacial Orthopedics*, vol. 134, no. 5, pp. 700–706, 2008.
32. J. Cook, J. Edwards, C. Mullings, and C. Stephens, “Dentists’ opinions of an online orthodontic advice service,” *Journal of Telemedicine and Telecare*, vol. 7, no. 6, pp. 334–337, 2001
33. M. A. Rocca, V. L. Kudryk, J. C. Pajak, and T. Morris, “The evolution of a teledentistry system within the Department of Defence,” pp. 921–924.
34. D. T. Kopycka-Kedzierawski, C. H. Bell, and R. J. Billings, “Prevalence of dental caries in Early Head Start children as diagnosed using teledentistry,” *Pediatric Dentistry*, vol. 30, no. 4, pp. 329–333, 2008.

35. M. Bradley, P. Black, S. Noble, R. Thompson, and P. J. Lamey, “Application of teledentistry in oral medicine in a community dental service,” *British Dental Journal*, vol. 29, pp. 399–404, 2009.
36. P. M. Sfikas, “Teledentistry: legal and regulatory issues explored,” *Journal of the American Dental Association* (1939), vol. 128, no. 12, pp. 1716–1718, 1997.
37. G. Wallace, “Information technology and telemedicine-commentary,” *CMAJ*, vol. 165, no. 6, pp. 777–779, 2001.38.J. H. Sanders and R. L. Bashshur, “Challenges to the implementation of telemedicine,” *Telemedicine Journal*, vol. 1, no. 2, pp. 115–123, 1995.