

## Teledentistry in Dental Education: A Futuristic Approach

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### Abstract

Health care has changed dramatically by the marriage of computers and telecommunications. Implications for hospitals and physicians already have received extensive media attention, but comparatively little has been said about the impact of information technology on dentistry. Teledentistry is a newly emerging area of dentistry that uses dental health records, telecommunication technology, digital imaging and the internet to link dental health care providers in rural or remote communications with specialists in larger communities to enhance communication, the exchange of health related information and access to dental care for underserved patients. This would increase accessibility of specialists, besides decreasing time and cost associated with specialty consultations.

**Keywords:** Teledentistry; Rural population; Telecommunication; Internet; Real time videoconferencing; Store and forward technique.

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### Introduction

Like other health professionals, dentists have seen a lot of change over the years. Dentistry at the beginning of the 21<sup>st</sup> century would be almost unrecognizable to a practitioner of 1900. The profession has come a long way from extractions and dentures. Modern oral health care is a remarkable achievement. Now, digital technology is taking dentistry to another level—creating practice possibilities that were hardly imaginable even 10 years ago.[1]

Within the past decade, significant changes have been occurred in information and telecommunication technology in health care fields that have a positive impact on practice

style. This new technology makes access to health care easier and faster. Although many disciplines exist within the health care field, they all share an important common denominator: the use of telecommunication technology has an important role in health care practice. The explosive growth of the Internet and its use brings with it the potential for electronic media to fundamentally alter the way dentistry and medicine are practiced. Information is now universally accessible to health care practitioners and to the general public.

The beginning of teledentistry can be roughly traced back to the beginnings of telemedicine, but more specific the birth of teledentistry as a subspecialist field of telemedicine could be linked to 1994 and a military project of the United States Army (U.S. Army's Total Dental Access Project), aiming to improve patient care, dental education, and effectuation of the communication between dentists and dental laboratories.[2]

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### Teledentistry

People living in rural or underserved areas are among the most in need of oral healthcare in their communities.[3,4] In addition the lack

of oral healthcare providers in these areas, barriers to the accessibility of quality dental care appear to be geographical distance and limited local resources.[5,6] Many rural communities lack the clinical settings and finance that are required to attract specialized dental providers. Patients living in rural areas who are referred to dental care providers in more urban settings must travel to these areas which is usually expensive and time consuming.

Teledentistry can close this gap by allowing oral healthcare providers in the rural areas to seek advice from specialists in the urban settings. This can be performed without the patient having to physically enter the specialty practice. An appropriate treatment plan can be devised prior to a direct patient-specialist visit. Thus saving at least one preliminary appointment for the patient.[7]

### Teledentistry methodologies

There are currently two basic techniques that are used for teledentistry. One is **real-time videoconferencing**, and the other, more common, is the basic **store and forward technique**. [8] Both techniques involve a dental care professional digitizing and electronically transmitting videos, drawings, diagrams, photographs and X-rays. The information is then prepared for transmission and the data are transmitted to the distant site.

*Real-time videoconferencing* allows people at two or more sites to communicate with each other by using a digital screen to display a video image of the person or people at either or both sites. These system uses a video camera and speaker phones so that the users at either site can see and hear them. For this type of consultation, both parties are agree upon a meeting time and information that is exchanged in real time is transmitted simultaneously between sites. Users can verbally clarify points, add comments, physically point to certain data and amend details already entered during the consultation as it happens. This type of consultation allows

for more in-depth discussion and personal contact than store and forward. However, the equipment and high speed network connection required to run the operations can be more expensive.[9]

*The store and forward technique* operates via the internet. The dental professional seeking advice collects all the necessary information and stores it in a file. The file is forwarded via e-mail as an encoded file to ensure a secure transfer of information, which can only be accessed by the appropriate parties. The consultant retrieves the file and examines its contents. Recommendations are then provided to the dental professional in the same manner in return. This technique is the least expensive, yet provides ample benefit for a wide range of applications, and is just effective as presenting cases in a real-time setting.[7]

Both real time, and store and forward require the same basic type of hardware, software, peripheral devices and telecommunications links with appropriate bandwidth. Real-time conferences do require slightly more sophisticated equipment and faster connections.[10]

### *Teledentistry in Dental Education*

*Web-based self-instruction*: Formal online education can be divided into two main categories:

Web-based self-instruction and interactive videoconferencing.

The Web-based self-instruction educational system contains information that has been developed and stored before the user accesses the program.[11] The advantage of Web-based self-instruction is that the user can control the pace of learning and can review the material as many times as he or she wishes.

Disadvantages of Web-based self-instruction also have been noted in areas of satisfaction and accuracy. The lack of face to-face communication with peers and instructors may be one of the main reasons for dissatisfaction. A study of electronic mail-

based oral medicine consultations[12] found that face-to-face patient examinations are more accurate in establishing a correct diagnosis for oral mucosal pathoses than the transmitted descriptive patient data alone.

#### *Interactive Videoconferencing*

Interactive videoconferencing (conducted via POTS, satellite, ISDN, Internet or Intranet) includes both a live interactive videoconference (with at least one camera set up where the patient's information is transmitted; however, cameras at both locations are ideal) and supportive information (such as patient's medical history, radiographs) that can be sent before or at the same time (for example, via fax) as the videoconference (with or without the patient present). The advantage of this educational style is that the user (typically the patient's health care provider) can receive immediate feedback.[13]

#### *Positive Feedback*

According to a 1999 U.S. Army study, teledentistry can be a very good tool for teaching postgraduate students and even for providing continuing education for dentists.[14] In interactive videoconferencing, patient information is evaluated first (with or without the patient presence), which allows interaction and feedback between the educator and students. Patient cases can be reviewed thoroughly and at the student's pace.

#### *Dental Chat Rooms*

In addition, teledentistry can be used widely and less formally at the grass-root level. Dental chat rooms can be made available for a variety of topics.

#### *Teledentistry Opportunities*

Teledentistry has the potential to expand oral healthcare being provided. It can be utilized by any dental care professional who wishes to gain advice, improve diagnostic care

or determine referrals. It has the ability to alleviate many barriers that currently exist in access to oral healthcare. Teledentistry is likely to be most beneficial in rural and underserved areas. It is a method of delivery that has the ability to extend care to patient population with limited or no access to dental care.

Teledentistry's ability to provide more professional connectedness for dental professionals working in rural areas could decrease the phenomenon of professional isolation. Teledentistry can bridge this gap by creating greater professional connectivity, thus enabling all dental care providers to work in conjunction to create complete, individualized treatment plans.[7]

#### *Implications and Challenges*

The digital transformation of oral health care promises many exciting changes during the next few years. However, like any revolution, it will not be easy or painless. Initially, there will be several skeptics for every true believer. Some traditionalists will oppose teledentistry openly refusing to believe that its initial problems can be solved. Many people and organizations will struggle to learn to use a keyboard or master the new vocabulary of electronic age.

Nevertheless, dentistry cannot seek a long term exemption from the Internet-based world of 21st-century health care, and the speed and success of its transformation can be affected positively by the right professional leadership. This leadership should come from organized dentistry. In particular, national and state dental societies must develop and implement plans for their own digital transformation— including state-of-the-art capabilities to provide public information about dentistry, electronic journals, Web-accessible libraries, fully automated records, research management, continuing dental education and other online membership services. Dental associations are still in a best position to provide meaningful guidance.[15]

### *Advantages*

Teledentistry has the ability to improve, access to care, the delivery of health care and lower its cost. For example, teledentistry can be a much needed resource for dental consulting, referral for specialized care, dental mentoring, dentist laboratory communications and continuing education. Dental consulting is an area in which teledentistry can help a great number of patients, including those in rural areas, the incarcerated and the elders.

Rural areas lack health care specialists. To gain access to specialized care, residents of rural areas frequently must travel significant distances. Teledentistry could enable rural patients to receive a specialty consultation without the expense of time and money in traveling to the site where a specialist is located.

Teledentistry can extend care to additional patient populations at a reasonable cost, as well as ease the problem of shortage of specialized dental consultants and professional isolation in rural areas.

### *Drawbacks*

There are no “rules” on the Internet – there is no licensure and no verification. Anyone with or without credentials can hold themselves out to the public as having expert knowledge. There is no regulation and little accountability. Nowhere is the phrase “caveat emptor” more appropriate than on the Internet.[16]

The problems with the Internet in general and teledentistry in particular are due primarily to a lack of well-defined standards.[17] Currently, there is no method to ensure quality, safety, efficiency or effectiveness of information or its exchange.

If technical problems occur during data transmission that causes a misdiagnosis or medical error, issues of responsibility and malpractice need to be considered. If patient data are lost or stolen during the process of transmission, the entire project may need to be discontinued.[18]

There are privacy and security issues as well as remuneration, fiscal and taxation issues associated with electronic commerce. Many of the legal issues, such as licensure, jurisdiction and malpractice, have not yet been definitively decided by legislative or judicial branches of government.

### *Malpractice*

The first issue that requires clarification is whether a doctor-patient relationship has been established. This is established, and legally begins, only with the consent of both the doctor and the patient. Traditionally, informal consultation, in which the practitioner discusses the patient’s dental history and current conditions with colleagues, does not establish a doctor-patient relationship as a result of those discussions.[19] However, it has been argued that any practitioner offering an opinion over the Internet, either to a colleague or a layperson, via e-mail or formal consultation, has indeed established a doctor-patient relationship.[20,21,22]

With respect to real-time video-conferencing consultations, technology now makes it possible for the patient, dentist and consultant to all be “present” at the same time, with the consultation being rendered both with the patient’s consent and on behalf of that patient. Under these circumstances, it is increasingly likely that the courts will determine that a doctor-patient relationship has been established via the electronic medium. Once this relationship is established, the consultant has a duty to act within the parameters of the standard of care.

### *Technological Issues*

Inherent in teledentistry is a great degree of technical sophistication with which many patients are unfamiliar. Patients should be informed as to the nature of the teledentistry referral, specially the risks associated with electronic transfer of information. With

teledentistry, it is no longer solely a failure of the practitioner (to treat or diagnose), but also the failure of the technology itself that can have a negative impact on outcomes of care. Communication and understanding of the technology and its potential problems become central to the issue of whether a patient has received sufficient information to give his or her informed consent. Failure of an accurate transmission, and its potential impact on clinical outcomes, should be communicated to the patient.[16]

### *Privacy*

No matter what precautions are taken, any electronic transfer of information carries with it the risk of a person intercepting that transmission and having access to the information it contains.[23,24,25,26] Patients should be willing to accept this risk as inherent to the nature of teledentistry.

Clearly, there are steps the practitioner can take to make it more difficult for a transmission to be intercepted. For example, data encryption, password protection and user access logs can help deter most people and protect patient confidentiality.

### *Security*

Preservation of the integrity of electronic data is in the best interest of patients, practitioners, insurance carriers, hardware and software vendors, and legislatures. All have a stake in the issues associated with electronic security.[27]

It should be stressed that no security protocol will be 100% effective, but a good effort to maintain system and data security will be important should a practitioner be challenged in a court of law. Indeed, federal legislation requires integrity and confidentiality of electronically transmitted information. Patients should be informed of the security measures that a practitioner uses to ensure the safety of patient's data. An explanation that there is the potential for a breach of that security should be included with

this statement. Computer viruses, hacking, hardware and software failure, and disasters such as fire or theft may result in loss of patient information. Again, the consent form should mention that while efforts are made to ensure data protection, some loss of information might be inevitable should an extreme event occur.

### *Backup*

No discussion of data security would be complete without a discussion of the importance of regular, secure data backup. This is the single most important way to maintain the integrity of electronic data, and is most often neglected. For a private practitioner, this cannot be overlooked. This becomes a critical issue when patient records are involved, and exposes a practice owner to a negligence suit in the event of lost data, when a backup is unavailable. Should patient data be unrecoverable, it would be difficult for the practitioner to avoid being held liable for negligence.

### *Recommendations*

Attention to details, good communication and excellent documentation can help to reduce a teledentistry practitioner's association liability. With regard to record keeping, it should be noted that e-mail sent to the practitioner by the patient in reference to his or her condition or treatment must be kept by the practitioner as part of the patient's medical record, and that the content of such e-mails can be made part of the discovery process in a potential legal proceeding.

Before attempting to practice teledentistry, the potential provider should clarify and document the parties responsible for installation, maintenance, access, security and privacy efforts associated with the equipment used.

Transmission verification procedures should be developed and documented at both the local and remote sites.

Documented contingency plans should be developed, including a description of the backup protocols used. Furthermore, clinical guidelines should be established and documented that are at least equal to the accepted standards of care in the dental community. Both the local and consulting doctors should separately and thoroughly document the patient's medical and dental histories, examination results, diagnosis, differential diagnosis, treatments, consultations and recommendations. It would also be wise for all practitioners involved to carry insurance specifically designed to provide coverage in the event of a teledentistry failure, including malfunction of any equipment or software.

### *Indian Scenario*

India is a vast country with inherently contrasting geographical, cultural and economic features. This South Asian country has a high population growth rate, high rural percentage of population, high illiteracy rates, poverty and unemployment. 80% of India's main healthcare centers are located in cities that host 30% of the population.[28] Telemedicine has contributed in bridging the gap between demand and supply. Sanjeevani is an integrated telemedicine application that is offering a suite of high utility features as a part of telemedicine technology which is based on store and forward technique as well as real time models.[29]

The existing health care delivery mechanism clubbed with advances in telecommunication technology could be an ideal setting for teledentistry. Graduate dentists with knowledge in teledentistry can be appointed at the primary health centers and community health centers for discussing the diagnosis and treatment plan of difficult cases with the specialists. The dental colleges with a predetermined catchment area could be ideal places to serve as hub sites for teledentistry consultation as they encompass all the specialists serving under a common roof. A team of specialists could communicate for a

few hours on a daily basis with the dentists/hygienists/ patients at the remote clinic.[30]

### **Conclusion**

Teledentistry is on the verge of an exciting new growth and opportunity. As the digital revolution moves forward, it is only a matter of time before most dental professionals will gain familiarity with, and have the necessary technology to make teledentistry a reality. Teledentistry will bridge the gaps between dental care professionals and specialists, tap into previously isolated manpower, and above all else, it will provide patients with affordable, accessible, quality dental care.

### **References**

1. Bauer JC, Brown WT. The digital transformation of oral health care. *J Am Dent Assoc.* 2001; 132: 204-208.
2. Rocca MA, Kudryk L, Pajak JC, Morris T. The evolution of teledentistry. [www.amia.org/pubs/symposia/D005388.pdf](http://www.amia.org/pubs/symposia/D005388.pdf). Accessed September 2011.
3. Allukian M Jr. MPH. The neglected epidemic and the surgeons general's report: a call to action for better oral health. *Am J Public Health.* 2000; 90(6): 843-5.
4. Beetstra S, Derksen D, Ro M, Powell W, Donald E, Kaufman A. A health commons approach to oral health for low-income populations in a rural state. *Am J Public Health.* 2002; 92(1): 12-13.
5. Clark GT. Teledentistry: what is it now, and what will it be tomorrow? *J Calif Dental Assoc.* 2000; 28 (2): 121-7.
6. Armer JM. A case study of the use of telemedicine by advanced practice nurses in rural missouri. *J Cont Ed Nurs.* 2003; 34(6): 226-33.
7. Sanchez Dils E, Lefebvre C, Abeyta K. Teledentistry in the United States: a new horizon of dental care. *Int J Dent Hygiene.* 2004; 2: 161-164.
8. Epley TK. III Telemedicine: practicing in the information age. *New Des Telemed Programs.* 1998; 14: 99-106.

9. Cook J, Austen G, Stephens C. Videoconferencing: what are the benefits for dental practice? *Br Dent J*. 2000; 188: 67-70.
10. National Research Council. *Networking Health: Prescriptions for the Internet*. National Research Council: Washington, DC, 2000: 38-51.
11. Johnson LA, Wohlgemuth B, Cameron CA, et al. Dental Interactive Simulations Corporation (DISC): simulations for education, continuing education and assessment. *J Dent Educ*. 1998; 62: 919-28.
12. Younai FS, Messadi DV. E-mail-based oral medicine consultation. *J Calif Dent Assoc*. 2000; 28(2): 144-51.
13. Chen JW, Hobdell MH, Dunn K, KA, Zhang J. Teledentistry and its use in dental education. *J Am Dent Assoc*. 2003; 134: 342-6.
14. Vandre RH, Kudryk VL. Teledentistry and the future of dental practice. *Dentomaxillofac Radiol*. 1999; 28(1): 60-1.
15. Meskin LH. Thinking outside the box. *J Am Dent Assoc*. 2000; 131: 12-6.
16. Golder DT, Brennan KA. Practising dentistry in the age of telemedicine. *J Am Dent Assoc*. 2000; 131: 734-44.
17. American College of Radiology (ACR) Standard for Teleradiology. Available at: "[http://www.acr.org/departments/stand\\_accred/standards/html\\_standards/html\\_files/diag/telerad.html](http://www.acr.org/departments/stand_accred/standards/html_standards/html_files/diag/telerad.html)". Accessed September 28, 2011.
18. Biegel S. Virtual health care: unresolved legal issues. *J Calif Dent Assoc*. 2000; 28(2): 128-32.
19. Kuszler PC. Telemedicine and integrated health care delivery: compounding malpractice liability. *Am J Law Med*. 1999; 25: 297-326.
20. Borowitz SM, Wyatt JC. The origin, content, and workload of e-mail consultations. *J Am Med Assoc*. 1998; 280: 1321-4.
21. Eysenbach G, Diepgen TL. Responses to unsolicited patient e-mail requests for medical advice on the World Wide Web. *J Am Med Assoc*. 1998; 280: 1333-5.
22. Spielberg AR. On call and online: sociohistorical, legal, and ethical implications of e-mail for the patient-physician relationship. *J Am Med Assoc*. 1998; 280: 1353-9.
23. Advanced health information system, telemedicine and the law. In: *Health information systems and telemedicine newsletter*. Washington: Arent, Fox, Kintner, Plotkin & Kahn; September 1996.
24. Andersen DC. The computerization of health care: can patient privacy survive? *J Health Hosp Law*. 1993; 26(1): 1-10.
25. Safran C, Rind D, Citroen M, Bakker AR, Slack WV, Bleich HL. Protection of confidentiality in the computerized-based patient record. *MD Comput*. 1995; 12(3): 187-92.
26. Tomes JP. *Healthcare privacy and confidentiality: the complete legal guide*. Chicago: Probus Publishers; 1994.
27. Barber B, Garwood D, Skerman P. Security in hospital information systems. *Internat J Bio-Medical Comput*. 1995; 39(1): 133-8.
28. Pal A, Mbarika V, Cobb-Payton F, Mc Coy S. Telemedicine diffusion in a developing country: the case of India. *IEEE transactions on information technology in biomedicine*. 2005; 9: 59-65.
29. Sood SP, Bhatia JS. Development of telemedicine technology in India: Sanjeevani-An integrated telemedicine application. *J Postgrad Med*. 2005; 51(4): 308-12.
30. Reddy VG. Using teledentistry for providing the specialist access to rural Indians. *Indian J Dent Res*. 2011; 22(2): 189.