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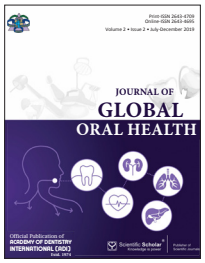

Systematic Reviews and Meta-analysis

Teledentistry: A literature review of evolution and ethicolegal aspects

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ABSTRACT

Teledentistry is about delivering data from one point (spoke site) to another point (hub site) using telecommunications technology. Teledentistry is a relatively new field that combines telecommunication technology and dental care. It provides new opportunities for education and delivery of care that offers much potential and challenges. Teledentistry is also useful in long-distance clinical training and continuing education, screening, and dentist laboratory communication. In rural areas, where there is a shortage of specialists, lack of comprehensive and sophisticated health-care teledentistry can extend care to remote patient populations at a reasonable cost as well as ease the problem of a shortage of specialized dental consultants.

Keywords: Telecommunication, Digital, Teledentistry, Data, Electronic health records

INTRODUCTION

Teledentistry is a developing area of dentistry that links dental providers to their patients. Cook defined teledentistry as "the practice of using videoconferencing technologies to diagnose and provide advice about treatment over a distance."[1] Interactive access to specialist opinion is provided with the use of telecommunication and computer technologies which is not limited by time and space.[2] It uses telecommunication technology to send data, graphics, audio, and video images between participants who are physically separated for the purpose of clinical care[3] (Association of American Medical Colleges).[4] Telemedicine program was launched in 1994 by the United States military.[5] Teledentistry harnesses the capability of modern telecommunications to allow offsite dentists of any specialty to assist their colleagues in providing care.[6] This consultation could be direct (between the patient and the expert) or indirect (between the patient's doctor and the expert).[7]

EVOLUTION OF TELEDENTISTRY

The changes within the past decade in the speed and method of data transfer have prompted clinicians and information technology experts to reevaluate teledentistry as a highly valuable tool. For example, cases submitted to the dental laboratories have subtle complications or esthetic nuances that require direct contact between the dentist and the laboratory technician. In these instances, the ability to send color images of the patient's teeth and then to talk about the images can help to prevent making improperly constructed appliances, thereby saving time and money.[8] The following steps show the use of technological advancements for better execution of teledentistry over the decade.

Step 1: Image file transfer through modem

In a study conducted at Fort Gordon, Georgia, a dental image management system was used in conjunction with an intraoral camera to capture color images of a patient's mouth. These images were then transmitted over a 9600-band modem from the Dental Clinic in Fort McPherson, Georgia, to Fort Gordon, a distance of 120 miles. Fifteen patients were referred for periodontal surgery to Fort Gordon. After healing had been determined to be complete, the patients then reported back to Fort McPherson for suture removal and intraoral imaging. Color still images of the surgical sites were then transmitted to the periodontist who performed the surgery. In conclusion, 14 patients were saved from visiting the hospital again. The patients uniformly felt that they had received better care and time was saved. The dentists were also comfortable in their ability to make proper decisions and diagnosis using the equipment.[9]

Step 2: File image transfer through satellite

The second study was performed in Haiti in 1995. In this study, a video teleconferencing system was used over international maritime satellite (Inmarsat) allowing the deployed dentists to talk face to face with specialists at Walter Reed Army Medical Center in Washington. The images were obtained with a high-resolution still camera and transmitted to Walter Reed, where the specialists reviewed them. This study showed that the video quality was insufficient for dental diagnosis of most pathologic conditions but that the Kodak gave diagnostic images. Due to the encouraging results of these two studies, it was decided to expand the scope of the Fort Gordon study to an actual research project.[10]

Step 3: Integrated services digital network (ISDN)-based teledentistry system

For this project, the Army posts of the Southeast Dental Service Support Area were networked using desktop video teleconferencing equipment and ISDN lines at 128 kbps data rates, an intraoral camera, and a document camera. This equipment allows live videoconsulting as well as capability to send still images. Whiteboarding is a feature of this system, which allows users to do annotation on an image.

In 1996, the US Department of Defense established a medical network in Bosnia that connected army field dentists at five regional military medical centers in the United States (Washington, Texas, California, District of Columbia, and Hawaii). Using commercially available technology, dentists transmitted radiographs, color images, and full-motion videos to remote field hospitals for diagnostic support and obtained results and prescription support by utilizing digitalized medical logistics and online clinical information.[5]

For primetime III, an integrated frame relay ISDN architecture was used. Landstuhl Regional Medical Center in Germany was the center, integrated into the internet and the commercial ISDN gateway link to the world. The Department of Defense concluded that the ISDN-based systems provide invaluable support for clinical decision making in time-critical contexts, though its major drawback is expense, both in initial purchase and equipment maintenance.[11] However, the savings in travel and work hours lost were recouped in <2 years.

Step 4: Plain old telephone system (POTS)-based teledentistry system

A POTS-based teledentistry network was tested in 1997 and implemented in Germany, Italy, Belgium, England, Spain, and Portugal. This system was mainly deployed to smaller dental clinics in Europe, which did not have internet access at the time. The POTS-based network has been established for the US Army, Navy, and Air Force dental clinics at over 52 sites in Europe and 16 sites in the United States.[10]

The POTS-based systems consist of a desktop computer, a 28.8 kbps modem, software and hardware (Share vision PCS 3000), intraoral camera, and a document camera. An online database was developed to gather information on user satisfaction, number of consults, frequency of use, and video or audio problems occurred and avoided travel. Dental providers complete this form each time they use the system. The data collected from the use of the POTS-based systems had been analyzed. The advantage of the POTS-based systems was that it was user friendly, low in cost, and easy to maintain.

Step 5: Web-based teledentistry systems

The web-based teledentistry system (October, 1997) consists of a laptop, a digital camera, a web browser, and requires internet access. Since most of the dental clinics in Europe have a local area network and access to internet through the medical hospitals, this system is being used in over 50 triservice dental clinics in Europe. A web-based clinical database has been developed for storing the consults. This system uses MS SQL server 7.0 for storing the consults as the database server and MS Internet information server 4.0 as web server.[12]

The referring dentist after logging into a secure server chooses a specialty (orthodontics, oral medicine, oral and maxillofacial surgery, endodontics, oral pathology, periodontics, prosthodontics, and pediatric dentistry). He then sends the patient's details including complaint, images, and radiographs to the specialist. The data gets sent to the database and an electronic mail notifies the specialist of the pending consult, which he will access through the internet. A plug-in developed in visual C++ enables him to do image

manipulations such as contrast and brightness changes of the radiographs within the web browser. The specialist after reviewing the details writes diagnosis and treatment plan which is sent through email to the referring dentist.[12]

In this practice, the data collected on the web-based teledentistry referrals show an average of forty consults per month. Advantages of a web-based teledentistry consultation system include low cost, expandable to a wide range of locations, and more complete information for data analysis.

SCOPE

Advancement in the technology has broadened the scope of utilization of teledentistry.

Patient care

In some of the remote clinics, a patient must travel hundreds of miles to receive specialty care. Often pre- and post-operative visits take only a few minutes of actual appointment time but require hours of travel by the patient. Cost and travel time required by the patient are reduced. Referral to specialists, consultations, and laboratory communications are some of the clinical areas where improvement can be done.

Teledentistry in consulting can present in two forms: Real-time consulting and store-and-forward consulting. In real time consulting, a videoconferencing format is used. In store and forward consulting, the referring dentist collects applicable data and sends them to the consulting doctor through an electronic medium.[13] The consultant reviews the material and returns as opinion through the same route. Either way, the potential for access to specialized care is increased. On the other hand, the potential for error could also be increased, as well as the potential for practitioners to incur additional liability. In either case, two or more practitioners are involved in the consultation. It is not advised to make a diagnosis based only on a telephone conversation with a patient. It is equally inadvisable to make a diagnosis, treatment recommendation, or both without an examination by a licensed practitioner.[14]

Continuing dental education

Through the use of video teleconferencing equipment, the lectures could be broadcasted to any clinic where continuing dental education is difficult to obtain.

LEGAL AND ETHICAL ISSUES IN PRACTISING TELEDENTISTRY

The universal use of teledentistry, accessibility to information has raised a number of legal concerns. Dentistry can be viewed as falling under telemedicine laws by inclusion. Alabama has recommended amendment of its Dental Practice Act to include the Federation of State Medical Award's interstate licensure model.[15]

The importance of the World Wide Web and its effect on the dental profession will be profound. There are no "rules" on the internet – there is no license and verification.[16]

Even simply sending as E-mail message to a colleague could be considered a teledentistry referral and may come under legal scrutiny. It is each practitioner's responsibility to understand the implications of the use of information technologies and their associated legal ramifications for the dental practice. Each practitioner should seek the advice of a qualified attorney who is familiar with teledentistry and its implications.[17]

Licensure

Earlier practitioners were free to communicate and exchange information with colleagues in other states. Inherently, a level of confidentiality was assumed when using these methods – the information was exchanged with only a single individual or office. Many states have decided that such referrals constitute the practice of medicine or dentistry in those states. Therefore, practitioners engaged in telemedicine/teledentistry must be licensed in each state in which they practice. In the United States currently, 20 states have restrictive licensure laws that required the health-care practitioner to obtain a full license (with some exceptions) to participate in teledentistry across state lines. This allows a practitioner who is licensed and good standing in one state to avail himself or herself of reciprocity with any of the states. If the matter is adjudicated, the practitioner could be found guilty of practicing without a license in those states in which he or she is practicing teledentistry. The risk may extend to software and hardware manufacturers as well.

Jurisdiction

To establish jurisdiction, a state court must establish that an act was committed and that either the act resulted in injury within one jurisdiction or the party has sufficient "minimum contacts" with the jurisdiction so that it would reasonably be expected to defend itself there.

Malpractice

Any practitioner offering an opinion over the internet, either to a colleague or a layperson, through e-mail or formal consultation has indeed established a doctor-patient relationship.[18] With respect to real-time videoconferencing 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 through the electronic medium. Once this relationship is established, the consultant has a duty to act within the parameters of the standard of care.

Establishment and acceptance of an altered standard of care, be it higher or lower than that for a traditional consultation, carries with them certain risks. Might providers be guilty of negligence for not availing themselves of the specialized care available through teledentistry? Failure to refer may constitute negligence. Telemedicine may affect the standard of care by elevating the standard to the point that not having telemedical capacity is in fact substandard.

The next concern is establishing the injuries a patient might suffer (or claim to suffer) stemming from a teledentistry referral. A consultant may be liable for the ultimate treatment undertaken by the referring dentist, especially if the consultant failed to independently inform the patient of his or her findings (termed "negligent supervision").

Technological issues

With teledentistry, it is no longer solely not only the 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. Understanding the technology and its potential problems by the patients are areas of concern.[19] Health-care professionals may find themselves sued for equipment failure or malfunction, if that failure results either directly or indirectly in an injury to a patient. In addition, the equipment manufacturer, hardware and software distributors, and utility and equipment service companies could be joined in a claim for equipment failure or malfunction and could be held liable for technological problems associated with their products under one of the five theories of product liability, including strict liability. There is currently little case law available discussing product liability as it relates to telemedicine.

Privacy

Patients should be informed that the potential exists for their medical or dental information to be accessed by unauthorized people, despite the best efforts of the physician or dentist treating the patient. 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.[20] Physicians and dentists engaged in telemedicine and teledentistry must make every effort to ensure the security of their systems, as well as any data they may transmit.

Patients should be made aware that their medical information might be subject to the differing laws and differing jurisdictions depending on where and how the information is transmitted.

While it is certainly true that unauthorized users could access paper records (and that disclosure of that fact is not the norm), electronic storage increases the number of potential unauthorized viewers; hence, disclosure of this possibility is advisable.

Security

It should be stressed that no security protocol will be 100% effective, but a good faith effort to maintain system and data security will be important should a practitioner be challenged in a court of law.

Patients should be informed of the security measures that a practitioner uses to ensure the safety of patient 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 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.

Informed consent

Patients should be informed that there may be the risk of an inaccurate diagnosis, treatment or both as a result of a failure in the technologies. For those practitioners who choose to venture toward this new frontier and its considerable additional legal exposure, a teledentistry consultation form is recommended and is required in some states. While not a guarantee of protection, this form could offer some substantiation of a good faith effort at patient informed consent. It should become a standard part of our patient documentation. Such documentation involves a description of the teledentistry arrangement and of the credentials of the consulting doctors.[21] The patient should understand that he or she would have access to all information transmitted during a teledentistry interaction and that he or she may withhold or withdraw at any time without affecting the right to future treatment.

Ethical issues

Maintenance of security during internet commerce and internet fraud are some of the ethical issues. These ethical

concerns extend to teledentistry. Of particular concern in the area of telemedicine are public protection and fraud.

Public protection

Health-care providers have an obligation to ensure that they as individuals as well as the profession as a whole provide the best possible health care to patients. While the internet offers the promise of an unprecedented improvement in patient care, it also can be easily abused. There are standards available helping internet users decipher the immense quantity of information available, but no simple way to verify the credentials of the provider of that information.

When an inquiry is posted (perhaps by a patient seeking treatment advice), anyone is free to respond – dentists, educators, other patients, and manufacturers. Unfortunately, there is no way to verify the credentials of the person responding. Given the anonymous nature of the internet, a person can answer a question even when he or she has a formal dental degree or not and even if the person wishes to falsify credentials by impersonating a dentist.[22] There is no simple way for a reader to substantiate any information about the person answering questions on a newsgroup.

While one can argue whether these replies were appropriate, it becomes apparent that the responses do create an impression of our profession. Hence it is important to remain cognizant of the impact, ethical implications and the impressions the words of a professional carry whether written or digitally encoded.

Fraud

Fraudulent alteration of medical records has been a long-standing problem. Unfortunately with the advent of electronic data storage, the potential exists for an undetectable alteration of an electronic record. As most states do not consider an electronic record an acceptable form of medical information storage; electronic records should be supported with a written copy of patient information. In addition, the original record should be identified and maintained as such.[23] While a printed copy of the radiograph can be made, this negates some of the advantages of digital imaging (for example, less storage space required).

The ethical implications of fraud for insurance carrier are even graver. Alterations could be used to falsify completion of procedures without ever having treated the patient. Indeed, a person familiar with this technology could alter digital dental radiographs at will. We as a professional must work cautiously and with the best interests of our patients in mind.[24]

Recommendations

Attention to detail, good communication, and excellent documentation can help reduce a teledentistry practitioner's medium-associated liability. 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 a part of the discovery process in a potential legal proceeding. Before practicing 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.[25]

CONCLUSION

Teledentistry is a relatively new and exciting field that has endless potential. It is useful in long-distance clinical training and continuing education, screening and dentist laboratory communication. In rural areas where there is a shortage of specialists, lack of comprehensive and sophisticated health care teledentistry can extend care to remote patient populations at a reasonable cost as well as ease the problem of a shortage of specialized dental consultants.

Declaration of patient consent

Patients consent not required as patients identity is not disclosed or compromised.

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Conflicts of interest

There are no conflicts of interest.

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