

Teledentistry as a Method to Improve Oral Health Access in Florida

-This white paper was prepared in 2006 by the SOHIP Teledentistry Workgroup, chaired by Douglas Manning, in support of the State Oral Health Improvement Plan for Disadvantaged Floridians, Recommendation 6, Strategy 10.-

INTRODUCTION

The 2000 Surgeon General's Report, *Oral Health in America: A Report of the Surgeon General*¹, called for "action to promote access to oral healthcare for all Americans, especially the disadvantaged and minority children found to be at greatest risk for severe medical complications resulting from minimal oral care and treatment".¹ Many of these disadvantaged populations and minority children reside in areas that lack access to oral health care and subspecialty services. Telehealth can be an effective way to improve access to care and ease of care. In theory, when data rather than clients are moved, health resources can extend their reach. Implementation of a telehealth system can increase access to prevention and educational health care services, can improve access to primary care services, can widen the reach of specialty care, and can expand the chance for utilization of medical education and training by health care professionals and community members. Telehealth brings services to clients rather than clients to services. In an effort to address improving access to oral health care for Florida's disadvantaged populations, the Florida Department of Health has instigated a study of the logistics, costs, and policy concerns involved in implementing a teledentistry program. This white paper will discuss the equipment and technology required to set up a teledentistry program in Florida Department of Health facilities. The paper will study two proposed situations: a fixed-based remote unit and a mobile-based remote unit each of which utilize dental hygienists who will link to a fixed-based hub unit with a dentist on site. The teledentistry technology linking a remote-based dental hygienist to an off-site dentist will increase access by expanding the capability of dentists to examine patients who cannot otherwise access or easily access a Department of Health or other organization or private dental facility. The Department of Health envisions using teledentistry for two distinct purposes: 1) to provide isolated populations with examination, consultation, and referral services for both basic and specialized oral healthcare; and 2) to fulfill the general supervision requirement of the Florida Statutes (Section 466.023 (2) (b) Dental hygienists; scope of practice and Section 466.003 (10) Definitions – "General Supervision")² and the Florida Administrative Code (F.A.C.) (Rule 64B5-16.001 (6))³ so that a remote-based dental hygienist may position and expose dental x-ray film or sensors; apply American Dental Association or Food and Drug Association approved topical fluorides (which would include fluoride varnishes); use appropriate instruments to pre-assess and chart suspected findings of the oral cavity; take or record patient's blood pressure rate, pulse rate, respiratory rate, case history, and oral temperature; perform prophylactic cleanings; applying dental sealants; provide oral hygiene instruction; and provide oral health education without a dentist needing to be physically present.

BACKGROUND

Telehealth Defined

Just as communication technology and uses of electronic information have developed over the years, the terms to describe health care services at a distance, such as "telehealth", "e-health",

and “telemedicine”, have also evolved. Currently, “telehealth” and “e-health” are generally used as umbrella terms.^{4,8} They describe all the possible variations of health care services using telecommunications.^{4,8} These services include the support of long-distance clinical health care, patient and professional health-related education, public health and health administration.^{4,8} “Telemedicine” has come to describe the direct provision or support of clinical care at a distance through the use of electronic communication and information technologies.^{4,6-9} Terms such as “telepathology”, “teleradiology” and “teledentistry” have evolved to describe the application of telehealth to those particular medical specialties. Thus, “teledentistry” has come to mean the use of electronic information and telecommunications technologies to support long-distance clinical oral health care, patient and professional health-related education, public health, and health administration.

Two other terms need clarification as they are sometimes used interchangeably in telehealth—“encounter” versus “consultation”. Both describe provider actions concerning a patient, but they each have distinct and different meanings. A “consultation” is a provider to provider discussion of a patient’s diagnosis, treatment, or condition.⁸ Usually the patient’s primary care provider seeks input from another general provider or specialist located at a distant site.⁸ Here, the care of the patient remains the responsibility of the patient’s primary care provider.⁸ Conversely, an “encounter” is an event where a provider has contact with a patient.⁸ The provider can be located at either the originating or distant site.⁸ In such situations, the care of the patient becomes the responsibility of any provider that has direct contact with the patient.⁸

Two different types of data transmission and technology make up most telehealth applications – “store and forward” and “two-way interactive” or “real time”. Store and forward technology is used to transfer digital data (e.g. still images, video, radiographs, CT scans, MRIs, EKGs, etc.) that is captured and stored in one location than forwarded or transferred to another location.^{4,6,8,10} Two-way interactive technology allows a person at a remote or distant site to see or hear in real time images or sound occurring at an originating site.^{4,6,8,10} In most health care applications, whether utilizing store and forward or two-way interactive technology, clarity and detail of the data are the most important issues.¹⁰ Speed of data transfer and the compatibility, interoperability, scalability, accessibility, and reliability of the technology are also significant.

History

In its simplest form, telehealth has been around for decades. The familiar use of the telephone for consultations between patients and clinicians and the use of radios to link emergency medical personnel to medical centers have been commonplace in health care for this and most of the last century.^{4,8} However, in the last 30 years, clinicians, health services researchers, and others have been investigating the use of advanced telecommunications and computer technologies to improve health care.⁴

The National Aeronautics and Space Administration (NASA) played an important role in the early development of telemedicine.^{11,12} Beginning in the 1960’s and continuing through the 1980’s, NASA provided much of the technology and funding for early telemedicine demonstration projects.¹¹ Early telemedicine projects focused upon populations in remote areas such as mountainous locales, island nations, open plains, and arctic regions where specialists and even primary care providers were scarce.⁴ Most of these early telemedicine projects, while

improving access, failed to survive the end of grant funding as telecommunications costs were high and the technologies were new, unfamiliar, and difficult to use and maintain.⁴ Moreover, most early (and many new) telehealth projects failed because of a lack of an initial needs assessment and business plan.^{4, 8, 13}

Over the past decade the technologies that provide health care services at a distance have improved dramatically.^{4, 6, 8, 11} They have become more commonplace and user-friendly.^{4, 6, 8, 11} Moreover, competition and the Federal Communication Commission's (FCC) Rural Health Care Support Mechanism including the Universal Service Fund have transpired to bring the costs of telecommunication services down.⁸ Telemedicine projects continue to serve isolated populations. The concept of isolated populations has expanded from not only those populations located in geographically remote localities, to include isolated populations located in urban settings, correctional facilities and home health settings.^{4, 11} The majority of the early and even later projects have used telemedicine for education, research, triage/evaluation/referral, and specialty consultation services.^{4, 11} One of the first teledentistry projects, the Department of Defense through the United States Armed Forces' Total Dental Access (TDA) project, focused on three applications: continuing dental education, dentist-laboratory communications, and referral and consultation patient care services.⁷ In general, clinical applications involving direct patient care have not been compatible with telemedicine services. However, certain fields such as mental health services (telemental health) and the advent of new robotic technology (telesurgery) offer the opportunity for clinical applications.^{4, 6-8, 11} Today, telehealth systems can be found in hospitals, clinics, private offices, nursing homes, rehabilitation facilities, homes, assisted living facilities, schools, prisons and health departments.⁸ As technology continues to evolve, telemedicine applications will continue to expand.

Services

Telehealth encompasses a broad array of medical health services. Telemedicine has a variety of applications in patient care, education, research, administration, and public health.

Medical education provides distance learning primary or continuing education services to health professionals located in remote locations.¹⁴

Consumer medical and health information includes the use of the internet or other electronic media for consumers to obtain specialized health information, on-line discussion groups, or peer-to-peer support.¹⁴

Health care research permits health care researchers to become linked to other health care researchers despite geographical separation.¹¹

Management and administration services allow key health centers to oversee satellite or remote sites.¹¹

Specialist referral/consultation services typically involve a specialist assisting a general practitioner in rendering a diagnosis. These services can involve a specialist interacting with a patient "live" or in "real time" or involve a specialist reviewing a patient's records without the patient being present via store and forward technology.¹⁴

Home health care or remote patient monitoring uses medical devices attached to a patient that collect and send patient data to a remote monitoring station for interpretation.^{6, 14}

Supervision of direct care services allows a doctor (or dentist) to provide statutory supervision of a health care auxiliary (e.g. nurse, physician assistant, dental hygienist) who then can provide direct patient care at a site remote from that of the supervising doctor.¹¹

Direct patient care allows a remote health care provider to provide direct patient care through interactive conversation, observation, or even new robotic technology.¹¹ Examination, diagnosis, treatment planning, prescription writing, mental health services including individual and group therapy, and robotic surgery are all possible.¹¹

These services utilize a wide range of technology including telephone lines, cable, fiber optics, wireless technology, and even satellites to transmit data over a variety of networks.^{4, 6, 8, 11, 12, 14, 15} Networks can be public or private. Public networks are shared while private networks are dedicated for a specific use and for a specific organization.^{8, 14, 15} Hub and spoke networks link large health care facilities with outlying or satellite offices.^{14, 15} Point-to-point connections use private networks to link sites in one organization or company.^{14, 15} Primary or specialty care to home connects primary care providers, specialists, or home health auxiliaries with patients over for interactive clinical examinations, consultations, and limited treatment.¹⁵ Home to monitoring center links connect home health care monitoring devices to call centers.^{14, 15} And web-based or e-health patient services sites utilize the internet to provide direct consumer outreach and information services.¹⁶

Telemedicine

Telemedicine, simply put, is the clinical application of providing care at a distance.⁸ A variety of medical specialties now utilize telemedicine in one form or another. Teleradiology, telepathology, and telepharmacy were some of the earliest telemedicine specialties and continue to be the most common applications of telemedicine today. Radiographs, CT scans, MRIs pathology slides, and scripts are easily sent from one location to another for diagnostic interpretation usually utilizing store and forward technology. Many medical specialties, including dermatology, oncology, internal medicine, obstetrics and gynecology, and neurology have found telemedicine technology to be conducive for consultative services.⁶

Interactive technology occurs when face to face, live consultations, diagnosis or treatment is necessary. Telemental health, teledermatology, teleemergency care all utilize interactive, real time technology.⁴

Telecardiology, telehome care, and telemedicine in correctional facilities utilize both store and forward and real time technology to monitor patient's vital signs.⁴ Stethoscopes, blood pressure cuffs, and heart monitors can all be hooked up to computers that send information in real time or stored and forwarded at a later time for evaluation.⁴

Telesurgery is a new field that utilizes exotic technologies like robotics that allow surgeons to operate on a patients at a distant location.⁴

For more information on telemedicine projects with specific applications using nurses or paramedics at distant sites, see: Space Technology Applied to Rural Papago Advanced Health Care (STARPAHC). 1972-75. (paramedics) and see Massachusetts General Hospital/Logan International Airport Medical Station. 1967 (nurses).¹¹

Teledentistry

Teledentistry is a relatively new adjunct in the modern trend of telemedicine. Teledentistry is a combination of telecommunications and dentistry which involves the exchange of clinical information and images over remote distances.¹⁷ Most teledentistry programs to date have focused upon distance management and administration of remote facilities, learning and continuing education, and consultation and referral services rather than supervision of auxiliaries or direct patient care. Most teledentistry programs are associated with a dental or medical school. Some of these are worthy of examining briefly. The following list of programs is not exhaustive as smaller programs and programs outside the United States may exist, but are not as well publicized. One last note, there are a number of internet dental consulting firms which offer teledental specialty consulting for a fee. Two examples of these are the Jordan Dental Center based in Amman, Jordan (<http://www.jordan-dental.com/index.html>)¹⁸ and Dental Consults based in England (<http://www.dental-consults.com/index.html>)¹⁹. Mention of these services is for educational purposes only and does not serve as an endorsement of either.

The Department of Defense initiated the “Total Dental Access” project in 1994. The Total Dental Access project focused on three areas of dentistry: patient care including referrals to specialists and consultations; continuing education; and dental-laboratory communications. The project utilized multiple transfer technologies including image file transfers by modem, image file transfers by satellite, ISDN-based (Integrated Services Digital Network) technology, POTS-based (Plain Old Telephone Service) technology, and web-based technology. An analysis of the Teledentistry project concluded that teledentistry demonstrated was cost-effective within 6 months to a year of initiation and that teledentistry improved access and quality of care by facilitating better and timely information to the dentists which improved decision making and produced better communication between the dentists and their patients. For more on the Total Dental Access project, see:

<http://www.amia.org/pubs/symposia/D005388.PDF#search='department%20of%20defense%20teledentistry>.⁷

Marquette University School of Dentistry initiated the Marquette University Dental Telehealth and Education Link in 2003. The project aimed to create a network linking Marquette and other health systems with dental sites in remote areas where access to care is problematic. The project utilized both store and forward and interactive technology for the purposes of primary care, consultation, education, and public awareness programs. The Wisconsin Advanced Telecommunications Foundation (WATF) was the major funding agency on this project, but the Milwaukee Area Health Education Center and Wisconsin Geriatric Education Center also were sponsors. For more on the Marquette University Dental Telehealth and Education Link see: <http://www.dental.mu.edu/teledent/index.html>.²⁰

In 2003 the Childrens Hospital Los Angeles Teledentistry Program began a store and forward teledentistry program. Initially this program was run in association with the University of Southern California School of Dentistry (USCSD) Mobile Dental Clinic (see below). This on-going program provides enhanced dental treatment to children in rural, remote, underserved areas of California. For more on the Childrens Hospital of Los Angeles Teledentistry Program see: <http://www.childrenshospitala.org/body.cfm?id=781>.²¹

The USCSD mobile clinic was the first non-military dental clinic in the United States to utilize digital imaging and the Internet to diagnose and treatment plan patients in remote locations. The Harold McAlister Charitable Foundation and The California Wellness Foundation (TCWF) grant funded this project. While the mobile clinics continue to operate they no longer utilize teledentistry at this time. For more on the USCSD Mobile Dental Clinic see: http://www.usc.edu/hsc/dental/update/january03/community_01.htm²² and see http://www.usc.edu/hsc/dental/community/mobile_clinic.htm²³.

In 2004, the State of Minnesota Department of Health in conjunction with the University of Minnesota School of Dentistry and the Hibbing Community College Dental Clinic sponsored a Teledentistry Project. The project continues to utilize direct videoconferencing to create a telecommunication network linking the University of Minnesota School of Dentistry's specialists with dentists and dental students in sites in remote rural areas where access to care is problematic. For more on the University of Minnesota School of Dentistry's Teledentistry Project see: http://www.dentistry.umn.edu/patients/tx_options/specialty_clinics/Teledentistry.html#whatsteledentistry.²⁴

The University of Rochester Medical Center's Eastman Dental Center in association with Aetna insurance established the Teledentistry in Childcare Project in 2005. This project helps inner city families easily access the oral health treatment they need for their children in childcare. The project's goal is to develop a new strategy for the prevention and early detection of early childhood caries (ECC). The project utilizes a computer and camera which allow dentists to examine and interact with a child in real-time. For more on the Teledentistry in Childcare Project see: <http://www.urmc.rochester.edu/pr/news/story.cfm?id=784>.²⁵

In the summer of 2005, the University of Washington School of Dentistry's Pediatric Dentistry residency program began a videoconferencing project based at a remote site at the Farm Workers Clinic in Yakima Valley. The project entails both a distance learning educational component, using both store and forward and live videoconferencing capabilities, and a clinical consultation component, which allows live video consultations chairside. The project utilizes an intra-oral camera in Yakima linked to the videoconferencing system in Seattle via the internet. For more on Washington University's Pediatric Dentistry residency program at Yakima Valley Farm Workers Clinic see, <http://www.dental.washington.edu/pedo/news/summer2005.pdf>.^{26, 27}

The University of Tennessee's Mid-South Telehealth Consortium (MSTC) in collaboration with the Tennessee Department of Health initiated a Mobile Healthcare Telehealth Project in 2002. The Department of Health and Human Services through the USDA: Rural Utilities Service and NTIA: Technology Opportunities Program with matching contributions from program partners funded the project. The mobile healthcare telehealth project provided mobile access to a variety

of dental and ophthalmology services previously unavailable in the rural communities of central and western Tennessee. The dental outreach program provides school-aged children with access to dental screenings, cleanings, education, and the application of dental sealants through a unique partnership between hygienists from the TN Department of Health and dentists at UTHSC College of Dentistry. For more on the MSTC mobile healthcare telehealth project see: <http://webster.utm.edu/telemedicine/projects.html>.²⁸

Recently, the University of Florida College of Dentistry (UFCD) received a grant from the Department of Health and Human Services, Health Resources and Services Administration (HRSA), Office for Advancement of Telehealth (OAT). The purpose of the project is to enhance UFCD's Statewide Network for Community Oral Health and improve access to oral health care for Florida residents. The project has 3 primary goals: to expand and evaluate video-conferencing (VC) capabilities from the University of Florida Gainesville campus to health facilities located throughout the state; to develop and evaluate web-based educational materials for dental students, dental residents, faculty and practitioners; and to develop and evaluate clinical consultation services including the use of digital radiography for the efficient exchange of diagnostic information across clinical locations. The project will utilize both store and forward and two-way interactive technologies. The grant period runs from September 1, 2004 through February 28, 2006. For more on UFCD's Teledentistry project see: <http://www.dental.ufl.edu/Offices/Teledentistry/Default.htm>.¹⁷

Since 2003, the Apple Tree/Head Start Teledentistry Model^{29, 30} has provided expanded access to oral health by providing mobile, teledental oral health care services in the Minneapolis, Minnesota area. Dental hygienists utilize store and forward technology (generally, utilizing portable, digital dental equipment (e.g. intraoral camera) and a laptop) to deliver oral health care services at five Head Start programs with federal funding. Hygienists provide on-site educational, diagnostic, and preventative services at Head Start facilities so that an off-site "collaborating" dentist can review findings and make the diagnosis needed to schedule invasive treatment. The legislatively approved "collaborative agreements" allow for dental hygienists to provide limited oral health care services (e.g. medical history, digital images, screening, cleanings, and oral hygiene education, but not fluoride treatments or sealants) off-site, without "direct" supervision of a dentist. For more on Apple Tree Dental see: <http://www.appletreedental.org/AppleTreeInstitute/InstituteProjects/ClinicalInnovations.aspx>.²⁹

The U.S. Department of Health and Human Services Indian Health Service also utilizes teledentistry to provide oral health care to American Indians and Alaskan Natives in various states around the country. However, there is little documented information regarding these programs. For more on the Indian Health Service Division of Oral Health see: <http://www.ihs.gov/MedicalPrograms/Dental/index.cfm>.³¹

TELEHEALTH TECHNOLOGY

There are many approaches, equipment, and technologies available to develop a telehealth network. There is no standard model or right or wrong design. The decision of which approach, equipment, and technology to use will depend on many factors: cost, availability of telecommunication services, and the type of health care services that the telehealth program wishes to deliver all will play a significant role in designing the network. These factors will play

a primary role in the decision of whether to use store and forward technology, two-way interactive technology, or some combination of both. One note, in the last decade, the technologies which provide healthcare services at a distance have improved dramatically and have significantly dropped in price and probably will continue to do so.⁸ For a more detailed account and an explanation of telehealth technology, network design, and specific telecommunication technology characteristics see Chapter 13, Telehealth Technology, section II – Networks; and section III – Network Equipment in the Office for the Advancement of Telehealth’s *Telemedicine Technical Assistance Documents: A Guide to Getting Started in Telemedicine*.⁸

Telecommunication Technologies

There is a wide-variety of telecommunications technologies available which can go into the design of a telehealth network. In fact, the technologies are constantly changing. Before designing any network a needs assessment that will determine the type of data transmission and technology required for the network must be accomplished. Factors such as how fast the data needs to be reviewed by the distant site, whether real time communication is necessary, and to what degree is quality and definition important will determine the choice between transmitting data via store and forward technology, two-way interactive technology, or some combination of both. Broadband video telehealth technologies and networks are more complex than store and forward or technologies using plain old telephone service. Information technology staff, telecommunications staff, as well as the telehealth staff should all have input in the decisions regarding specific technologies and products that are used in the development of the network. A team approach is most effective and valuable. The following sections will attempt to explain the different telecommunications available for the design of a telehealth network. Some basic terminology and concepts need explanation first.

Definitions

“Broadband” - refers to telecommunication in which a wide band of frequencies is available to transmit information.^{8, 10, 32-35} Because a wide band of frequencies is available, information can be multiplexed and sent on many different frequencies or channels within the band concurrently, allowing more information to be transmitted in a given amount of time (much as more lanes on a highway allow more cars to travel on it at the same time).^{8, 10, 32-34}

“Bandwidth” - is a primary factor governing the performance of a network. Bandwidth is the rate that data flows over the network. It is a measure of capacity rather than speed.^{8, 10, 33-36} Bandwidth is proportional to the complexity of the data for a given level of system performance.¹⁰ Bandwidth serves as a practical limit to the size, cost, and capability of the telehealth service.³⁴ Providers of telecommunication technologies can deliver bandwidth on a variety of physical and transmission medium such as: twisted wire pairs or optical fiber strung on telephone poles or buried as cables beneath the surface; or radio waves or satellite transmissions which are completely wireless.^{8, 10} Although standard phone lines can support certain telemedicine applications, frequently higher bandwidth technologies are necessary.^{8, 10}

“Latency”^{33, 35, 37} - is another measure of the performance of a network. Together, latency and bandwidth define the speed and capacity of a network. Latency is the time it takes a piece of

transmitted data to be received at its destination. It is measured in milliseconds. Video conferencing becomes unusable with latency greater than 300 milliseconds. High latency degrades the performance of even the largest capacity networks. Variations in latency create “jitter” – data packets reach the destination with different delays.^{35, 38} Jitter can seriously affect the quality of streaming audio and/or video.³⁸

“Quality of Service” (QoS)³⁸ – refers to the probability of data succeeding in passing between two points in a network. QoS is a guaranteed throughput level – that an amount of data will be transferred from one place to another in a specific amount of time.³⁹ QoS is of particular concern for the continuous transmission of high-bandwidth video and multimedia information such as video conferencing. Availability of service 24/7, continuous adequate bandwidth levels (vs. average bandwidth level), delay or latency (transmission capability), jitter or latency variation, and transmission loss are all measures of QoS. A defined or guaranteed QoS may be required for certain types of network traffic. Generally, QoS can be guaranteed by over provisioning a network so that all data get a QoS sufficient to support QoS-sensitive applications or network customers and providers can enter into contractual agreements which specify the ability of a network to give guaranteed performance/throughput/latency bounds usually by prioritising traffic.

“Videoconference” – A videoconference is a live connection between people located in separate facilities for the purpose of communication.^{35, 40} The connection can be site to site or multisite. At its simplest, videoconferencing provides transmission of static images and text between two locations.⁴⁰ At its most sophisticated, it provides transmission of full-motion video images and high-quality audio between multiple locations.⁴⁰ Videoconferencing is not limited to a single telecommunications technology. Videoconferencing requires a computer with videoconferencing software and an internet connection.⁴⁰ Most videoconferencing calls require at least 384 Kbps of bandwidth to function with adequate speed and quality.⁸

Characteristics

There are five basic technical factors that should be considered when looking at purchasing any telehealth technology.^{8, 41}

“Compatibility” - newer versions of telehealth technologies should be compatible with earlier versions of similar technologies, decreasing the likelihood of rapid product obsolescence.^{8, 41}

“Interoperability” - technologies should meet the Health Resources and Services Administration, Office for the Advancement of Telehealth (OAT) recommended guidelines and standards so that developing telehealth networks can interface together; creating a national infrastructure that can share information.^{8, 41}

“Scalability” – the telehealth technology should be capable of migrating into expanded capabilities without total replacement.^{8, 41} Additionally, features and functions should be available as options rather than impacting the base cost of the technology.^{8, 41}

“Accessibility” - the level of access to the vendor's in terms of sales, timely delivery, and equipment maintenance.^{8, 41}

“Reliability” - that the network and equipment will work as intended, that the end user can consistently use the equipment for its intended purpose without operational error, and that the technologies can be reliably serviced with minimum downtime.^{8,41}

Networks

A network is a connection of related items, no matter what is being connected together.⁸ In telehealth, a network using wires, hubs, switches, and routers creates a computer network.⁸ There are two basic types of computer networks.

“Local Area Networks” or “LAN”^{8,35} – A LAN is also known as an Intranet. A LAN connects computers in a building or in an organization together so they are able to communicate with each other and other computer based equipment such as printers, servers, and routers.

“Wide Area Networks” or “WAN”^{8,35} - A WAN, or Internet, connects LANs to other LANs so they can communicate. This network is accomplished using wired or wireless telecommunication connections and a device known as a router.

“Private Networks”⁸ – are designed for the use of a specific organization or company. The networks can use dedicated connections that are always on and ready for use (tends to be more expensive), or they can use dial-up services that connect certain network devices on demand (tends to be less expensive). Telecommunications provider may guarantee such factors as constant bandwidth of the WAN connection and QoS. Guaranteed bandwidth means that the capabilities of the WAN connection will not change. QoS on the other hand allows certain types of data over a network connection to have priority over other types of data in an effort to guarantee a certain level of connection quality.

“Public Networks”⁸ - is a WAN connection which a number of other people share with little or no guarantee of QoS. The telecommunications carrier cannot guarantee the speed and quality of the data transmissions. One person on the connection could possibly interfere with the information someone else may be trying to send or receive since it is all on the same connection.

“Virtual Private Network” or “VPN”^{35,42} - is a network that uses a public telecommunication infrastructure, such as the Internet, to provide remote offices or individual users with secure access to their organization's network. A virtual private network can be contrasted with an expensive system of owned or leased lines that can only be used by one organization. Shared networks are not secure unless the use of encryption software or hardware is used to ensure privacy.

Telecommunication services

Telecommunication services may be supplied via phone service – wired or wireless - or cable service. The costs vary greatly from service to service, from state to state, and between phone companies.⁴¹ Listed below are the most common types of telecommunications services utilized in telehealth.

Media

The physical material used to link computers together is called the media.⁴³ The most common forms of media are telephone lines, twisted-pair cable, coaxial (coax) cable, and fiber-optic cable.⁴³ Others include infrared light, radio waves, and additional wireless communication equipment.⁴³

“Telephone Lines”^{43, 44} - Telephone lines, although not designed for computer networking, are the most common method of linking remote computers to computer networks. The advantages of telephone lines are that they are widely available, no special network cables need be installed, range is unlimited, and (unless one is dialing long distance) they are inexpensive to use. The disadvantage of telephone lines is that they transfer data very slowly. Due to line noise, wire properties, and power constraints, most modem connections are limited to 33 Kbps or less. This slow transfer speed keeps them from being commonly used for computer networks.

“Twisted Pair Cable”^{35, 43, 45} - Twisted-pair cables are used for most [Ethernet LANs](#). Twisted-pair cable can transmit information at varying rates of speed, depending on their type. There are five types, the most commonly used being CAT3 and CAT5. CAT3 can handle speeds up to 10 Mbps and CAT5 can transmit data at speeds of up to 100 Mbps.

“Coaxial Cable”^{35, 43, 46} – Coaxial networking cable is very similar to that used for cable TV connections. Coaxial cable is a high bandwidth carrier with the ability to transmit data, voice, and video.

“Fiber Optics”^{35, 47} – is a high-bandwidth transmission technology that uses light rather than electricity to transmit digital audio, video, and data signals. This system permits high capacity transmission at extreme speeds with very low error rates as optical fiber is immune to electrical interference. Data transfer speeds from 100 Mbps to 2 Gbps are possible. Fiber optic lines are the next generation of carrier and are currently being deployed to replace coaxial cable and wire pair carriers.

“Wireless Media”^{43, 48} - There are a variety of wireless network media, each of which uses a different transmission protocol. Typically, a wireless network uses infrared light or radio transmissions to distribute data.

Wired Services

“Plain Old Telephone Service” or “POTS” - is analog service used for most home telephone connections and dial-up Internet connections.^{8, 35, 41} Although POTS lines are provisioned for 64 Kbps of bandwidth, connections are rarely above 33 Kbps and in most cases never above 45 Kbps.^{8, 41} POTS lines utilize twisted-pair cable. A POTS connection can work for store and forward telehealth and it can support POTS based video connections to reach areas where broadband is not available.⁸

“Digital Subscriber Line” or “DSL”^{8, 35, 43, 49} – uses existing phone lines and is a type of broadband connection with a constant connection. It can provide up to 1.5 Mbs of bandwidth,

but speeds are dependent on distance. DSL lines utilize twisted-pair cable. However, the speed and availability of DSL is limited by the customer's distance from the local telephone switch.

“Integrated Services Digital Network” or “ISDN”^{8, 35, 41, 43} – is a common dial-up transmission path for videoconferencing that uses existing phone networks.^{8, 41} There are two kinds BRI and PRI. BRI is an ISDN interface that provides 128 Kbps of bandwidth, while PRI is an ISDN interface standard that operates using 23, 64 Kbps channels and one 64 Kbps data channel.^{8, 34, 41} BRI lines utilize twisted-pair cable. PRI lines utilize twisted-pair or coaxial cable. ISDN services are generally switchable (e.g. can be dialed like a phone and used on demand).^{8, 41} Thus, they are not dedicated.⁴¹ Per minute charges accumulate at some contracted rate and then are billed to the site placing the call.⁸ A device known as a “inverse multiplexor” can combine multiple ISDN inputs into aggregate signal of 384 Kbps that is needed for videoconferencing.^{8, 41}

“T-1” – is a digital carrier capable of transmitting 1.544 Mbps of electronic information.^{8, 34, 35, 41} T-1 is the general term for a digital carrier available for high-value voice, data, or compressed video traffic.⁸ T1 services can be provisioned to use various communication protocols (e.g., Frame Relay, ATM, etc.).⁸ Telehealth users typically purchase T-1 as a leased phone line that is dedicated from point to point.⁴¹ T-1 lines utilize twisted-pair or coaxial cable.

“T-3” – is a digital carrier which multiplexes multiple T-1 lines.^{10, 35} A T3 line is comprised of 28 T1 lines. This coupling allows for transmission speeds of electronic information up to 45 Mbps.^{10, 34} T-3 lines utilize optical fiber cable.

Wireless Services

“Cellular Phone Service”^{35, 50} - Cellular telephone is wireless voice and data communications that uses short-wave analog or digital cellular radio transmission. The subscriber has a wireless connection from a mobile telephone to a nearby transmitter. The transmitter's span of coverage is called a cell. As a user moves around, the user's phone signal is picked up by the nearest antenna and then forwarded to a base station that connects to the wired network. It requires cell transmitters for coverage; otherwise there will be blind or dead spots.

“Wi-Fi” sometimes known as “wireless fidelity”⁵¹ – is a wireless protocol where wireless users can connect to the wired network via local wireless access points or hotspots. Wi-Fi uses radio waves (rather than telephone cable) to connect to the Internet. Unlike cellular phone service, Wi-Fi offerings can connect to only one access point at a time. Once the customer is out of range of a “hotspot”, the connection will drop, and the customer will need to re-connect to the Internet via another hotspot. A disadvantage of Wi-Fi is that the network connections are not secure, thus, encryption and privacy are issues.

“Satellite”^{52, 53} - Satellite telecommunication is one particular example of a wireless communication system. Satellite telecommunication as a whole has distinct advantages and disadvantages compared to terrestrial data connections. Satellite telecommunication can extend service into areas of sparse population, harsh climatic conditions and rugged terrain where it is uneconomic or impractical to extend the terrestrial network. Moreover, satellite telecommunication is able to deliver data to any number of end points for the same cost — the multicasting model (vs. point to point) and it is also insensitive to time, distance and location.

Satellite telecommunication systems utilize human-made satellites, which are highly specialized wireless receiver/transmitters that act as radio wave relay stations and require the following earth-based equipment: the antenna (often a dish which will vary in size to match the particular service for which they are designed) and the associated equipment (receiver/decoder, transmitter which usually are packaged as part of the modem). The dish/antenna can be fixed with coordinates set to one position (e.g. fixed to the side of a building); fixed with coordinates that need to be set for each new location and position (e.g. fixed to a mobile van – utilizing an auto-acquire feature); or portable with coordinates that need to be set for each new location and position (e.g. a briefcase style dish).

The most common telecommunication satellites are in a geostationary orbit. In this orbit, satellites do not appear to move in relation to the earth. Thus, an earth-based dish/antenna only needs to acquire the satellite once to have continuous communication. In orbits closer to the earth (medium-earth orbit or low-earth orbit) the satellite appears to travel around the earth, thus creating the need for the earth-based dish/antenna to track the satellite or satellites.

A satellite telecommunications system with satellite return works in the following basic manner: the earth-based satellite dish/antenna acquires a satellite; it uses the Indoor Transmit Unit (ITU) to send data up to the satellite; and the satellite in turn sends the data to a terrestrial-based Network Operations Center (NOC). The NOC forwards the request to the Internet, where the data is routed to its final destination. Data returning from the Internet is routed to the NOC, where it is sent up to the satellite. The satellite relays the data to the specified satellite dish/antenna where, the satellite telecommunications system's Indoor Receive Unit (IRU) receives and decodes the high-speed data, then presents the data to the user.

Bandwidth, latency, security, and the ability to acquire a satellite are the main problems associated with satellite telecommunication service. Depending on service plan, bandwidth can run up to a maximum of 1.0 Mbps upload and 2.5 Mbps download. The issue with bandwidth is whether 384 Mbps (the bandwidth needed for diagnostic quality videoconferencing) can be guaranteed. Small transmission delays do occur, but these are normally in the millisecond time frame, thus, not an issue in teledentistry. While security of data transmitted via radio waves can be a problem, most systems come with encryption to overcome this issue. Trees, tall buildings, and rain can affect service by blocking the dish/antenna's sightline to the satellite. However, newer systems, like the Broadband Global Area Network (BGAN) system, eliminate most weather related transmission issues.

HughesNet is the main provider of satellite telecommunication service in North America.⁵⁴

Technical Standards

“DICOM” or “Digital Imaging and Communication in Medicine”^{34, 35, 55, 56} – is the industry standard for communications transfers of digital images and other medical information between computers. The DICOM Standards Committee exists to create and maintain international standards for communication of biomedical diagnostic and therapeutic information in disciplines that use digital images and associated data. The goals of DICOM are to achieve compatibility and to improve workflow efficiency between imaging systems and other information systems in

healthcare environments worldwide. DICOM standards can be accessed at: <http://medical.nema.org/>.

To help insure that different manufactures CODEC equipment can work together, there are a set of videoconferencing standards in place.⁸ The most common standards for videoconferencing are the International Telecommunication Union Telecommunication Standardization Sector (ITU-T) standards - H.323 and H.320.⁸ The H.323 standard is used for videoconferencing on IP networks and H.320 is the standard used for ISDN networks.⁸ These standards are further broken down into protocol standards for data transport over networks; video protocols; audio protocols; far end camera control; and file transfer.⁸ It is important to know what standard protocols the network videoconferencing equipment uses so that people outside of an organization's network can communicate with that network.⁸ Some examples of standard protocols that video conferencing equipment can use are: Video: H.261, H.263, H.264; Audio: G.711, G.722; Camera control: H.281; and Data transfer: T.120.⁸

Network Equipment

“CODEC”^{34, 35} – is an acronym for coder-decoder. This is a videoconferencing device that converts analog video and audio signals to digital video and audio code and vice versa. CODECs typically compress the digital code to conserve bandwidth on a telecommunications path. CODECs usually come with software that will encrypt data transmissions.

“Router”^{34, 35} – is a network device that routes network data transmissions between a transmitter (sender) and a receiver. Routers are typically software-controlled and can be programmed to provide the least expensive, fastest or least busy of available routes.

“Switch”^{34, 35} - is an electrical device that selects the path of a video transmission. Switches are used to control network traffic by directing traffic on specific ports to specific destinations.

Room Design⁸

When choosing a room for videoconferencing the following characteristics are important in order to allow the participants to be well seen and heard. The ideal telehealth room should be a quiet room. The walls should be solid blue or gray in color and have some sort of cloth, padding or sound panels on them to absorb some sound. Fluorescent lighting should be in the room with the bulbs being 3200 to 4700 Kelvin degrees in temperature. Lighting should cover the top and front of conference participants and should be adequate for the room's size. Windows, if any, should be covered with room darkening cloth curtains. Any tables in the room should be dark in color, non-glass top, and cloth covered if possible. For a more detailed account and an explanation of these room design characteristics see Chapter 13, Telehealth Technology, section V, Room Evaluation in the Office for the Advancement of Telehealth's *Telemedicine Technical Assistance Documents: A Guide to Getting Started in Telemedicine*.

Funding/Subsidy Programs

There are a number of Federal government and foundation resources available for telehealth funding. A good starting point for information on telehealth grants and funding are: the

Telemedicine Information Exchange (TIE) (<http://tie.telemed.org/>); the Office for the Advancement of Telehealth (OAT) (<http://telehealth.hrsa.gov/>) of the U.S. Department of Health and Human Services, Health Resources and Services Administration (HRSA), HIV/AIDS Bureau (HAB); the American Telehealth Association (ATA) (<http://www.atmeda.org/>); and the Foundation Center (<http://fdncenter.org>).⁵⁷ The following organizations and programs are a sampling of telehealth funding sources that may be applicable to a teledentistry project.

United States Department of Agriculture (USDA) Rural Development

USDA Rural Development administers a number of rural utilities programs to enhance telecommunications services in rural areas through the Rural Utilities Service (RUS).

Distance Learning and Telemedicine (DLT) Program⁵⁸ is charged with bringing electronic educational resources to rural schools and improving health care delivery in rural America. It is specifically designed to meet the educational and health care needs of rural America through the use of advanced telecommunications technologies. The DLT program administers \$20 million in grants with minimum grants of \$50,000 and maximum grants of \$500,000.

Rural Development Broadband Loan and Loan Guarantee Program^{59, 60} provides loans and loan guarantees to fund the cost of construction, improvement, or acquisition of facilities and equipment for the provision of broadband service in eligible rural. The Programs' goal is to ensure that rural consumers enjoy the same quality and range of telecommunications services that are available in urban and suburban communities.

Rural Development Community Connect Grant Program⁶¹ is designed to provide financial assistance in the form of grants to eligible applicants that will provide currently un-served areas, on a "community-oriented connectivity" basis, with broadband transmission service that fosters economic growth and delivers enhanced education, health care, and public safety services. This all-encompassing connectivity concept will give small, rural communities a chance to benefit from the advanced technologies that are necessary to foster economic growth, provide quality education and health care opportunities, and increase and enhance public safety efforts.

The Universal Service Administration (USAC)⁶²

Rural Health Care Program Universal Service Fund⁶³ is a support program authorized by Congress and designed by the Federal Communications Commission (FCC) to provide reduced rates to rural health care providers (HCPs) for telecommunications services and Internet access charges related to the use of telemedicine & tele-health. Support is available for telecommunications services and monthly Internet access charges (only the monthly ISP charge is eligible for support) used for the provision of health care. However, equipment charges are not eligible for support.

Health Resources and Services Administration (HRSA), Office for the Advancement of Telehealth (OAT)⁵⁷

Telehealth Network Grant Program (TNGP)^{57, 64} helps communities build the human, technical, and financial capacity to develop sustainable telehealth programs and networks. Grants may be

used to develop telehealth network projects in rural areas, in medically underserved areas, in frontier communities, and for medically underserved populations, to (a) expand access to, coordinate, and improve the quality of health care services; (b) improve and expand the training of health care providers; and (c) expand and improve the quality of health information available to health care providers, and patients and their families. Awards will be made for up to three years.

National Telecommunications and Information Administration (NTIA)⁶⁵

The Technology Opportunities Program (TOP)⁶⁶ supported demonstrations of new telecommunications and information technologies to provide education, health care, or public information in the public and non-profit sectors. However, as of 2004, matching grant funds are no longer available under TOP.

Teledental Equipment

Teledentistry sites require some or all of the following basic equipment. The exact equipment required will depend on the nature of the site being outfitted. Hub sites will be different from remote sites – hub sites will only require videoconferencing equipment, whereas remote sites will require digital dental diagnostic equipment along with videoconferencing equipment. Moreover, mobile sites may require different transmission equipment than fixed sites (e.g. satellite dishes and modems). The equipment listed does not include telecommunication service equipment (e.g. routers, switches, T-1 lines, etc.). The nature of the telecommunication equipment will depend on the type of telecommunication service utilized by each site. Further, the teledental equipment does not include the equipment or supplies needed to outfit a traditional dental unit with traditional dental (which will be necessary in the remote sites). One other note, there are a variety of manufacturers and models. Thus, there are a variety of choices for each individual piece of equipment.

Videoconferencing System⁸

The videoconferencing system should include: a CODEC unit with a pan tilt video camera, monitor (preferably one that can split screen or comes as two monitor units), mobile cart with shelf for laptop computer or keyboard, back-up battery, input and output connections, and have the ability to encrypt and unencrypt data. Tandberg and Polycom are the leaders in this industry.

Extraoral Digital Camera⁶⁷⁻⁷²

Extraoral cameras are good for face, smile, arch, and anterior teeth images. There are 3 types of digital cameras: point and shoot, professional, and modified point and shoots. Point and shoot are typically off-the-shelf and can take good portrait photo images, but have limited close-up and intraoral capabilities. Professional level SLR cameras are top of the line single lens reflex camera bodies that allow for the addition of an assortment of lens and flash attachments. While these can take the most accurate images, they are the most difficult to manage. Modified point and shoots are off-the-shelf cameras that have been modified for dentistry. These cameras have added hardware (e.g. macro lens and flashes) to improve the macro capability of the camera and the ability of the flash to disperse or expose correctly under macro conditions.

Extraoral cameras should be able to capture color and have sufficient image resolution capacity. Extraoral cameras should include: at least 4 megapixel resolution, be capable of faster shutter speeds, have through the lens viewing (SLR) or an LCD monitor (for direct viewing for accurate, repeatable framing alignment), manual focus macro lens (at least 3x optical zoom), dual point lighting (e.g. ring flash or flash diffuser to distribute light evenly – standard flashes create washout), glass lens rather than plastic, manual focus and f-stop (aperture-size) settings (for consistent, repeatable results), a video-out port to download to a monitor and/or a USB hub to download to a computer, and selectable compression/resolution levels for final imaging. Moreover, the camera system should include mirrors and retractors (an occlusal mirror, a buccal No. 1 mirror, and universal retractors), and computer dental software that supports viewing the images, storing the images, and editing the images.

Intraoral Wand Digital Camera^{71, 73}

Intraoral wand cameras are good for diagnostic purposes because of the high intensity light they utilize and the magnification they can produce. They are good for individual teeth, for hard to reach areas and where light is difficult (posterior areas), and are excellent for locating early white spot lesions. Intraoral wand cameras can take still images or video. Intraoral wand cameras should be lightweight (to reduce operator fatigue), have focus-free optics, integrate seamlessly with other dental digital software packages, utilize LED lighting (rather than fragile fiber-optic or fan cooled lighting sources), and they should come with USB or firewire interfaces (for direct connectivity to a computer)

Digital Radiographic Equipment⁷¹

There are 3 ways to obtain digitized radiographs: 1) converting traditional film radiographs to digital (digitized) images via a scanner – the digitized images are then transferred to and viewed on a computer; 2) using phosphor plate technology – a radiograph is taken using a phosphor plate (instead of film) to store the image, the plate is then scanned by a laser to produce an image which can be viewed on a computer; and 3) using sensor or direct digital technology – radiographs are taken using digital sensors – the image is immediately shown on a computer screen. The scanner and phosphor plate technologies are slower, but less expensive. The sensor technology is real time.

Laser Caries Detection Device (KaVo DIAGNOdent)^{74, 75}

The DIAGNOdent uses laser technology to detect and quantify hidden or sub-surface caries by measuring laser fluorescence within the tooth structure. The DIAGNOdent is designed to be an adjunct to the traditional oral examination in the detection of occlusal decay. However, the DIAGNOdent is limited in that it will only detect caries in pit and fissure lesions - it will not detect interproximal decay or decay around or under existing restorations. Moreover, while the DIAGNOdent has high sensitivity (% correctly diagnoses cariously involved sites), it does not have as high a specificity (% correctly diagnoses healthy sites). This results in too many false positives and the restoration of healthy teeth.

Computer⁷¹

Every teledentistry site, whether a remote or hub site, must be equipped with a computer. The computer can be either a laptop or desktop computer. No matter the type or brand of computer it must have the following minimum requirements: CPU Speed: 2.8 GHz Pentium 4; Operating System: Windows 2000 Service Pack 4 or Windows XP Service Pack 1 w/Microsoft knowledge base KB822603 update; System RAM: 1 KB; Hard Drive: 80 GB; CD-ROM Drive: 48x; Video Display Adapter: 64 MB RAM; and USB Port: Must be USB 2.0.

Regulations

***State Dental Practice Act, Statutes, and Rules*^{2,3}**

The Department of Health envisions using teledentistry for two distinct purposes: 1) to provide isolated populations with examination, consultation, and referral services for both basic and specialized oral healthcare; and 2) to fulfill the general supervision requirement of the Florida Statutes (Section 466.023 (2) (b) Dental hygienists; scope of practice and Section 466.003 (10) Definitions – “General Supervision”)² and the Florida Administrative Code (F.A.C.) (Rule 64B5-16.001 (6)) so that a remote-based dental hygienist may position and expose dental x-ray film or sensors; apply American Dental Association or Food and Drug Association approved topical fluorides (which would include fluoride varnishes); use appropriate instruments to pre-assess and chart suspected findings of the oral cavity; take or record patient’s blood pressure rate, pulse rate, respiratory rate, case history, and oral temperature; perform prophylactic cleanings; provide oral hygiene instruction; and provide oral health education without a dentist needing to be physically present. The Florida Statutes (F.S.) and the F.A.C. do not directly address teledentistry. However, both the statutes and rules read together may support the Department of Health’s need for teledentistry, but in a limited fashion.

Teledental Exam

Section 466.024 (3) F.S. requires that “[a]ll remedial tasks shall be performed under the direct, indirect, or general supervision, of a dentist, as determined by rule of the board . . .” Rule 64B5-16.001 (6), F.A.C. states that “[g]eneral supervision requires that a licensed dentist examine the patient, diagnose a condition to be treated, authorize the procedure to be performed. Whether a dentist may utilize teledentistry to examine a patient, diagnose a condition to be treated, and authorize procedures that a dental hygienist may perform and thus, satisfy the general supervision requirement is not addressed in either the Florida Statutes or F.A.C.

Supervision

Section 466.003 (10) F.S. defines “general supervision” as “supervision whereby a dentist authorizes the procedures which are being carried out but need not be present when the authorized procedures are being performed. The authorized procedures may also be performed at a place other than the dentist’s usual place of practice. . . .” Rule 64B5-16.001 (6), F.A.C., which also defines “general supervision”, is silent as to whether a dentist must be present or not. In contrast, Rules 64B5-16.001 (4 & 5), F.A.C. which define “direct supervision” and indirect supervision”, respectively, both have language requiring the dentist “be on the premises” while the delegated remedial tasks are being performed by a dental hygienist.

Section 466.023 (1) F.S. states that “[a] dentist may only delegate remedial tasks [to be performed by a dental hygienist] so defined by law or rule of the board.” Section 466.023 (1) F.S. and section 466.024 F.S. and Rules 64B5-16.006 (3) (c) & (h) & 4 (c) and 64B5-16.007 (3 & 4) F.A.C. describe which tasks are remedial and delegable and determine which tasks shall be performed under direct, indirect, or general supervision of a dentist. Accordingly, dental hygienists may under general supervision apply American Dental Association or Food and Drug Association approved topical fluorides (which would include fluoride varnishes); use appropriate instruments to preassess and chart suspected findings of the oral cavity; take or record patient’s blood pressure rate, pulse rate, respiratory rate, case history, and oral temperature; perform prophylactic cleanings; position and expose dental x-ray film or sensors; and provide oral hygiene instruction; and provide oral health education without supervision.

However, Rule 64B5-16.006 (2) (h) F.A.C. states that the following remedial tasks – “[a]pplying sealants” - may be performed by a dental hygienist only under indirect supervision. Indirect supervision requires that the dentist be on the premises. See, section 466.003 (9) F.S. and Rule 64B5-16.001 (5) F.A.C. This is in contrast to section 466.023 (2) (b) F.S. which allows dental hygienists to perform their duties “in public health programs and institutions of the Department of Children and Family Services, Department of Health, and Department of Juvenile Justice *under the general supervision* of a licensed dentist.” (emphasis added). Whether this means a dental hygienist may apply sealants under general supervision in a DOH facility as the teledentistry project desires is unclear.

Privacy and Security^{8, 76}

In 1996, Congress passed the Health Insurance Portability and Accountability Act (HIPAA, Public Law 104-191). HIPAA gives guidance on most privacy and security issues in health care. HIPAA seeks to streamline electronic medical record systems while protecting patients, improving health care efficiency, and reducing fraud and abuse. HIPAA’s privacy rule deems that any “individually identifiable health information” in any form or medium is to be “protected health information”. This information includes, but is not limited to: name and address; date of birth; social security number; payment history; account number; and name and address of the health care provider and/or health plan. HIPAA’s privacy rule applies to health plans, health care clearinghouses, and health care providers that transmit “protected health information” in any form or medium, including electronic, paper, and oral.

Telehealth encounters and consultations by their nature are transmissions of health information. Protected health information can potentially be sent anywhere in the world in a matter of seconds. HIPAA requires that health care providers protect this individually identifiable health information. Thus, telehealth systems should have security measures such as encryption and dedicated lines where possible designed into the system. Moreover, HIPAA requires that health care providers obtain consent prior to using or disclosing protected health information to carry out treatment, payment or other health care operations. Thus, before a teledental encounter or consultation takes place, the patient must be made aware of and give his or her consent to the fact that teledentistry involves the electronic transmission of his or her protected health information.

Reimbursement^{8, 77-80}

The ability of providers to bill and collect fees for health care services provided via telehealth is a large issue for sustaining a telehealth program. Reimbursement for telehealth services is limited. Reimbursement for teledental services is almost non-existent. The primary health care insurers, Medicare, Medicaid, and private insurance each have different positions regarding reimbursement for telehealth services.

The Center for Medicare and Medicaid Services (CMS) administers the Medicare and Medicaid programs in the United States. CMS recognizes telemedicine not as a discrete medical procedure, but rather as a method for delivering care. As such, the Medicare program, permits reimbursement for telehealth in rural health professional shortage areas (HPSAs) in three areas: remote patient face-to-face services seen via live video conferencing; non face-to-face services that can be conducted either through live video conferencing or via store and forward telecommunication services; and for home telehealth services. Medicare, however, has very limited dental coverage and thus, does not reimburse for teledental services.

Conversely, the Medicaid program, which covers dental services for qualified children, pregnant mothers and some adults, allows each state to determine whether they will reimburse for telehealth and thus, teledental services. Therefore, Medicaid reimbursement for telehealth services varies from state to state. In 2003, 34 states had some reimbursement for telehealth services. Florida's Medicaid program does not reimburse for telehealth or teledental services.

Medicaid reimbursement for teledental services can be accomplished in one of a number of ways. State mandates, where either State legislatures or state regulatory agencies, such as the Florida's Office of Insurance Regulation, can enact rules or statutes that mandate reimbursement of teledental services. Or negotiations with the state agency responsible for Medicaid programs, such as Florida's Agency for Health Care Administration, to persuade the Medicaid program to reimburse for teledental services. One approach here can be to obtain a program waiver or propose a short term pilot program.

Like Medicaid, reimbursement through private commercial insurers varies from state to state and even region to region within individual states. As of 2003, private insurance reimbursement for teledental services was also limited. Only 29 states had some private insurers who would reimburse for telehealth procedures. Five states, Louisiana, California, Oklahoma, Texas, and Kentucky, have passed legislation mandating private payer reimbursement of telemedicine services. Florida is one of the 21 states that have no private insurers who covered telehealth services.

Liability⁸

Liability or medical malpractice exposure will attach to any health care practitioner who actively participates in the treatment of a patient. Liability will attach irregardless of whether the health care practitioner participates in person or via an interactive telehealth link or via store and forward technology and irregardless of whether his or her participation is regarded as a direct patient encounter or a consultation. Any provider should inquire as to whether his or her existing malpractice policy, covers procedures performed utilizing telehealth technology. However, for

this DOH teledentistry pilot program, health care practitioners are probably protected against liability under the State's sovereign immunity policy.

Storage of Medical Records

Health care practitioners in the electronic era must consider a variety of legal, ethical and clinical issues in deciding how to keep their medical records. Since teledentistry involves the electronic transmission of health care data, issues regarding whether to record and store this data are relevant. The prevailing thought is that any data that is recorded must be made part of the patient's permanent record. Thus, still photos, digital radiographs, and paper or electronic medical histories must be saved and stored. However, any data that is not recorded, such as live interactive videoconferencing transmissions, need not be recorded or stored.

Conclusion

Teledentistry is not a separate dental specialty. Teledentistry does not create new oral health care services. It simply provides an alternative method to deliver existing services. Currently, teledental technologies have not yet become an integral part of mainstream oral health care. The reasons are many including: reimbursement; regulatory and legal sanction; privacy and security; compatibility and interoperability of technology across systems; sustainability; and acceptance of teledentistry by patients and providers alike. Yet despite these barriers, the technology currently exists to provide teledental specialty consultation and referral services, distance learning educational services, and limited teledental clinical preventative services. It is not far fetched to imagine that in the near future teledentistry will be just another way to access an oral health care provider. This is especially encouraging for isolated populations who may have difficulty accessing the oral health care system due to distance, ability to travel, or lack of oral health care providers in their area.

1. U.S. Department of Health and Human Services. *Oral Health in America: A Report of the Surgeon General*: U.S. Department of Health and Human Services, National Institutes of Health, National Institute of Dental and Craniofacial Research; 2000.
2. Florida Statutes; Title XXXII Regulation of Professions and Occupations; Chapter 466 Dentistry, Dental Hygiene, and Dental Laboratories; 2005.
3. Florida Administrative Code; Chapter 64B-16 Remedial Tasks Delegable to Dental Hygienists and Dental Assistants. *64B5-16*; 2000.
4. Institute of Medicine. *Telemedicine: A Guide to Assessing Telecommunications in Health Care*. Washington, DC: National Academy Press; 1996.
5. U.S. Department of Health and Human Services. *Telemedicine Report to Congress*: U.S. Department of Health and Human Services; 2001.
6. Brown N. Telemedicine Coming of Age. *Telemedicine Research Center; Telemedicine Information Exchange*. January 13, 2005. Available at: http://tie.telemed.org/articles/article.asp?path=articles&article=tmcoming_nb_tie96.xml. Accessed March 27, 2006.
7. Rocca MA, Kudryk VL, C. PJ, Tommy. M. The Evolution of a Teledentistry System Within the Department of Defense. *American Medical Informatics Association*. Available at: <http://www.amia.org/pubs/symposia/D005388.PDF#search='total%20dental%20access'>. Accessed March 27, 2006.

8. Office for the Advancement of Telehealth. *Telemedicine Technical Assistance Documents: A Guide to Getting Started in Telemedicine*. Rockville, MD: Office for the Advancement of Telehealth, Health Resources and Services Administration, U.S. Department of Health and Human Services; March 27, 2006 2004.
9. U.S. Department of Commerce. *Telemedicine Report to Congress*: U.S. Department of Commerce; 1997.
10. Wachter GW. Telecommunication, Linking Providers and Patients. *Telemedicine Research Center, Telemedicine Information Exchange*. February 23, 2006. Available at: http://tie.telemed.org/articles/article.asp?path=telemed101&article=telecomLinking_gw_tie00.xml. Accessed March 27, 2006.
11. Brown N. A Brief History of Telemedicine. *Telemedicine Research Center, Telemedicine Information Exchange*. Available at: http://tie.telemed.org/articles/article.asp?path=articles&article=tmhistory_nb_tie95.xml. Accessed March 28, 2006.
12. Welsh TS. Telemedicine. *University of Tennessee Medical Center Telemedicine Network*. Available at: <http://ocean.st.usm.edu/~w146169/teleweb/telemed.htm>. Accessed March 28, 2006.
13. Wachter GW. Needs Assessment: A Key to Building Better Telemedicine Programs. *Telemedicine Research Center, Telemedicine Information Exchange*. Available at: http://tie.telemed.org/articles/article.asp?path=articles&article=needsAssess_gw_tie00.xml. Accessed March 20, 2006.
14. American Telemedicine Association. Overview of Telemedicine. *American Telemedicine Association*. Available at: <http://www.americantelemed.org/news/overview.htm>. Accessed March 22, 2006.
15. American Telemedicine Association. Defining Telemedicine. *American Telemedicine Association*. Available at: <http://www.americantelemed.org/news/definition.html>. Accessed March 29, 2006.
16. Regulation of Professions and Occupations; Dentistry, Dental Hygiene, and Dental Laboratories. *Title XXXII*; 2005.
17. University of Florida College of Dentistry. UF College of Dentistry - Teledentistry. *University of Florida College of Dentistry*. Available at: <http://www.dental.ufl.edu/Offices/Teledentistry/Default.htm>. Accessed March 27, 2006.
18. Jordan Dental Center. Jordan Dental Center. *Jordan Dental Center*. Available at: <http://www.jordan-dental.com/index.html>. Accessed March 30, 2006.
19. Dental Consults. Dental Consults Teledentistry That Empowers. *Dental Consults*. Available at: <http://www.dental-consults.com/index.html>. Accessed March 30, 2006.
20. Marquette University School of Dentistry. Telehealth Initiatives at Marquette University School of Dentistry. *Marquette University School of Dentistry*. Accessed March 27, 2006.
21. Childrens Hospital Los Angeles. eHealth Program: Teledentistry. *Childrens Hospital Los Angeles*. Available at: <http://www.childrenshospitala.org/body.cfm?id=781>. Accessed March 22, 2006.
22. University of Southern California School of Dentistry. Mobile Clinic to Employ Digital Technology. *USC School of Dentistry Office of Public Relations*. Available at: http://www.usc.edu/hsc/dental/update/january03/community_01.htm. Accessed March 22, 2006.
23. University of Southern California School of Dentistry. Community Health Programs: Mobile Clinic. *University of Southern California School of Dentistry*. Available at: http://www.usc.edu/hsc/dental/community/mobile_clinic.htm. Accessed March 22, 2006.

24. University of Minnesota School of Dentistry. Teledentistry Project: Increasing Rural Access to Dental Specialists. *University of Minnesota School of Dentistry*. Available at: http://www.dentistry.umn.edu/patients/tx_options/specialty_clinics/Teledentistry.html#whatsteledentistry. Accessed March 27, 2006.
25. University of Rochester Medical Center. Reaching out to underserved children in childcare. *University of Rochester Medical Center*. Available at: <http://www.urmc.rochester.edu/pr/news/story.cfm?id=784>. Accessed March 25, 2006.
26. University of Washington. Videoconferencing: new era for residents and Yakima UW pediatric dentistry connection. *Pediatric Dentistry Alumni News*. Summer 2005;2(3):1-2.
27. University of Washington. What a difference videoconferencing makes: WOW! *Pediatric Dentist Alumni News*. Summer 2005;2(3):8.
28. The University of Tennessee's MidSouth Telehealth Consortium. Telehealth Projects. *The University of Tennessee's MidSouth Telehealth Consortium*. Available at: <http://webster.utmem.edu/telemedicine/projects.html>. Accessed March 30, 2006.
29. Apple Tree Dental. Clinical Innovations. *Apple Tree Dental*. Available at: <http://www.appletreedental.org/AppleTreeInstitute/InstituteProjects/ClinicalInnovations.aspx>. Accessed May 11, 2006.
30. Minnesota Head Start Association. Working Toward Better Oral Health for Minnesota Head Start Children and Families: A 2005 Progress Report. Duluth, MN: Minnesota Head Start Association, Inc.; 2005.
31. U.S. Department of Health and Human Services Indian Health Service. Division of Oral Health. *Indian Health Service*. Available at: <http://www.ihs.gov/MedicalPrograms/Dental/index.cfm>. Accessed May 16, 2006.
32. SearchTechTarget.com. Broadband. *TechTarget*. Available at: http://searchnetworking.techtarget.com/sDefinition/0,,sid7_gci211706,00.html. Accessed March 27, 2006.
33. Indiana University UITS. Knowledge Base: Glossary. *The Trustees of Indiana University*. Available at: <http://kb.iu.edu/data/glos.html#B>. Accessed April 3, 2006.
34. American Telemedicine Association. Telemedicine/Telehealth Terminology. *American Telemedicine Association*. Available at: <http://www.americantelemed.org/ICOT/Terminology.pdf>. Accessed March 31, 2006.
35. Gartner Inc. The Gartner Glossary of Information Technology Acronyms and Terms. *Gartner, Inc.* Available at: http://www.gartner.com/6_help/glossary/Gartner_IT_Glossary.pdf. Accessed April 3, 2006.
36. SearchTechTarget.com. Bandwidth. *TechTarget*. Available at: http://searchnetworking.techtarget.com/sDefinition/0,,sid7_gci211634,00.html. Accessed March 27, 2006.
37. Wi-Fi Planet. Latency. *JupiterMedia Corporation*. Available at: <http://wi-fiplanet.webopedia.com/TERM/L/latency.html>. Accessed May 10, 2006.
38. Wikipedia contributors. Quality of service. *Wikipedia, the Free Encyclopedia*. Available at: http://en.wikipedia.org/wiki/Quality_of_service. Accessed May 9, 2006.
39. Wi-Fi Planet. Quality of Service. *JupiterMedia Corporation*. Available at: <http://wi-fiplanet.webopedia.com/TERM/T/throughput.html>. Accessed May 10, 2006.
40. SearchTechTarget.com. Videoconference. *TechTarget*. Available at: http://searchmobilecomputing.techtarget.com/sDefinition/0,,sid40_gci213291,00.html. Accessed April 3, 2006.

41. Office for the Advancement of Telehealth. Telehealth Technology Guidelines. *Health Resources and Services Administration*. Available at: <http://telehealth.hrsa.gov/pubs/tech/techhome.htm>. Accessed March 27, 2006.
42. SearchTechTarget.com. Virtual Private Network. *TechTarget*. Available at: http://searchnetworking.techtarget.com/sDefinition/0,,sid7_gci213324,00.html. Accessed May 10, 2006.
43. Indiana University UITS. What are some common networking terms? *The Trustees of Indiana University*. Available at: <http://kb.iu.edu/data/ahpn.html>. Accessed April 3, 2006.
44. Wikipedia contributors. Telephone line. *Wikipedia, The Free Encyclopedia*. Available at: http://en.wikipedia.org/wiki/Telephone_line. Accessed May 10, 2006.
45. Wikipedia contributors. Twisted pair. *Wikipedia, The Free Encyclopedia*. Available at: http://en.wikipedia.org/wiki/Twisted_pair. Accessed May 10, 2006.
46. Wikipedia contributors. Coaxial cable. *Wikipedia, The Free Encyclopedia*. Available at: http://en.wikipedia.org/wiki/Coaxial_cable. Accessed May 10, 2006.
47. Wikipedia contributors. Optical fiber. *Wikipedia, The Free Encyclopedia*. Available at: http://en.wikipedia.org/wiki/Fiber_optic. Accessed May 10, 2006.
48. Wikipedia contributors. Wireless. *Wikipedia, The Free Encyclopedia*. Available at: <http://en.wikipedia.org/wiki/Wireless>. Accessed May 10, 2006.
49. Wikipedia contributors. Digital Subscriber Line. *Wikipedia, The Free Encyclopedia*. Available at: http://en.wikipedia.org/wiki/Digital_Subscriber_Line. Accessed May 10, 2006.
50. Wikipedia contributors. Mobile phone. *Wikipedia, The Free Encyclopedia*. Available at: http://en.wikipedia.org/wiki/Cellular_phone. Accessed May 10, 2006.
51. Friedman E. Wi-Fi: What It Is and What It Isn't. *Telehealth Practice Report*. May/June 2003;8(2):4-5, 10.
52. Committee for Information Computer and Communications Policy. *Satellite Communication: Structural Change and Competition*. Paris: Organisation for Economic Co-operation and Development; September 11, 1995.
53. Vanbuel M. *Satellite Technology and Education: The Joint Information Systems Committee*; 2001.
54. Hughes Network Systems LLC. HughesNet Home. *Hughes Network Systems LLC*. Available at: [http://www.hughesnet.com/HUGHES/Rooms/DisplayPages/LayoutInitial?pageid=HughesNet_home&Container=com.webridge.entity.Entity\[OID\[871FBF90DAB30B4792CDE6AF6D3E6B0E\]\]](http://www.hughesnet.com/HUGHES/Rooms/DisplayPages/LayoutInitial?pageid=HughesNet_home&Container=com.webridge.entity.Entity[OID[871FBF90DAB30B4792CDE6AF6D3E6B0E]]). Accessed April 15, 2006.
55. American Telemedicine Association. Telemedicine Guidelines and Technical Standards Affecting Telemedicine Transmissions. *American Telemedicine Association*,. Available at: <http://www.atmeda.org/news/standards.htm>. Accessed March 22, 2006.
56. DICOM. Strategic Document. *National Electrical Manufacturers Association (NEMA)*. Available at: <http://medical.nema.org/dicom/geninfo/Strategy.pdf>. Accessed May 10, 2006.
57. U.S. Department of Health and Human Services Health Resources and Services Administration (HRSA) HIV/AIDS Bureau (HAB) Office for the Advancement of Telehealth (OAT). Telehealth Funding Guide. *Office for the Advancement of Telehealth*. Available at: <http://telehealth.hrsa.gov/grants/funds.htm#rus>. Accessed May 22, 2006.
58. U.S. Department of Agriculture (USDA) Rural Development Telecommunications Program. Distance Learning and Telemedicine Program. *United States Department of Agriculture (USDA)*. Available at: <http://www.usda.gov/rus/telecom/dlt/dlt.htm>. Accessed May 13, 2006.

59. U.S. Department of Agriculture (USDA) Rural Development Telecommunications Program. Rural Development Broadband Loan and Loan Guarantee Program. *U.S. Department of Agriculture (USDA)*. Available at: <http://www.usda.gov/rus/telecom/broadband.htm>. Accessed May 13, 2006.
60. U.S. Department of Agriculture (USDA) Rural Development Utilities Programs. Rural Broadband Access Loan and Loan Guarantee Program Application Guide. *United States Department of Agriculture*. Available at: <http://www.usda.gov/rus/telecom/broadband/guide-9-15-2005/broadband-application-guide-9-16-2005.pdf>. Accessed May 22, 2006.
61. U.S. Department of Agriculture (USDA) Rural Development Telecommunications Program. Rural Development Community Connect Grant Program. *U.S. Department of Agriculture (USDA)*. Available at: <http://www.usda.gov/rus/telecom/commconnect.htm>. Accessed May 22, 2006.
62. Universal Services Administrative Company. Rural Health Care. *Universal Services Administrative Company*. Available at: <http://www.universalservice.org/rhc/>. Accessed May 22, 2006.
63. Universal Services Administrative Company. Overview of the Rural Health Care Program. *Universal Services Administrative Company*. Available at: <http://www.universalservice.org/rhc/about/program-overview.aspx>. Accessed May 22, 2006.
64. U.S. Department of Health and Human Services Health Resources and Services Administration (HRSA) HIV/AIDS Bureau (HAB) Office for the Advancement of Telehealth (OAT). Grants. *Office for the Advancement of Telehealth*. Available at: <http://telehealth.hrsa.gov/grants.htm>. Accessed May 23, 2006.
65. U.S. Department of Commerce National Telecommunications and Information Administration. Office of Telecommunications and Information Applications. *National Telecommunications and Information Administration*. Available at: <http://www.ntia.doc.gov/otiahome/otiahome.html>. Accessed May 23, 2006.
66. U.S. Department of Commerce National Telecommunications and Information Administration Office of Telecommunications and Information Applications. Technology Opportunities Program. *National Telecommunications and Information Administration*. Available at: <http://www.ntia.doc.gov/top/>. Accessed March 27, 2006.
67. Dental Products Report. Digital Dynamos. *Dental Products Report*. Available at: www.dentalproducts.net/xml/display.asp?file=2793. Accessed April 25, 2006.
68. Digident.com. Digital Photography. *Digident.com*. Available at: <http://www.digident.com/camera.html>. Accessed April 25, 2006.
69. Emmott L. Picture-perfect digital images. *Dental Products Report*. June 2004.
70. Snow SR. Dental Photography: Why Go Digital? *Dental Products Report*. Available at: www.dentalproducts.net/xml/display.asp?file=1046. Accessed April 25, 2006.
71. Steinberg AD. Dental Informatics. *University of Illinois at Chicago*. Available at: <http://www.uic.edu/classes/dadm/dadm396/lect5-04/inform4a.htm>. Accessed April 10, 2006.
72. Retzlaff J. Upgrading Wisely to Digital Photography Can Add Bottom Line Benefits to Your Practice. *Newsmile.com*. Available at: <http://www.newsmile.com/pro/pm/retzlaff1.html>. Accessed April 25, 2006.
73. Patterson Dental. Intraoral and Extraoral Digital Cameras. St. Paul, MN: Patterson Dental; 2006.
74. Alwas-Danowska H, Plasschaert A, Suliborski S, Verdonshot E. Reliability and validity issues of laser fluorescence measurements in occlusal caries diagnosis. *Journal of Dentistry*. 2002;30(4):129-134.

75. KaVo Dental Corporation. KaVo DIAGNOdent/DIAGNOdent pen Laser Caries Detection Aid: Scanning is Believing: Reveal the Hidden . . . Treat with Confidence. *KaVo Dental Corporation*. Available at: http://www.kavousa.com/downloads/prospekte/handpieces_accessories/61_Brochure_diagnodent.pdf?navid=500129&lan=Us&znavid=311000. Accessed May 16, 2006.
76. Wachter GW. HIPAA's Privacy Rule Summarized: What Does It Mean For Telemedicine? *Telemedicine Research Center, Telemedicine Information Exchange*. Available at: http://tie.telemed.org/articles/article.asp?path=articles&article=hipaaSummary_gw_tie01.xml. Accessed March 20, 2006.
77. American Telemedicine Association, AMD Telemedicine. Reimbursement, Telehealth and Telemedicine: The State of Reimbursement in the U.S. *Telemedicine Information Exchange*. Available at: http://tie.telemed.org/legal/state_data.asp?type=reimburse. Accessed May 23, 2006.
78. American Telemedicine Association. Report on Reimbursement. *American Telemedicine Association*. Available at: <http://www.atmeda.org/news/Reiumburement%20White%20paperfinal.pdf>. Accessed May 23, 2006.
79. American Telemedicine Association. Medicare Payment of Telemedicine and Telehealth Services. *American Telemedicine Association*. Available at: <http://www.atmeda.org/news/Medicare%20Payment%20Of%20Services%20Provided%20Via%20Telecommunications.pdf>. Accessed May 23, 2006.
80. Center for Telemedicine Law. Telemedicine Reimbursement Report. *Health Resources and Services Administration, Office for the Advancement of Telehealth*. October. Available at: <ftp://ftp.hrsa.gov/telehealth/licen.pdf>. Accessed May 24, 2006.