

State of Telemedicine in the field of Neonatology

Telemedicine is composed of the Greek word $\tau\epsilon\lambda\epsilon$ (tele) meaning 'far', and medicine. It is therefore the delivery of medicine at a distance (“Telemedicine”, 2007). Telemedicine is the use of modern telecommunication and information technologies for the provision of clinical care to individuals located at a distance and to the transmission of information to provide that care.

Telematics is the use of telecommunications technologies to solve a wide variety of problems, remotely. **Healthcare Telematics** or **Telemedicine** is the application of telematics to medicine to facilitate healthcare delivery (“What is Telemedicine/Healthcare Telematics? “).

Telemedicine can be defined as the investigation, monitoring and management of patients, using systems that allow ready access to expert advice and to patient information, no matter where the patient or relevant information is located. This involves the transfer of medical information from one location to another. Increasingly, computer technology will allow much of the work currently being carried out in hospital, to be carried out in people's homes, in an effort not only to improve the efficiency and standards of patient care, but also to reduce its cost drastically (“What is Telemedicine/Healthcare Telematics? “).

Telemedicine refers to the use of various telecommunications by physicians and medical institutions that provide health care to their patients through electronic or digital means. Telemedicine employs technology that makes it possible for health care providers to care for their patients in the patients' homes or in other remote areas. Telemedicine affords caregivers the ability to collect and transfer medical data, still images, and live audio and video transmissions. Some of the common methods used are ordinary telephone lines, the Internet, and satellites, although any means of transmission can be used (Gunsch, 2007)

Telemedicine is used in a variety of medical fields; for example, cardiology, radiology, psychiatry, and oncology. Diagnoses, treatments that include telesurgery, physician and patient education, and medical administration video conferencing between healthcare providers are all possible with telemedicine.

Telemedicine has a surprisingly long history that began with the advent of the telephone. In 1906, Einthoven first investigated the use of electrocardiogram (EKG) transmission over telephone lines. In the 1920s, ship radios were used to link physicians with sailors to assist during medical emergencies at sea. In 1955, the Nebraska Psychiatric Institute was one of the first facilities to use closed-circuit television for healthcare purposes. In the 1970s, paramedics in remote Alaskan and Canadian villages were able to perform lifesaving techniques while linked with hospitals in distant towns via satellite. Today, telemedicine is beginning to exponentially mature with progressive advances in technology (Gunsch, 2007).

The use of telemedicine is generally considered positive for both patients and the economy. Through remote health monitoring, telemedicine may allow countless numbers of people to avoid nursing homes and hospitals, allowing them to remain productive, stay home longer, and consequently incur less health care costs. The economy also benefits from the diminished need to transport patients to other facilities when a health care specialist is needed.

CURRENT STATE OF THE FIELD OF TELEMEDICINE

Telemedicine holds considerable promise for pediatrics and pediatricians. Virtually any service can be provided via telecommunications technology, but a careful evaluation of telemedicine's potential is hampered by a lack of high-quality studies and cost-benefit analyses, especially in pediatrics.

Certain pediatric services seem well adapted to telemedicine, including the following:

Radiology

Effective teleradiology programs have been in existence for the last 30 years. Over this period, the profession has developed extensive standards for how images should be stored and displayed to ensure accurate representations. Radiology reports are forwarded easily by using secure, low-bandwidth messaging systems. The electronic transmission of images to meet the needs of pediatric care has been well researched and is routine in most medical centers. The implications for providing high-quality pediatric radiology services over broad areas (and concomitant health care workforce redistribution issues) are immense (American Academy of Pediatrics, 2004)

Mental Health

Evidence suggests that patients are highly satisfied with psychiatric counseling delivered via telemedicine, and this is true also for children. Diagnostic accuracy seems to be excellent. Before applying telemedicine applications in mental health, it is important to consider the setting, staff capabilities, and access to information sharing (American Academy of Pediatrics, 2004)

Dermatology

Many diagnostic dermatologic evaluations can be performed by using high-quality still images. Although standard video cameras used in teleconferencing systems may not provide enough detail to make a dermatologic diagnosis, special peripheral cameras termed "dermatoscopes" have proved adequate. Remote "teledermatology" consultations

have become commonplace at many medical centers (American Academy of Pediatrics, 2004)

Cardiology

Cardiology has already widely embraced telemedicine. Electronic stethoscopes can facilitate the transmission of heart sounds with excellent fidelity. Echocardiograms, ultrasonographic images, electrocardiograms, and other images can readily be transmitted electronically and evaluated accurately as part of established telecardiology programs (American Academy of Pediatrics, 2004)

Emergency and Transport Services

According to one study, teleconferencing provides a way by which practitioners in a remote area can receive real-time emergency consultations with acceptable diagnostic sensitivity and specificity. Emergency teleconferencing may be particularly beneficial for infants and children in rural general emergency departments, in which complex pediatric disease is seen only rarely, giving these patients the benefit of pediatric consultants where none were available previously. One of the most immediately visible cost savings of telemedicine is the decreased need to transport patients to pediatric centers for critical care (American Academy of Pediatrics, 2004)

Hospital Care and Family Communication

The Infant Carelink Program, initially developed at Beth Israel Deaconess Medical Center (Boston, MA), allows families separated from their infants to keep updated on

their infants' condition and to view images of their infants while they are in the neonatal intensive care unit. Data show that parental satisfaction with care is enhanced by this system. One study showed an increase in the rate of direct discharge home from the neonatal intensive care unit, as opposed to a costly intermediate transfer to a community hospital. Media reports suggest that similar projects are in place at other hospitals (American Academy of Pediatrics, 2004)

Pathology

Similar to dermatology and radiology, this visually intensive discipline is readily amenable to telemedicine consultation, especially in developing or rural areas. Telepathology may offer some financial benefits over physical transportation of specimens, and there may be a financial model for pediatric pathology services (American Academy of Pediatrics, 2004)

Child Abuse

Expertise in child abuse and neglect and the interdisciplinary communication that often must take place for an adequate child-maltreatment investigation present challenges that telemedicine could help to address. One pilot study on the use of teleconference facilities in the evaluation of child abuse in Florida showed that teleconferencing was acceptable to patients. No evaluation data were provided. There is at least one software package (Second Opinion Software, Gardena, CA) specifically marketed for the sharing of still photographs in child abuse consultations (American Academy of Pediatrics, 2004)

Patient Education and Chronic Disease

Some evidence exists that children who depend on medical equipment have access to improved care by use of telemedicine monitoring. The efficacy of telemedicine in patient education via teleconferencing to teach the proper use of asthma medications has been demonstrated, as has patient satisfaction. Similar results have been reported for childhood diabetes teaching (American Academy of Pediatrics, 2004)

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School Health

Some school systems are experimenting with telemedicine links to extend the range of services in school-based clinics and decrease absenteeism for illness or disease-management encounters (American Academy of Pediatrics, 2004)

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Home Health

Health care professionals can remotely monitor a patient's vital signs, pulmonary function, or glucose concentration and then communicate with the patient to direct care by telephone, computer, or television monitor. Technology for this type of monitoring requires only a conventional telephone line. Communication technology has helped enable patients to remain at home while being monitored for congestive heart failure, diabetic control, arrhythmias, or metabolic stability. Research suggests that homebound patients are pleased with this type of home health care service. Some data suggest that telemedicine-mediated home care of children with chronic disease can save money while preserving care quality (American Academy of Pediatrics, 2004)

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Other Services

Although not extensively studied, there also have been some promising results using telemedicine for pediatric dentistry (assessment of tooth decay), neonatal ophthalmology (retinopathy assessment), and interpretation of radiographs by neonatologists (American Academy of Pediatrics, 2004)

STATE OF TELEMEDICINE IN THE FIELD OF NEONATOLOGY

Research into telemedicine's usefulness has a long way to go. The American Academy of Pediatrics recognizes the need for additional research on the appropriate and effective use of telemedicine, including exploration of the following issues specifically related to pediatrics.

Medical Home

Does a telemedicine relationship change the concept of the traditional medical home? Telemedicine may have an increasing role in ensuring continuously available ambulatory and inpatient pediatric care. Telemedicine in the medical home will require that safeguards be built into insurance-contracting procedures, which will help to preserve the medical home when health services are available from telemedicine practitioners (American Academy of Pediatrics, 2004)

Incarcerated Youth

The provision of health care to prison inmates and children incarcerated in juvenile detention facilities presents special challenges. It is expensive and cumbersome to transport incarcerated individuals to health care facilities. The need for the transport of

patients has resulted in delayed access to care. Telecommunication technologies have enabled adult prisoners to access care more rapidly and have minimized the potential danger to those at nonsecure facilities to which prisoners might otherwise be transported. Studies have shown acceptance of this technology by both prisoners and practitioners and reasonable cost-effectiveness. This technology has not been studied yet in incarcerated children. Can it be demonstrated that standards of care delivered by telemedicine for the incarcerated child population are at least equivalent to those accepted in the local community? (American Academy of Pediatrics, 2004)

Genetics and Dysmorphology

It is remarkable how little telemedicine has been used in genetics and dysmorphology, considering that telemedicine's strengths (visual diagnosis and counseling) would seem to have obvious application to this specialty. Given the scarcity of practitioners in genetics and dysmorphology, it would seem that telemedicine would afford a tremendous increase in patient access to these services. Application of telemedicine to this area of pediatrics should be considered well suited for effectiveness studies (American Academy of Pediatrics, 2004)

Subspecialty Distribution and Access Issues

The most natural use of telemedicine in pediatrics is the use of teleconferencing facilities to connect patients to pediatric subspecialists. There are a growing number of reports that suggest this is feasible and well accepted by patients.^{13,50-52} The ability of pediatric subspecialists to provide telemedicine care in areas now served only by adult medical

specialists should increase the options and quality of services available to patients.⁵³ Studies still need to be performed to demonstrate that subspecialty consultation by telemedicine improves access for children located in rural areas and that such programs are economically sustainable without grant support. Health care workforce studies need to be performed to evaluate assumptions about the effectiveness and penetration of telemedicine into pediatric practice (American Academy of Pediatrics, 2004)

Ethical Issues

It is possible that telemedicine could create a 2-tiered system in which patients who are able to pay are granted in-person access and poor children are treated by telemedicine. On the other hand, will off-hours telemedicine consultation become available only to those who can pay while poorer patients wait for an in-person encounter? (American Academy of Pediatrics, 2004)

Educational Issues

There are several educational considerations related to teaching telemedicine as a technique in pediatric residency. For example, should proficiency with telemedicine equipment be assessed to determine an understanding of telemedicine applications and technologies? An assessment could be done at telecommunications facilities used in telemedicine to provide supervision for residents and students in, for example, rural or other underserved communities. Special educational training programs for pediatric subspecialists would provide the preparation needed to assist patients via telemedicine. Residency training programs that incorporate a multidisciplinary approach may provide

an additional benefit. A multidisciplinary telemedical program might include primary care pediatricians, pediatric medical subspecialists, pediatric surgical specialists, primary care physicians, and other midlevel practitioners. As the need for telemedicine increases, medical schools and residency training must prepare to train physicians using the latest techniques in the 21st century (American Academy of Pediatrics, 2004)

STATE OF TELEMEDICINE IN THE FIELD OF NEONATOLOGY

This research defines telemedicine in pediatrics as the use of electronic communications technology to provide and support health care for infants, children, adolescents, and young adults when distance separates the practitioner from the patient, parent, guardian, or referring practitioner. This definition specifically excludes from discussion the use of ordinary telephone communication between practitioners and patients and the use of communications technology for education of practitioners. This research includes what some have termed "e-health," meaning use of the Internet (with or without using videoconference functions) to provide health care.

The information transferred in a telemedicine exchange may include live bidirectional audio or video, recorded audio or video sent after the encounter (so-called "store-and-forward" technology), medical records, medical images, sounds, or output from medical devices such as pulmonary function instruments, electrocardiographs, and ultrasonography devices.

Much has been written about the potential for telemedicine to increase access to care, but applications in pediatrics are sparse. Nevertheless, when telemedicine researchers and application developers apply their efforts to pediatric applications, one would expect that there would be significant benefits to children with special needs or children residing in underserved areas. This

report explores the special pediatric needs that may be met by telemedicine. By understanding these needs and the efforts made thus far to develop telemedicine applications to meet those needs, pediatricians and the American Academy of Pediatrics are in a position to develop priorities and agendas for child health advocacy and telemedicine research.

Research is limited on the clinical usage of telemedicine in pediatrics. Telemedicine has important implications for accessing pediatric subspecialty services, determining future health care workforce requirements and their distribution, improving communications with parents of sick and chronically ill children, and extending the boundaries of the medical home

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