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TECHNICAL REPORT

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Telemedicine: Pediatric Applications

ABSTRACT. The newly developing field of telemedicine has the potential to benefit pediatric care by increasing access to pediatric specialists and services. This report explores the current uses and limitations of telemedicine in pediatrics. *Pediatrics* 2004;113:e639–e643. URL: <http://www.pediatrics.org/cgi/content/full/113/6/e639>; telemedicine, pediatrics, access to care.

ABBREVIATION. CMS, Centers for Medicaid and Medicare Services.

INTRODUCTION

This report 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 discussion includes what some have termed “e-health,” meaning use of the Internet (with or without using videoconference functions) to provide health care.¹

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.²

SCOPE OF TELEMEDICINE

It is worth stressing that there is not universal agreement on the scope of the new field of telemedicine. Field³ defines telemedicine as the use of electronic information and communications to provide and support health care when distance separates the participants. The American Telemedicine Association defines it as the use of medical information exchanged from one site to another via electronic communication for the health and education of the patient or practitioner and for the purpose of improving patient care.⁴ This definition of telemedicine would seem to include ordinary telephone communications with patients for the purpose of diagnosis and treatment. Although the use of the telephone to implement care is telemedicine, it usually is not included in telemedicine discussions. The scope of reimbursable telemedicine described under the Medicare Reimbursement for Telehealth Services legislation is much narrower.⁵ Within this legislation, the Centers for Medicaid and Medicare Services (CMS [formerly the Health Care Financing Administration]) defines reimbursable telemedicine encounters as “interactive audio and video telecommunications . . . permitting real-time communication between the distant site physician or practitioner and the Medicare beneficiary.” This narrower view specifically excludes store-and-forward methods. In addition, CMS limits reimbursement by Medicare for telemedicine services to beneficiaries who are treated in rural health practice shortage areas. The CMS has not formally defined telemedicine for the Medicaid program, and federal Medicaid law does not recognize telemedicine as a distinct service, but reimbursement is available at a state’s option as a cost-effective alternative to traditional care.²

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 rigorous evaluation of telemedicine’s potential is

The guidance in this report does not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

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hampered by a lack of high-quality studies⁶ and cost-benefit analyses, especially in pediatrics.^{6,7}

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.^{8,9} 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 researched¹⁰ 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.

Mental Health

Evidence suggests that patients are highly satisfied with psychiatric counseling delivered via telemedicine,^{11,12} and this is true also for children.^{13,14} Diagnostic accuracy seems to be excellent.¹⁴ Before applying telemedicine applications in mental health, it is important to consider the setting, staff capabilities, and access to information sharing.

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.¹⁵

Cardiology

Cardiology has already widely embraced telemedicine.¹⁶⁻¹⁹ Electronic stethoscopes can facilitate the transmission of heart sounds with excellent fidelity.²⁰ Echocardiograms, ultrasonographic images, electrocardiograms, and other images can readily be transmitted electronically and evaluated accurately as part of established telecardiology programs.¹⁸

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.²¹ 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.^{17,18,21}

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.^{22,23} 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.²⁴

Pathology

Similar to dermatology and radiology, this visually intensive discipline is readily amenable to telemedicine consultation, especially in developing or rural areas.²⁵ Telepathology may offer some financial benefits over physical transportation of specimens, and there may be a financial model for pediatric pathology services.²⁶

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.²⁷ One pilot study on the use of teleconference facilities in the evaluation of child abuse in Florida showed that teleconferencing was acceptable to patients.²⁸ No evaluation data were provided. There is at least one software package (Second Opinion Software, Gardenia, CA) specifically marketed for the sharing of still photographs in child abuse consultations.

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.²⁹ The efficacy of telemedicine in patient education via teleconferencing to teach the proper use of asthma medications has been demonstrated, as has patient satisfaction.^{30,31} Similar results have been reported for childhood diabetes teaching.³²

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.³³⁻³⁸

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, arrhyth-

mias, or metabolic stability.^{6,39} Research suggests that homebound patients are pleased with this type of home health care service.⁴⁰ Some data suggest that telemedicine-mediated home care of children with chronic disease can save money while preserving care quality.^{41,42}

Other Services

Although not extensively studied, there also have been some promising results using telemedicine for pediatric dentistry (assessment of tooth decay),⁴³ neonatal ophthalmology (retinopathy assessment),⁴⁴ and interpretation of radiographs by neonatologists.⁴⁵

RESEARCH AND POLICY QUESTIONS

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.

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.^{46,47} 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?⁴⁸

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.⁴⁹ 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 tele-

medicine to this area of pediatrics should be considered well suited for effectiveness studies.

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.

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?

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.

REIMBURSEMENT ISSUES

Physicians have been relatively slow to adopt telemedicine. Where telemedicine has been used, it has frequently been a demonstration or research project and has been supported by grants and contracts. Without the widespread agreement by insurers on reimbursement issues surrounding telemedicine, the adoption of this technology may be delayed. There is little solid research examining how reimbursement for physician telemedicine services has developed in real-world settings. There is no literature on the need

for parity with other specialties of pediatric reimbursement for telemedicine care. Such evaluations need to be performed before a long-term commitment by the pediatric community is likely to occur.

CONCLUSIONS

Research is limited on the clinical usage of telemedicine in pediatrics.⁶ The few studies cited here seem to indicate that 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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