

# Innovation in Telehealth and A Role for the Government<sup>1 2</sup>

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## Abstract

The convergence of information technology and telecommunications, including Internet technologies, is emerging as a key tool to drive increased efficiency and effectiveness in health systems worldwide. With part of its roots in medical research for military and space applications, telemedicine is expected to make it possible to link medical expertise with patients in the most distant locations--providing clinicians with valuable new tools for remote monitoring, diagnosis, and intervention.<sup>4</sup>

## 1. Introduction

A 1997 Kaiser Permanente study of telehealth concluded that “technology in healthcare can be an asset for patients and providers and has the potential to save costs; therefore, this technology must be a part of continuous planning for quality improvement.”<sup>5</sup>

Innovation in healthcare technologies can contribute to increased access to and improved quality of care, reduced costs, and better national security. With healthcare expenditures of over \$1.5 trillion accounting for 13 percent of U.S. GDP in 2002,<sup>6</sup> even incremental improvements in delivery can have a significant economic impact. Although telehealth technologies currently account for a small segment of all healthcare technologies (an estimated \$380 million out of \$71 billion nationwide and \$169 billion globally),

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<sup>2</sup> This chapter is based on the following report prepared for the U.S. Department of Commerce. “Innovation, Demand and Investment in Telehealth,” by David Brantley, Karen Laney-Cummings, and Richard Spivack. The full report is available at: <http://www.technology.gov/reports/TechPolicy/Telehealth/2004Contents>.

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<sup>4</sup> “Technology Forecast” from *Medical Device Link*, at <http://www.devicelink.com/mddi/archive/00/01/012.html>

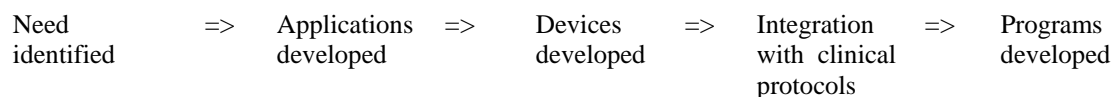
<sup>5</sup> Barbara Johnston, RN, MSNM&L; Linda Wheeler, RN, MSNM&L; Jill Deuser, RN, MBA; Karen H. Sousa, RN, PhD “Outcomes of the Kaiser Permanente Tele-Home Health Research Project” from the *Archives of Family Medicine*, January 2000. View the 1997 study at: <http://archfami.ama-assn.org/issues/v9n1/ffull/foc8072.html#a4>.

<sup>6</sup> “U.S. Statistics in Brief,” *Statistical Abstract of the United States 2003*, U.S. Commerce Department.

innovation in this area could spur significant improvements in sector productivity and quality of life.<sup>7</sup> Today, after more than 30 years since the introduction of telehealth, that potential still has not been fully realized. This Chapter assesses telehealth technology and research and identifies barriers to innovation that have impeded its potential and identifies a role for the government.

## 2. Telehealth Technologies

Telehealth focuses on the transfer of basic patient information over networks and the diagnosis, treatment, monitoring, and education of patients using systems that allow access to expert advice and patient information. A technical definition of telehealth technology includes devices and software that enable healthcare providers and educators to diagnose, consult with, monitor, treat and educate patients and consumers remotely. In order for the devices and software to be effective, however, it is necessary to integrate technology with healthcare applications and clinical procedures. The integration of devices and applications with clinical processes must then be integrated with provider workflow or protocols that would add value to a network of providers and patients. This innovation continuum may be characterized as a five stage process:



Effective functioning requires proper infrastructure including the physical facilities, setup, and equipment used to capture, transmit, store, process, and display voice, data, and images. Examples of infrastructure devices and systems required to support telehealth include:<sup>8</sup>

- “Capture” devices such as digital and video cameras, radiographs (e.g. x-ray images), and physiologic monitors (e.g. EKGs, oxygen saturation monitors);
- Basic telecommunications and networking of computer systems;
- Communications software, including electronic mail and browsers for the World Wide Web, and forms of telecommunications, including videoconferencing, remote data monitoring and file transfer, applicable to medical care in remote or rural areas; and
- Electronic data storage facilities (e.g. disk arrays to store patient records and/or digital images).

Current telehealth technologies can be grouped into nine broad categories which include remote monitoring, diagnostics, video conferencing, digital imaging, information technologies (IT), networking/interfaces, robotics/remote controls, store-and-forward, simulation and training. Table 1 presents examples of devices and software and applications representative of organizations that are active in each of these areas.

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<sup>7</sup> Table A-2, “Health Insurance Coverage Status and Type of Coverage by Selected Characteristics: 2000,” U.S. Census Bureau, can be viewed at: <http://www.census.gov/prod/2001pubs/p60-215.pdf>.

<sup>8</sup> Guler, Nihal Fatma and Elif Derya Ubeyli. “Theory and Applications of Telemedicine.” *Journal of Medical Systems*, vol. 26, No. 3, June 2002. p. 202.

Table 1  
Current Telehealth Technologies

<i>TECHNOLOGY</i>	<i>EXAMPLES OF DEVICES and SOFTWARE</i>	<i>EXAMPLES OF APPLICATIONS</i>	<i>INNOVATORS</i>
Remote Monitoring	Sensors Instruments Ultrasound	Bio-defense Telehomecare	Laboratories Sensor manufacturers Telemedicine centers Military/Veterans Administration
Diagnostics	Otoscope Stethoscope EKG	Consultations Telehomecare	Medical device manufacturers
Video-conferencing	Cameras (Videocams, Webcams) Computer-based desktops Portable communications and data systems	Consultations Teledermatology Telementalhealth	Videoconferencing manufacturers
Digital imaging	Instruments Media (e.g. film, magnetic tape) Scanners/Viewers Digital cameras Videocams with scopes	Telepathology Teleradiology Teledentistry Teledermatology TeleENT, TeleGI	Laboratories Instrument manufacturers Media manufacturers
IT	Data storage systems Servers Software/Informatics/ Middleware	Electronic medical record Data mining Syndromic surveillance Web portals Decision-support systems Administration	IT manufacturers Systems integrators Software developers Database developers Webmasters
Networking/ Interfaces	Hubs, routers, servers "Black boxes" System software	Interoperability Internet/intranet Hub and spoke networks Mobile data transmission	IT/telecom manufacturers System integrators
Robotics/Remote Controls	Instruments Controls Viewers	Telesurgery Telepathology Homeland security	Instrument manufacturers Control manufacturers Defense Advanced Research Projects Agency (DARPA)
Store-and-Forward	Data/image/video/audio card capture/scanners Computer/camera/microphone & image management software	Electronic medical record Report generator	Card capture manufacturers Scanner manufacturers Software developers
Simulation and Training	Multi-media graphics Software Audio-visual	eLearning Curriculum Conferencing	Multimedia firms Software developers

The telehealth technologies in Table 1 may be classified according to the point in time when the encounter is transacted: *store-and-forward* (asynchronous) and *interactive* (synchronous). *Store-and-forward* technology is a lower-cost method of transmitting images by computer; currently this technology is most frequently used for transmitting radiological and dermatological pictures, and is employed by hospitals and clinics across the country. Store-and-forward technology allows the provider to perform a procedure, store the material, notes, etc. for a later use, or forward this material to another location for further activity. *Interactive* telehealth implies face-to-face interaction with a patient, health professional, or both, and requires some combination of audio, full-motion video, and still images. Although these categories are sometimes used in conjunction with one another,

store-and-forward technologies are more widely used due to lower start-up and sustainability costs, and increased flexibility and productivity in scheduling encounters and managing workload.

Leaders in the field of telemedicine/telehealth suggest that the current state of technology is moving from its second generation into its third.<sup>9</sup> The “*first generation*” can be traced as far back as the 1950s. “One of the earliest uses was at the University of Nebraska where psychiatric consultations were conducted on two-way closed-circuit TV using microwave technologies.”<sup>10</sup> The *second generation* might be dated from 1989, when then Secretary Bowen of the Department of Health and Human Services (HHS) directed the Health Resources Services Administration (HRSA) and the Centers for Medicare and Medicaid Services (CMS)<sup>11</sup> to fund a telemedicine project called “the MedNet Project” (now HealthNet) at Texas Tech University. Until then, telehealth was limited to a few medical specialties such as radiology and focused on either store-and-forward or video conferencing applications. That first generation was characterized by specialized devices that did not interface easily with other devices and have not integrated well with clinical protocols. This lack of “interoperability” and technical know-how frequently led to user dissatisfaction and may have created a negative image of telehealth products and services within the traditional medical community.<sup>12</sup>

With the *second generation* of telehealth technologies, users demanded greater ability to integrate with legacy systems and peripheral devices, and manufacturers responded with multi-application systems. Successful first generation telehealth applications, such as monitoring, radiology and video consults, were joined by other specialty applications such as dermatology and pathology. Most first and second generation technologies were based in some way on remote monitoring, video conferencing, or digital imaging technologies.

At the beginning of the 21<sup>st</sup> century technological advances in videoconferencing and digital imaging are now well into a *third generation* of telehealth. Several factors account for the faster pace of innovation in these technologies and their attendant applications: the underlying technologies are multi-use, the broadcast infrastructure is stable, cost effectiveness is more evident, and their market is much broader than simply healthcare.<sup>13</sup>

### 3. Innovators And The Federal Role

Telehealth research since 1975 has included a mix of public and private sector R&D, clinical studies, and demonstration projects. Federal departments and agencies, state and local governments, universities, private foundations, manufacturers, insurers, and other sources provide varying amounts and forms of research funding. Technology and research efforts span a wide range of organizations and medical specialties, from military medical commands to rural clinics, from major medical centers to the needs of sparsely populated regions and territories. This diversity (and fragmentation) complicates quantitative analysis

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<sup>9</sup> A generation is defined as a period of time in which stakeholder interests and technological development are at a similar stage. A generation changes when breakthroughs occur in technologies and innovation moves quickly to a different level.

<sup>10</sup> For more history of telehealth, see *Telecommunications for Nurses, 2<sup>nd</sup> Edition*, Armstrong and Frueh (editors), “An Overview of Telemedicine: Through the Looking Glass,” (D.S. Puskin), Springer Publishing, 2003

<sup>11</sup> Formerly the Health Care Financing Administration.

<sup>12</sup> Mark Newburger, CEO of Apollo Telemedicine and a panelist at the U.S. Department of Commerce Technology Administration’s Roundtable discussion “Innovation, Demand and Investment in Telehealth,” June 19, 2002 in Washington D.C.

<sup>13</sup> Many technologies have found their way into healthcare from a variety of business backgrounds, e.g., inventory tracking technologies are also useful in tracking patient records as well as a patient’s lab results.

of R&D expenditures, as well as the collection of information about current and required R&D and technology transfer.

Public sector research and innovation are centered on applications (including software) and programs, but not devices. Federal civilian and state R&D is most often associated with “demonstration grants.” Attempts have been made to quantify public investment in telehealth in the past, but have been largely unsuccessful because agencies are not required to either collect or report on their telehealth investments. Although data are not easily identifiable, it is estimated that, in FY2001, federal agencies spent at least \$332 million for military and civilian telehealth research and programs. That amount grew in FY2003 as recent legislation included funding for telehealth infrastructure, programs, and projects, and, because of telehealth’s potential role in homeland security, as homeland security research, program development, and procurement were funded.

Table 2 summarizes federal funding for telehealth initiatives by federal agency for FY 2000-2001. Over eighteen agencies or bureaus were involved in telehealth initiatives during this period. The Defense Department and HHS receive the greatest share of the funding as the U.S. Army possesses the world’s largest telehealth research program, and the U.S. Public Health Service is the largest in the world and comprises a significant part of the HHS budget.

Table 2  
Federal Telehealth Research Funding (FY2000-01)

<i>Department</i>	<i>Agency or Bureau</i>	<i>Nature of Research or Program</i>	<i>Nature of Technologies</i>	<i>FY2000 Funding \$million</i>	<i>FY2001 Funding \$million</i>
Agriculture	Rural Utilities Service	Program grants	Distance learning and telemedicine	25	25
Commerce	National Telecommunications and Information Administration (NTIA)	Demo Projects	Network Infrastructure	15.5	15.5
	NIST Advanced Technology Program (ATP)	High-risk, enabling technology development and commercialization	All technologies	3	3
Defense	Defense Research Projects Administration (DARPA)	Applied	All technologies	<1	<1
	Telemedicine and Advanced Technology Research Center (TATRC)	Applied	Remote access, warfighter	100	100
	Army Medical Department (AMEDD)	Applied	Web-based triage	3.1	3.6
	Navy	Applied	Shipboard applications	*	20
	Air Force	Applied	Several	*	11.5
Energy	Sandia	Applied	Robotics	*	*
	Sandia	Applied	Diagnostic devices	*	*
	Oak Ridge	Applied	Sensors	*	*
	Oak Ridge	Pure	Sensors	*	*
U.S. Department of Health and Human Services	Agency for Health Research and Quality (AHRQ)	Evaluation	***	*	*
	Health Resources and Services	Demo Projects <sup>14</sup>	***	34.5	34.7

<sup>14</sup> These figures are the latest amounts available and include Congressional earmarks.

	Administration (HRSA)-Office for the Advancement of Telehealth (OAT)				
	HRSA -Office of Rural Health Policy (ORHP)	Demonstration projects	AHEC, Community Health Centers, Rural development	*	13
	Center for Medicare & Medicaid Services (CMS)	Demo Project	***	6	6 <sup>15</sup>
	U.S. Food & Drug Administration (FDA)	Demo Projects	***	*	*
	National Institutes of Health (NIH) National Library of Medicine (NLM) National Institute for Biomedical Imaging & Bioengineering (NIBIB)**	Applied Demo projects	Next generation Internet	45	45
Justice	Bureau of Prisons	Clinical	Consultations Cost-benefit	*	*
National Aeronautics and Space Administration (NASA)	Various	Pure Applied	Remote monitoring	10	10
Veterans Administration (VA)	Various	Applications Clinical	Ongoing programs Efficacy Studies	45	45
Federal Communications Commission (FCC)	Universal Service Administrative Company (USAC)	Subsidies	ERate	*	18
* Funding amounts not available ** Began telehealth initiatives in FY2003 *** No particular names have been chosen				TOTAL	287
					332

The Department of Veterans Affairs (VA) operates the nation's largest civilian telehealth program, conducting more than three hundred thousand teleconsultations annually. Like the Department of Defense, the VA is considered a "closed system" that includes patients, providers and payers, and is not significantly affected by the need to annually compete for grant funding. Therefore, it offers the size and stability necessary to provide one of the best available "testbeds" for research, development, standards, clinical efficacy and cost-benefit studies, and needs assessment. The VA is also considered unique among telehealth programs because of its leadership in taking on the role of "early adopter" of healthcare technologies, and in its being adequately funded to procure and integrate telehealth with clinical medicine on a very broad scale.

Most states and some local governments fund telehealth research, programs and procurement, generally with the goal of supporting program infrastructure, project development, or feasibility studies. A number of states have developed statewide public and private strategies for increasing access to quality healthcare through telehealth technologies. In several cases, states have organized "taskforces" responsible for assessing needs and factors affecting telehealth adoption and deployment.

<sup>15</sup> Amounts for the Center for Medicare & Medicaid Services represent one year of a five-year, \$30 million demonstration grant managed by Columbia Presbyterian.

#### 4. Identifying Technologies

It was not until the National Research Council and Institute of Medicine issued “Crossing the Quality Chasm: A New Health System for the 21<sup>st</sup> Century”<sup>16</sup> that the concept of a national health information infrastructure began to acquire traction. The Council’s report was followed by “Information for Health: A Strategy for Building a National Health Information Infrastructure (NHII)” by the National Committee on Vital and Health Statistics.<sup>17</sup> In June 2003, HHS convened a conference that brought together representatives from all stakeholders to develop a consensus for a national action agenda, which was then published and widely disseminated, and offered as a guide to the further development of NHII.<sup>18</sup>

Consideration of such an infrastructure would include the converging technologies of telehealth, healthcare informatics, and eHealth as well as other healthcare devices and applications. The nation’s interstate highway system, banking (ATM and credit card) network, and Internet are good examples of current national infrastructures, and may, in fact, provide models for national health infrastructure development.

With a few exceptions, little effort or coordination has yet been directed toward the “front end” identification of research, clinical healthcare or homeland security requirements for telehealth. This is not unexpected, however, since the focus of healthcare is healing and not technology. The healthcare industry is largely disaggregated, and providers focus on their own services and patients rather than on national needs or priorities. Issues such as reimbursement and the availability of clinical studies would facilitate provider’s decisions regarding technology needs. In addition, increased attention to homeland security has underscored a need supported by President Bush that the technology be multi-use.<sup>19</sup>

The events of September 11, 2001 reinforce the concept that telehealth technology must meet the primary requirements of being both multi-use and interoperable. To accomplish these requirements most effectively and efficiently, homeland security and clinical healthcare needs must be integrated at every possible level, locally, regionally and nationally. As a first step a needs assessment process will not only identify current “gaps,” but will also identify technology and information needs not currently being addressed and which require additional effort and/or investment in research, development, testing, and evaluation.

Some activities that would contribute to telehealth needs assessment are currently under way. The National Library of Medicine, for example, evaluates commercial telehealth, informatics and eHealth products. The Office for the Advancement of Telehealth (OAT) of HHS requires its grantees to meet periodically to discuss lessons learned, and uses the proposal process as a method of assessing technology needs. It has also developed guidance for strategic planning, technical guidelines for purchasing equipment for specific telehealth applications, and is currently developing a series of technical assistance documents for its grantees to guide them in assessing needs.

Early efforts to develop a national health technology and information infrastructure include the Information Infrastructure for Healthcare (1994-1997) of the U.S. Department of Commerce National Institute of Standards and Technology Advanced Technology

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<sup>16</sup> “Crossing the Quality Chasm: A New Health System for the 21<sup>st</sup> Century,” Committee on Quality Health Care in America, 2001, Washington D.C, National Academy Press.

<sup>17</sup> “Information for Health: A Strategy for Building a National Health Information Infrastructure (NHII)” by the National Committee on Vital and Health Statistics. U.S. Department of Health and Human Services. Washington, DC. November 2001.

<sup>18</sup> For more information on “Developing a National Action Agenda for NHII” see: <http://www.nhii-03.s-3.net/welcome.htm>.

<sup>19</sup> Phil Bond, Under Secretary for Technology United States Department of Commerce, address to the American Telemedicine Association conference, Orlando, FL., April 2003.

Program (ATP). The Information Infrastructure for Healthcare was an ATP focused program that provided funding for infrastructural technology development to enable enterprise-wide integration of information among all sectors of the healthcare industry. Of 221 proposals submitted under three competitions to this program, 32 multi-year awards were made to 79 participants, totaling \$295 million in R&D funding (\$146 million from ATP, and \$149 million from industry). Funded projects included informatics tools to automate, validate, and distribute clinical best practice guidelines for an array of medical situations for practitioner use; tools to enable community-wide, computerized information sharing of multi-media information across local area and wide-area networks; and an interoperable, open-system architecture to connect independent, and often legacy, healthcare information systems.<sup>20</sup>

A number of technologies from the focused program have found their way into the market place. Several Harvard affiliated hospitals have adopted *Baby Care Link*, a technology that enables parents to view patient information about their children from remote locations, and *Care Web*, a collection of web sites offering healthcare advice and direction to people of all ages. In another project the Connecticut Hospital Association (CHA) was initially approached by a healthcare research joint venture for their services in providing needed data. The data were provided and the CHA went on to develop a for-profit division, Chime, to pursue further development of necessary information technologies for the telehealth industry. Chime-Net, a subsidiary of Chime, has established a strategic alliance with Passport Health Communications Inc. of Nashville, Tenn., to provide electronic-based insurance eligibility, benefit coverage, claim status, and address verification transactions to Connecticut healthcare providers through their private data network.<sup>21</sup>

ATP has continued to fund projects in telehealth since the conclusion of the focused program in healthcare information infrastructure. Seven additional projects from open competitions totaling \$27 million in which industry has contributed \$14 million, continues ATP's involvement in this area. Examples of recent ATP awards in telehealth include:

- the combination of surgical robotic systems with telemedicine to allow a mentoring surgeon to physically interact with an in-training surgeon from a remote location and guide the in-training surgeon through complex minimally invasive surgical procedures;
- development of a software architecture for physicians and researchers that automatically extracts patient data from electronic medical records and generates a list of patient problems, and displays information in ways that support diagnostic and therapeutic decision making;
- development of a wallet-sized, wireless server for America's mobile workforce that will provide medical personnel with secure, instant access to all e-mail and automatically updated data files, everywhere.<sup>22</sup>

## **5. Homeland Security And The Role Of Telehealth**

A major activity of the Department of Homeland Security's Office of Science and Technology is coordinating research, development, science and technology activities among multiple agencies, and identifying homeland security research, science, and

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<sup>20</sup> For more information, see Bettijoyce Lide and Richard N. Spivack, "Advanced Technology Program Information Infrastructure for Healthcare Focused Program: A Brief History," (NISTIR 6477), February 2000.

<sup>21</sup> For more information on the many telehealth services offered by the Connecticut Hospital Association please refer to <<http://www.chime.org/>>.

<sup>22</sup> For a more complete description of these technologies as well as others funded in the ATP go to <[www.atp.nist.gov](http://www.atp.nist.gov)>



technology requirements. Interagency teams tasked with evaluating federal needs for homeland security infrastructure have been convened in several critical areas, but not, as yet, for healthcare. It is important that any consolidation of healthcare technology requirements for homeland security be integrated considering other private and public stakeholders, including such research organizations as the Army's Telemedicine and Advanced Technology Research Center (TATRC). Cooperation among users in requirements definition as well as research and development could well result in multi-use breakthrough innovations for homeland security, public health and clinical healthcare technologies.

Telehealth technologies offer the opportunity to not only augment the "first response level" but also empower successive levels of authority in crafting an overall response network. Such a network would require: 1) updated, open-platform systems; 2) high-speed networks; 3) workstations; 4) industry-standard applications; 5) standardized nomenclatures and taxonomies; 6) data security tools and protocols; and 7) computer-based patient records.<sup>23</sup> While each of these requirements is being addressed in some fashion by researchers and federal organizations, there has been little coordination with each other or within the telehealth community.

Homeland security technology needs include sensors and surveillance devices, related information systems for syndromic surveillance, and alert capabilities. One of the leading examples is the Real-time Outbreak and Disease Surveillance (RODS) system developed by the University of Pittsburgh's Center for Biomedical Informatics and funded by the National Library of Medicine, the Agency for Healthcare Research and Quality (AHRQ), the Centers for Disease Control and Prevention (CDC), and the Defense Advanced Research Project Agency (DARPA). RODS is essentially a proven telehealth technology that could be used as the basic platform supporting national Chemical, Biological, Radiological and Nuclear Resource Links (CBRN/E) development programs.

Of the total 736 projects awarded to high risk, enabling projects from 1990 through May 2004, the National Institute of Standards and Technology's Advanced Technology Program (ATP) has provided \$290 million in cost-shared funding to 106 projects for research and development of important technologies with direct application to Homeland Security. ATP projects in the area of Homeland Security include:

- an automated security surveillance system that combines closed circuit video cameras, radio-frequency identification technology, and computer modeling and analysis of human behaviors, with the aim of achieving rapid, reliable detection of suspicious events warranting the attention of security personnel;
- a large-area digital X-ray inspection system with heretofore-unavailable accuracy for near error-free screening of cargo and sealed container freight at airports, seaports, and other points of entry;
- a system to guarantee telephone call delivery and dial tone in order to maintain telecommunications continuity during and following terror attack, natural disaster, equipment failure, or human error.<sup>24</sup>

Beyond surveillance and detection, other areas of focus for innovation and adoption related to development of a technology infrastructure for homeland security include telecommunications, information, and training networks which link providers and institutions. Deploying these technologies and programs, and providing training to the nation's public health providers to meet their new homeland security responsibilities,

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<sup>23</sup> Simpson, Roy L. "Our First Line of Defense Against Bioterrorism." *Nursing Management* 2002 May 33(5):10-13. p. 12.

<sup>24</sup> For a more complete description of these technologies as well as others funded in the ATP go to <[www.atp.nist.gov](http://www.atp.nist.gov)>

present both financial challenges and opportunities to increase access to quality healthcare for medically underserved areas. Linking sensors to central receivers or monitors and linking those facilities, in turn, to centralized databases requires telecommunications infrastructure that does not exist in much of the nation's rural and remote areas. Although wireless communications may provide a partial answer (Oak Ridge Laboratory's "Sensor Net" uses wireless telephony, although over a relatively limited area), most sensor research and development has yet to address interfaces or integration with public health systems.

## 6. Standards Requirements

*The integration of technology with medicine may be the single greatest current research need for the telehealth community.*<sup>25</sup>

Increasing the interoperability of devices and the integration of telehealth with clinical medicine and other healthcare technologies is a near term focus of telehealth innovation. Standards are a means by which interoperability is achieved. Interoperability is the ability of two or more systems to interact with one another and exchange information in order to achieve predictable results. Innovations in this area include the integration of networks with programs, of devices with applications, of applications with clinical protocols, and of technologies with business processes. For telehealth to improve productivity, increase quality and reduce costs, the following three levels of interoperability are needed:<sup>26</sup>

- Interactions among stations or applications developed by independent vendors;
- Connectivity among medical devices and other "peripherals" developed by independent vendors; and
- "Plug and play" components developed by multiple vendors for independent vendors.

The use of open standards and wide publication will facilitate interoperability, eventually enabling most applications to link back to electronic clinical patient record databases.

Problems associated with interoperability are due in large part to the fragmented nature of telehealth, many participants each having different requirements or solutions and each applying different technical standards. The healthcare industry is not unique in having multiple standards that are developed by various organizations. Other organizations face similar situations and challenges with respect to electronic business specifications. Healthcare is unique, however, in the diversity of standards such as: infrastructure standards, clinical information standards, and business information standards, as well as standards within each medical discipline, only some of which are comparable. Healthcare is also unique in that, due to the number and diversity of providers and technology suppliers, interoperability is significantly more challenging.

Some vendors' telehealth systems are similar enough that physicians need not be fully retrained when they move to a new delivery system or combine services with another provider. But the lack of compatibility among many homegrown systems has limited just how far many telehealth services can extend. On a national level, compatibility is essential

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<sup>25</sup> Jon Linkous, Executive Director, American Telemedicine Association, September 2002.

<sup>26</sup> Col. Ron Porapatich's address at the American Telemedicine Association conference, Los Angeles, CA., December 2002.

to constructing a larger infrastructure of healthcare service. The National Institute of Standards and Technology (NIST) works with industry, research, and government organizations to make emerging information technologies, including telehealth technologies, more usable, more secure, more scalable, and more interoperable. NIST has identified healthcare as a “strategic focus area” and is working with private organizations to assist in the development of standards. Through NIST developed tests, test methods, measurements and related material, both the implementers and the users of telehealth technologies can objectively measure, compare and improve their systems.

Faster connection and transmission speeds have increased the capabilities of telehealth applications overall, but without standards (or the ability to integrate patient information among various internal or external systems) many telehealth services cannot be performed within or across delivery systems. Standards form the building blocks of effective health information systems and are essential for efficient and effective public health and healthcare delivery systems.

Adoption of standards that make it easier for telehealth systems to interoperate with other hospital information systems and easier to integrate technology with routine care should encourage physicians to adopt telehealth applications. Without standards that make telehealth technologies easier to use or that enable interoperability among disparate systems, physicians are unlikely to embrace advancements in telehealth applications.<sup>27</sup>

## **7. The Future For Telehealth**

As the need for providers to transmit data increases, the need for higher speed and higher capacity telecommunications such as broadband becomes as important as securing additional resources for further research and development. Speed and capacity are but two areas of need for an industry that is still in its infancy. In the case of broadband technologies, advantages for the Internet and voice-over-internet applications include the “always on” feature required for store and forward applications. Higher capacity bandwidth is also important for accuracy and clarity in digital imaging applications such as teleradiology, teledermatology and pathology.

Inadequate private sector resources have led to a number of “public-private partnerships” for research, development, testing and promotion of products. As discussed earlier, the Army’s Telemedicine and Advanced Technology Research Center conducts much of its research with private sector “partners” and the Advanced Technology Program makes awards to companies to develop telehealth technologies deemed too high-risk for private sector investment. These arrangements increase the probability that the technologies will be commercialized. In the case of the Advanced Technology Program, the emphasis is on both the acceleration of technology and the commercialization of enabling technologies leading to national economic benefits.

Government already plays a role in developing and delivering telehealth services as well as offering assistance in standards development. In some cases the role is that of investor in R&D where the private sector may consider the investment technically “too risky”. In other cases telehealth is used as an adjunct to regular health services. Support in standards development, guaranteeing that standards are complete, unambiguous and testable, is crucial to an industry that needs further development of interoperable technologies.

The very existence of so many government telehealth programs is reflective of the industry itself, in that there are a number of providers operating on, in some cases,

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<sup>27</sup> Kelly, Becky. “Telemedicine Begins to Make Progress.” *Health Data Management*, Jan. 2002, p. 76.

incompatible systems. In order to improve upon existing technologies and develop new ones, there is a need to continuously innovate and develop. In this instance public-private partnerships make sense. Development of a national health technology and information infrastructure requires the resources of both the private and the public sectors. The power of telecommunications can contribute significantly to an industry that is seeking to improve quality while at the same time contain costs. A more effective manner of delivering healthcare services is needed in order to respond to national emergencies in a manner that meets the expectations of the American people. Telehealth offers these opportunities. Due to the early stage of development of telehealth and the extent of disaggregation in the industry there is a need for a public partner.

Note: Certain commercial equipment, instruments, or materials are identified in this paper in order to specify the experimental procedure adequately. Such identification is not intended to imply recommendation or endorsement by the National Institute of Standards and Technology, nor is it intended to imply that the materials or equipment identified are necessarily the best available for the purpose.