Telemedicine: Remote Access to Health Services and Information 5

Telemedicine can be broadly defined as the use of information technology to deliver medical services and information from one location to another. Since the 1960s, telecommunication has been used to exchange medical information between sites in both rural and urban areas. One of the earliest applications of telemedicine was at the University of Nebraska where two-way, closed-circuit microwave television was used for psychiatric consultations. Another was in Boston, where a video link was established between a health clinic at Logan Airport and the Massachusetts General Hospital. The National Aeronautics and Space Administration (NASA) also was a pioneer in the 1960s with its satellite support of a telemedicine project, conducted by the National Library of Medicine (NLM), that provided health services to the Appalachian and Rocky Mountain regions and Alaska. In the 1970s, NASA also sponsored the STARPAHC (Space Technology Applied to Rural Papago Advanced Health Care) project, implemented with the Indian Health Service and the Department of Health, Education and Welfare on the Papago Indian Reservation in Arizona.

Early expansion of telemedicine was affected, however, by the cost and limitations of the technology. Recent technological advances—such as fiber optics, integrated services digital networks (ISDN), and compressed video—have eliminated or minimized many of these problems, fostering a resurgence of private- and public-sector interest in the potential of telemedicine to lower costs, improve quality, and increase access to health care, especially for those who live in remote or underserved areas. The technology is not only better; it is also becoming cheaper.

While telemedicine has been practiced for more than 30 years, its current iteration is still in the early stages of development. One

recent journal article remarked that: "Telemedicine is on its way (although it has not yet arrived)."[1] Others believe that telemedicine has now come into its own.

> Having now come of age, telemedicine has the potential of having a greater impact on the future of medicine than any other modality . . . Telemedicine is, in the final analysis, bringing reality to the vision of an enhanced accessibility of medical care and a global network of health care.[2]

It may be a number of years before telemedicine is used widely enough and evaluated sufficiently in terms of its effectiveness and efficiency for definitive statements to be made about its overall value and recommended uses. Like all new technologies, there will be impacts that cannot be anticipated in advance. Rigorous evaluation studies are needed to determine telemedicine's potential benefits, and such research is beginning to take place.

With Congress, the Administration, the health care industry, and consumers all searching for ways to reduce the costs of delivering health care, the potential of telemedicine has been receiving careful scrutiny. A number of bills directly related to telemedicine were introduced in the 103d Congress; so far in the 104th Congress, four bills have been introduced that refer to telemedicine. The Administration's Information Infrastructure Task Force is considering the role that information technology can play in delivering health services more efficiently and effectively as part of the National Information Infrastructure (NII) initiative. A task force subgroup of representatives from federal agencies is addressing the current status and potential of telemedicine. Telemedicine also has important international implications, and organizations like the World Health Organization and the European Commission are exploring its potential as well.

TELEMEDICINE'S POTENTIAL EFFECTS

Parts of the United States that are sparsely populated continue to have difficulty attracting and retaining health professionals, as well as supporting local hospitals and clinics. An earlier OTA report outlined the ongoing problems of delivering adequate, high-quality health care to people who live in rural areas.[3] Since the report was released in 1990, the problems rural residents face in accessing health care have not changed substantially, although there have been some selected improvements. Although access to physicians continues to be limited and rural hospitals continue to close, the financial picture for rural hospitals that remain open has improved somewhat.[4]

One physician, discussing the potential benefits of telemedicine, described the problems facing rural health care this way:

> What do you call a place the size of New York State with almost no medical, surgical, or pediatric subspecialists? . . . Western Kansas. This area has been medically underserved for generations. Subspecialty access has not been the only difficulty. There are also serious problems with the retention of primary care physicians, the provision of nursing education and emergency room coverage, and the financial health of rural hospitals. The primary challenge has been geographic—and until recently there did not seem

[1] E.A. Franken et al., "Telemedicine and Teleradiology: A Tale of Two Cultures," *Telemedicine Journal*, vol. 1, No. 1, spring 1995, p. 7.

[2] Michael E. DeBakey, "Telemedicine Has Now Come of Age," *Telemedicine Journal*, vol. 1, No. 1, spring 1995, p. 4

[3] U.S. Congress, Office of Technology Assessment, *Health Care in Rural America*, OTA-H-434 (Washington, DC: U.S. Government Printing Office, September 1990).

[4] "Health Care in Rural America," statement of the Office of Technology Assessment at a hearing of the Senate Committee on Agriculture, Nutrition, and Forestry, June 9, 1994.

to be any way adequately to confront the challenge.[5]

There are a number of reasons why isolated areas have difficulty attracting and retaining health care professionals. Medical practice is often more demanding and less lucrative than in larger centers. Providers may also feel isolated from mentors, colleagues, and the information resources necessary to support them personally and professionally. Equipment may be less up to date and facilities less than adequate. Similar problems often plague the delivery of health care to large inner-city populations. Telemedicine is a tool that may help address the problem of provider distribution by improving communication capabilities and providing convenient access to up-to-date information, consultations, and other forms of support.[6]

The use of telecommunications to deliver health services has the potential to reduce costs, improve quality, and improve access to care in rural and other underserved areas of the country. Although the extent of this potential is largely speculative at this time, researchers are beginning to address telemedicine's impacts. According to one researcher:

> . . . telemedicine may be unique in having the potential for introducing low-cost, high-efficiency components that may, under certain conditions, increase access to care while possibly limiting increases in cost by enhancing health outcomes.[7]

If research results prove to be largely positive, telemedicine is likely to become fairly routine over the next 10 to 20 years.[8]

One thing is certain—no single technological solution will work for all communities. Each location is unique, and systems designed to address access problems must be tailored to meet the particular needs and culture of each community, whether rural or urban. As noted in an earlier OTA report, communities are endowed differently with respect to their cultures, locations, landscapes, and natural and human resources, as well as their access to information technologies.[9]

Costs of Delivering Health Care

Determining the costs of delivering medical services is a difficult task under any circumstances. It is even more complicated when dealing with a technical application like telemedicine where so many aspects of its practice are still unknown. Comparing the cost of telemedicine with the delivery of conventional medical services is one approach. However, it is important to keep in mind that, in reality, the practice of telemedicine will assume its own characteristics and may ultimately be quite different from previous models. Another approach might be to compare telemedicine to other ways of increasing access to specialist care (i.e., visiting consultant clinics or satellite clinics).[10] The cost of telemedicine needs to be considered in relation to how it contributes to

[5] Ace Allen, "Telemedicine in Kansas: Introduction," *Kansas Medicine*, vol. 93, No. 12, December 1992, p. 322.

[6] See Daniel McCarthy, "The Virtual Health Economy: Telemedicine and the Supply of Primary Care Physicians in Rural America," *American Journal of Law & Medicine*, vol. 21, No. 1, 1995.

[7] R.L. Bashshur, "On the Definition and Evaluation of Telemedicine," *Telemedicine Journal*, vol. 1, No. 1, spring 1995, p. 23.

[8] Jim Grigsby et al., "Analysis of Expansion of Access to Care Through Use of Telemedicine, Report 4: Study Summary and Recommendations for Further Research," Center for Health Policy Research, Denver, CO, December 1994, p. 3.2.

[9] U.S. Congress, Office of Technology Assessment, *Rural America at the Crossroads: Networking for the Future*, OTA-TCT-471 (Washington, DC: U.S. Government Printing Office, April 1991), p. 7.

[10] Michael G. Kienzle, Project Director, University of Iowa National Laboratory for the Study of Rural Telemedicine, Iowa City, IA, personal communication, May 10, 1995.

improving the health of the population by preventing disease, treating illness, and ameliorating pain and suffering, and how it compares with alternative systems.[11]

A recent report prepared for the Health Care Financing Administration (HCFA) that included an extensive literature review of telemedicine research found no studies that provided an adequate overview of its cost-effectiveness.[12] Although it is too soon to know whether the use of telecommunications to deliver health care services will actually lower costs, it would seem to have the potential to do so for some participants. For example, telemedicine can eliminate time and wages lost at work and traveling expenses incurred when specialists and/or patients have to travel for consultations. In addition, keeping patients in their own communities can increase local hospital revenues and decrease the cost to patients. The cost of a bed in a community hospital is considerably less than in a large medical center. Costs might also be reduced by staffing hospitals and clinics with allied health professionals, such as nurse practitioners and physician assistants, who would deliver services where there is no resident physician. These providers could be assisted and monitored remotely by physicians using a telecommunications link. In some cases, overall costs might also be lowered using telemedicine if patients are treated sooner when their illnesses are less severe. However, if earlier diagnosis leads to an expensive course of treatment that would otherwise not have been provided, costs could increase.

An earlier OTA report noted that one of the greatest problems rural hospitals face is the outmigration of residents to urban areas for care.[13] Many hospitals in small communities have been forced to close because their bed census dropped so low they became uneconomical to operate. The economic impact on a small community when its hospital closes is enormous. In addition to reducing access to care, such closures have a major impact on employment opportunities. The viability of small hospitals might improve if telemedicine allowed more patients to receive consultative services locally, rather than being referred to large medical centers.

In addition to cost considerations, it is important not to lose sight of the *value* of telemedicine in delivering services or ensuring health care jobs. Communities suffer when people do not receive needed care or become unemployed when a hospital closes because it is no longer economically viable. These societal costs are important, but extremely difficult to measure. As one recent report stated:

> . . . improved access and quality, benefits from preventive care, and rural economic development are difficult to quantify and are likely to be left out of the cost-effectiveness equation. When this occurs, the cost-effectiveness analysis will misrepresent telemedicine's true benefits and lead to sub-optimal decisions on whether and how to invest in these systems.[14]

While telemedicine might reduce costs in certain cases, there is also the potential that costs may increase, at least in the short term. A consultation could represent an additional cost when used for a patient who would not have been seen by a specialist at all without the availability of telemedi-

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[11] For a discussion of cost-benefit analysis and cost-effectiveness analysis, see R.L. Bashshur, "Telemedicine Effects: Cost, Quality and Access," *Journal of Medical Systems*, April 1995.

[12] Jim Grigsby et al., "Analysis of Expansion of Access to Care Through Use of Telemedicine and Mobile Health Services, Report 1: Literature Review and Analytic Framework," December 1993, p. 2.3. The lack of cost-effectiveness data on the use of information technology in health care delivery is not unusual. An OTA contractor report reviewing such studies as they apply to administrative simplification found little in the literature. "Estimating the Cost-Effectiveness of Selected Information Technology Applications," Project HOPE, Center for Health Affairs, unpublished contractor report prepared for the Office of Technology Assessment, March 1995.

[13] U.S. Congress, Office of Technology Assessment, op. cit., footnote 3, p. 12.

[14] Office of Rural Health Policy, Health Resources and Services Administration, Public Health Service, Department of Health and Human Services, *Reaching Rural*, (Washington, DC: 1994), p. 11.

cine.[15] However, the advantage of early diagnosis and treatment using telemedicine may offset later, more expensive episodes, thereby reducing the overall costs of care. Concerns have also been raised about the potential for overutilization or fraud if third-party reimbursement for telemedicine consultations becomes widespread, thus driving up costs. There is also the possibility that telemedicine might lower costs to patients, but increase costs for Medicare because more people are provided access to health care.[16] What is not known is whether real improvements in health status would offset the increase in demand for care, should either occur.[17]


EAST CAROLINA UNIVERSITY SCHOOL OF MEDICINE

For practitioners in rural or other underserved areas, telemedicine can improve communication capabilities by providing convenient access to consultants, up-to-date information, and other forms of support.

Access to Health Services

Access to health services is a function of demographic factors such as geography, education, economic status, and age. For patients to have access, there must be health care providers and adequate facilities and services to deliver care. In a June 1994 hearing, the Chair of the Congressional Rural Caucus testified:

> . . . the primary discussion in rural areas about health care reform is not focused on the structure of alliances or the composition of the standard benefits package, but is concerned about the financial stability of the local hospital or recruitment of a new town doctor.[18]

Rural and remote areas face special problems when it comes to delivering health care. For example, the rural population is disproportionately older and poorer. They have more chronic illnesses and more work-related accidents. A large percentage of general physicians are within five years of retirement.[19]

Geography is a critical factor because, traditionally, there has been a shortage of care in areas where medical providers are less likely to want to practice, such as rural and inner city locations.[20] It is difficult to recruit and retain health care providers because this type of practice tends to be less lucrative, fails to provide professional interaction and support, and places high demands on practitioners. Although the number of physicians practicing in rural areas is increasing overall, rural residents continue to be more than twice as likely

[15] Jim Grigsby et al., "Analysis of Expansion of Access to Care Through Use of Telemedicine and Mobile Health Services, Report 2: Case Studies and Current Status of Telemedicine," May 1994, p. 3.2.

[16] Grigsby et al., Report 4, op. cit., footnote 8, p. 7.6.

[17] R. L. Bashshur, School of Public Health, University of Michigan, personal communication, May 15, 1995.

[18] Congresswoman Jill Long, Chair, Congressional Rural Caucus, testimony before the Senate Committee on Agriculture, Nutrition and Forestry, June 9, 1994.

[19] Ibid.

[20] Ibid.

as the nation as a whole to face shortages of primary care physicians.[21] To help attract and keep physicians, it seems clear that a community's access to health services may increasingly depend on providing practitioners with electronic access to information, continuing medical education, and peer support. This may be particularly true for a new generation of practitioners who are accustomed to using computers in their work.

The availability of telemedicine services may help rural and other underserved communities solve some of their problems in accessing health care by making rural practice more attractive. Online access to information and expert advice may help rural health care professionals overcome their sense of isolation from other colleagues and the lack of access to the up-to-date information they need to practice effectively. Telemedicine services also increase the access of rural physicians to medical specialists and vice versa, providing a two-way educational experience. Teachers in academic medical centers learn about the problems physicians face in a rural practice, which will help them better prepare medical students for the realities of practice. Rural physicians gain in two ways—from the educational experience of interacting with and learning from specialists, and by having access to formal continuing medical education courses.[22] Some people caution, however, that improving telecommunication links should not be viewed as a substitute for improved physician availability in rural areas.[23] Citizens may take the view that they are receiving second-class medical services if the role of telemedicine is perceived as a substitute for a health care provider in their community.

Quality of Care

Experts who assess the quality of conventional medical care use complicated measures of structure, process, and outcome.[24] Structure refers to staff, equipment, and organization; process refers to measures of appropriateness, necessity, and technical quality; and outcome refers to measures of effectiveness, as well as the patient's functional status, health status, and satisfaction and quality of life.

Because telemedicine is an electronic means to deliver care, not a specific medical procedure, it cannot be compared with conventional care in the same way that individual procedures can be measured.[25] Clinical effectiveness has not been demonstrated for all clinical functions using all types of technology. However, a scale of clinical effectiveness can be constructed to differentiate those services that have been assessed from those that are still experimental. Grigsby et al. have suggested one way of demonstrating how the quality of care delivered using telemedicine could be assessed, based on a number of applications. Their report suggests four categories of current telemedicine applications:

1. Applications that are plainly effective.
2. Applications that are likely to be effective, but the implications of implementing them are unclear. They would require further research to understand their effects.

[21] S.M. Korczyk, "Health Care Needs, Resources and Access in Rural America," a report for the National Rural Electric Cooperative Association (Washington, DC: National Rural Electric Cooperative Association's Retirement, Safety and Insurance Department, spring 1994), p. 14.

[22] For a relevant discussion related to education, see U.S. Congress, Office of Technology Assessment, *Teachers and Technology: Making the Connection,* OTA-EHR-616 (Washington, DC: U.S. Government Printing Office, April 1995).

[23] Korczyk, op. cit., footnote 21, p. 19.

[24] For a more complete discussion of quality assessment, see ch. 4, "Information Technologies and the Quality of Health Care."

[25] Grigsby et al., "Analysis of Expansion of Access to Care Through Use of Telemedicine and Mobile Health Services, Report 3: Telemedicine Policy: Quality Assurance, Utilization Reviews, and Coverage," Center for Health Policy Research, Denver, CO, August 1994, p. 3.3.

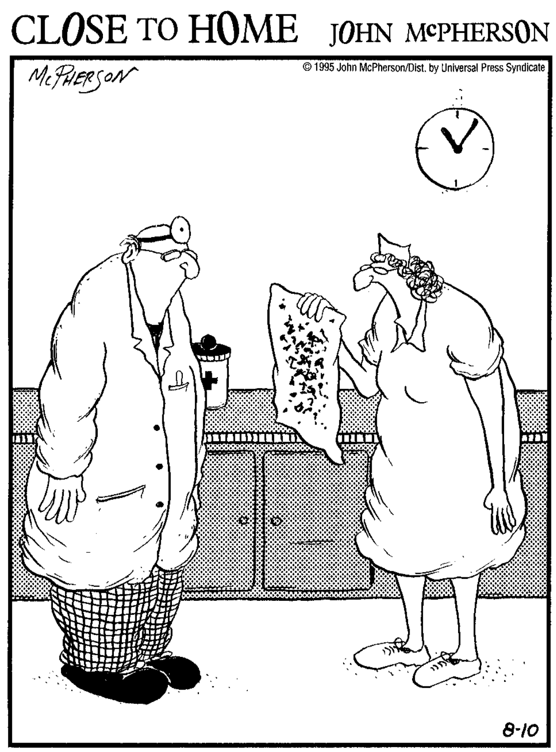
3. Applications for which the safety and effectiveness are currently unknown, or for which basic research is required to specify requisite technical parameters.
4. Applications that are entirely experimental, or which anticipate the integration of different existing advanced technologies.[26]

Whether and how telemedicine affects the quality of care delivered has not yet been proven. However, it is possible to speculate that some aspects of the electronic medical encounter might provide better care from the patient's perspective. Telemedicine could provide faster, more convenient treatment.[27] The ability to receive the services of a specialist without having to leave one's community also provides better continuity of care. Similarly, allowing a patient to remain in the local hospital with family and friends for support could improve the quality of the experience for the patient and could, in fact, contribute to a faster recovery. These benefits would minimize the disruption of the patient's life and reduce the amount of working time lost. Followup care seems well suited to telemedicine, and might be carried out more effectively and efficiently by electronic means, thereby avoiding the costs of time and travel for an office visit.

For the health care provider, telemedicine can offer tools to assist in providing high-quality services. Having timely, convenient access to the most up-to-date information, continuing medical education programs, decision support systems, and consultations with specialists in large medical centers should increase the provider's options and improve his or her ability to accurately diagnose and effectively treat patients. The development of clinical practice guidelines for telemedicine could enable providers to deliver better care. However, whether or not telemedicine consultations improve the quality of care will only be known when the research has been done to determine patient outcomes.

TELEMEDICINE APPLICATIONS

Telemedicine is broadly defined as the use of information technology to deliver medical services and information from one location to another. However, there are differences of opinion regarding what the definition should include.[28] Most agree that it includes applications in areas such as pathology and radiology, as well as consultations



"Mrs. Nortman just sent in this fax of a rash that she's got on her stomach."

[26] Ibid., p. 3.4.

[27] Norwegian researchers have found that—assessed by criteria for delivering health services in a timely fashion and as close to the patient's residence as possible—telemedicine maintains a higher level of quality than traditional medical services. U. Holand and S. Pedersen, "Quality Requirements for Telemedical Services," Telemedicine, *Telektronikk*, vol. 89, No. 1, 1993, p. 52.

[28] For a discussion of telemedicine definitions, see Bashshur, op. cit., footnote 7, pp. 20-22.

TABLE 5-1: Summary of Telemedicine Application Categories

- Initial urgent evaluation of patients, triage decisions, and pretransfer arrangements.
- Medical and surgical followup and medication checks.
- Supervision and consultation for primary care encounters in sites where a physician is not available.
- Routine consultations and second opinions based on history, physical exam findings, and available test data.
- Transmission of diagnostic images.
- Extended diagnostic work-ups or short-term management of self-limited conditions.
- Management of chronic diseases and conditions requiring a specialist not available locally.
- Transmission of medical data.
- Public health, preventive medicine, and patient education.

SOURCE: Grigsby et al., "Analysis of Expansion of Access to Care Through Telemedicine, Report 4, Study Summary and Recommendations for Further Research," Center for Health Policy Research, Denver, CO, December 1994, p. 4.3.

in specialties such as neurology, dermatology, cardiology, and general medicine. While some consider certain forms of medical education within the definition, others would exclude the use of video to transmit purely didactic classroom lectures where there is no direct interaction between student and teacher. Whatever the definition, telemedicine implies a closer link between the telecommunications infrastructure and the health care system that includes the entire range of teleservices.[29]

Telemedicine can be used for a variety of purposes (see table 5-1).[30] Some applications of telecommunications in the health field have been in use longer than others. Teleradiology, for example, has about 30 years' experience and a literature dating from the early 1970s. Other applications are newer, and as yet have produced few research results. Current telemedicine projects vary with respect to goals, organization, funding, and technology. This diversity is shown in brief descriptions of some current telemedicine programs.

Teleconsultations

Medical College of Georgia Telemedicine System

The Telemedicine System was initiated by the Medical College of Georgia (MCG) in November 1991 when it connected with Dodge County Hospital in Eastman, Georgia, 130 miles away. The system's overall goal is to ensure that everyone in the state has immediate access to quality health care.[31] The director envisions a telemedicine network that would spread out from a medical center complex to a number of satellite sites, such as rural hospitals, correctional facilities, and even military bases (see figure 5-1). Although the system is currently used largely for cardiology and neurology consultations, it can be adapted for a variety of specialties, such as dermatology, ophthalmology, or gastroenterology through the use of a variety of camera adapters. In addition to consultations, the system can also be used to guide certain procedures, such as a endoscopy or laparoscopy. MCG's

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[29] Birger J. Nymo, "Telemedicine," *Telektronikk*, vol. 89, No. 1, 1993, p. 4.

[30] A recent study prepared for HCFA reported findings on the current status of telemedicine in the United States. Grigsby et al., Report 3, op. cit., footnote 25, pp. 3.1-3.5.

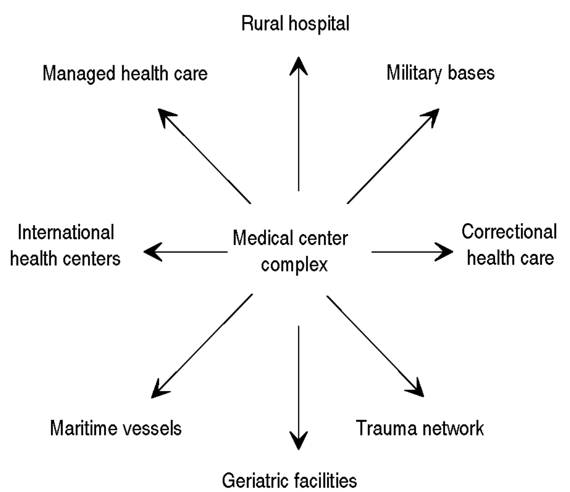
[31] J.H. Sanders and F.J. Tedesco, "Telemedicine: Bringing Medical Care to Isolated Communities," *Journal of the Medical Association of Georgia*, May 1993, pp. 237-241.

system is compatible with multiple types of communication systems—telephone, cable, microwave, and satellite. It is also portable and can be loaded into a van and transported. This is particularly useful for locations that are too small to warrant a system of their own.

The system provides two-way interactive audio/video communications. It has an open architecture and individual components can be replaced and upgraded. Hardware and software are off-the-shelf technologies. The equipment includes a video conferencing console with a codec,[32] personal computer, VCR, electronic stethoscope with an equalizer, a fax machine, CD-ROM, cameras, and monitors. At the remote site, the doctor has a camera that can be attached to any scope (e.g., microscope or otoscope) to project images for the consultant. The CD-ROM provides a medical textbook database, the Scientific American Consult Program, that allows the consulting physician to call up information on a particular diagnosis and send it to the remote physician by fax or modem. The Telemedicine Center, with a grant from the BellSouth Foundation, surveyed physicians who have used the system. Seventy-eight percent felt that their use of the system had been satisfactory to highly satisfactory.

The network has been paid for by the State of Georgia as part of the Georgia statewide communications network. A dedicated T1 communications line is used.[33] There are four channels and a multiplexer. Four to 20 consultations take place each week. A facilitator is available at both sites during the consultation to manage paperwork and videotapes, direct the camera, and operate the equipment (or help the doctor do it). The setup cost for each remote site is from $95,000 to $115,000, and for the MCG hub site from $90,000 to $105,000. These costs include the system,

FIGURE 5-1: A Telemedicine Health Care Network



SOURCE: Jay H. Sanders, M.D., Medical College of Georgia (c) 1993.

training, and system support (a teleradiology system costs extra).

The Telemedicine System is state supported; personnel support is provided by the rural hospitals. The network is being extended statewide, and consists of two tertiary care academic medical centers (MCG and Emory) connected to nine secondary hubs that are comprehensive community hospitals strategically located in a specific health care region of the state. From each of the tertiary and secondary hub sites, there will be three or four spokes going out to primary health care facilities consisting of rural hospitals, correctional facilities, public health facilities, and Area Health Education Center sites. Present initiatives also include interfacing this system with all the distance learning sites in the state so that real-time, interactive preventive and episodic health care can be provided in the classrooms. Plans are also in place

[32] Codec is an abbreviation for *coder/decoder*. It is an electronic device that converts an analog electrical signal into a digital form for transmission purposes and decodes it at the receiving end.

[33] A T1 line refers to a digital carrier capable of transmitting 1.544 megabits/second, suitable for high-volume voice, data, or compressed video traffic.

to interface military health care needs with the civilian hospital backbone. Based on the telecommunication infrastructure put into place to support the telemedicine system, a patient at any site can be examined by a physician at any other site. Distance is totally transparent and seamless. MCG also has plans for a demonstration project that will monitor certain patients in their homes, the so-called *electronic house call*, as well as for a desktop telemedicine system for the physicians' offices.

Medicaid and Medicare are currently reimbursing the consultant and the referring physician at Dodge County Hospital, and Medicaid pays the rural hospital a facility fee. This reimbursement was granted by the Medicare carrier (Aetna), and applies only to the original sites in Georgia and not to new ones. Blue Cross/Blue Shield reimburses only the consultant. MCG has estimated that approximately 86 percent of patients who previously would have been transported to MCG now are kept at the remote sites. The daily cost of a hospital bed in a rural area is placed at approximately $800, compared with $1,300 at MCG, and the costs of transportation, increased time away from work, and delay in therapy represent additional expenses.

Physicians in remote areas who use the MCG system for consultations are given credit hours toward meeting their continuing medical education (CME) requirements, which are necessary for license renewals. They do not have to interrupt their practice to attend classroom lectures in a different location. This educational activity becomes directly relevant to their day-to-day practice and more meaningful than a lecture format.

Texas Telemedicine Project

With funding provided by foundations and vendors, the Texas Telemedicine Project began operations in April 1991. It was established as a research project to study viability factors potentially operative in a national health care delivery system. The project uses interactive two-way audio and video to connect sites in Austin with sites in Giddings, a small town with fewer than 4,000 people.[34] The sites in Austin are the Austin State Hospital, the state headquarters of the Texas Youth Commission, the Austin Diagnostic Clinic, and the Texas Telemedicine project office. In Giddings, the Lee Memorial Hospital, a Texas Youth Commission maximum-security unit, the Giddings Regional Dialysis Clinic, and the Community Mental Health Clinic are connected. Each site has a unit with video, audio, and high-speed data transfer channels; ports for a fax and laser printer; and two 20-inch color monitors, two video cameras, two microphones, and a speaker. T1 telecommunication circuits are provided in part by Southwestern Bell, GTE, and LDDS. Economies of scale are produced by scheduled sharing of telecommunication lines.

At night, when emergency triage may be needed for auto accident victims, the system connects the Giddings Hospital with the Austin Diagnostic Clinic. In the morning, the Austin Diagnostic Clinic is connected to the Giddings Dialysis Center to monitor patients coming off and going on dialysis. Management rounds of each site are made electronically by Telemedicine Interactive Consultative Services each day. The Texas Telemedicine Project used a questionnaire for patients and providers to document problems and satisfaction with the system. Results over the first two years documented a 99.35 percent satisfaction rate.

Kansas University Medical Center

Telemedicine in Kansas is a cooperative effort involving the Kansas City and Wichita campuses of the Kansas University Medical Center (KUMC),

[34] Description taken from J. Preston, F.W. Brown, and B. Hartley, "Using Telemedicine To Improve Health Care in Distance Areas," *Hospital and Community Psychiatry*, vol. 43, No. 1, January 1992, pp. 29-30; also J. Preston, Director, Texas Telemedicine Project, personal communication, May 14, 1995.

THE UNIVERSITY OF KANSAS MEDICAL CENTER

In 1991, before telemedicine was available, physicians from The University of Kansas Medical Center in Kansas City, Kansas, traveled 270 miles to Hays, Kansas, to visit patients.

THE UNIVERSITY OF KANSAS MEDICAL CENTER

In 1995, an oncologist at The University of Kansas Medical Center in Kansas City, Kansas, consults with a nurse practitioner at the Hayes Medical Center via an interactive videoconference without leaving the medical center.

the state government, the Northwest Kansas Area Health Education Center, and nine rural hospitals.[35] The system is designed to provide real-time medical consultations involving a patient and practitioner (physician, nurse practitioner, or physician assistant) at the distant end and a specialist at the medical center. Full-motion, compressed two-way video is used, and there are facilities for interfacing imaging equipment, using an electronic stethoscope, for example. Continuing education courses (including courses that provide CME credit for physicians) are offered over the same equipment. The system is currently used 20 to 25 percent for clinical applications, 30 percent for continuing education (nonphysicians), 20 percent continuing medical education (physicians), and 20 to 25 percent for administrative functions.

Teleconsultations are mainly used to determine the need for face-to-face treatment or for regular followup after a face-to-face visit. In 1993, 180 consultations were conducted in 931 hours of total operations (including continuing education and administrative uses). In 1994, there were 189 consultations. KUMC estimates that, while telemedicine does not completely replace the need for transportation, it can eliminate a significant amount of travel for patients and specialists.

Use of T1 telecommunications lines in the State of Kansas network costs $35 per hour for on-peak use and $20 per hour for off-peak; but local access is expensive, especially if the transmission has to cross local access transport area (LATA) boundaries. Hospitals in the telemedicine program are paying between $421 and $1,318 per month for local access to the nearest point-of-presence of the State network. Local access charges for T1 lines are mileage-sensitive.

A telemedicine suite includes one or two 35-inch, 650-line digital monitors, one or two video cameras, graphics stand, slide converter (35mm to video interface), VCRs, microphones, and auscultation equipment (wireless stethoscope). The camera at the distant site can be controlled remotely by the physician at the central site. Any medical imaging equipment that puts out an NTSC (television) signal can be interfaced directly, or a videotape made by that equipment can be played. Radiographic images are transmitted via video camera (use of a digitizing scan-

[35] Description based on site visit, descriptive material provided; A. Allen, R. Cox, and C. Thomas, "Telemedicine in Kansas," *Kansas Medicine*, December 1992, pp. 323-325; and A. Allen, Oncologist, Telemedicine Project, University of Kansas, personal communication, July 6, 1995.

ner is far more expensive). All inputs are sent to a codec, which converts analog signals to digital ones for transmission. When purchased, the cost of a basic equipment suite was about $90,000, and now has dropped closer to $50,000.

The State of Kansas permits educational, medical, county government, and other such organizations to connect to the KANS-A-N state-owned digital telephone network. The network does not yet extend to every county, and T1 lines are not yet available for local access in all counties. The telemedicine application usually uses one-quarter of a T1 line (384 kb). Compression to this bandwidth gives some "ghosting" and "tiling" on fast motion, but is acceptable for viewing normal, medically significant motions such as a patient's gait. KUMC's experience is that picture quality for medical images such as ultrasound, computerized axial tomography (CT) scans, magnetic resonance imaging (MRI), or some x-rays is not perceptibly impaired; however, quality is not good enough for a mammogram. Picture quality on fast motion is reportedly better using one-half T1 bandwidth.

The Mayo Clinic

The Mayo Clinic in Rochester, Minnesota, became a major developer of telemedicine in 1987 when it expanded to sites in Scottsdale, Arizona, and Jacksonville, Florida. Today, Mayo uses telemedicine for clinical care, education, and administrative coordination to integrate the three sites. Current projects include the use of satellite communications to deliver consultative care to the Middle East and the use of compressed video and land lines to deliver a wide range of services to affiliated entities within Iowa, Wisconsin, and Minnesota. Mayo Clinic also provides services for the Amman Diagnostic Clinic in Jordan. During 12 weeks in 1994, Mayo joined with the Pine Ridge Indian Reservation and NASA in an experiment to provide professional education and clinical consulting services to professionals at Pine Ridge. Based on questionnaires completed by all the participants, it was determined that the project was both feasible and useful.[36]

Mayo is collaborating with NASA and the Advanced Research Projects Agency (ARPA) on a project to use the Advanced Communications and Technology Satellite (ACTS) to deliver services to small communities in remote environments.[37] In November 1993, Mayo sponsored a telemedicine symposium, and in April 1995 hosted the Second International Conference on the Medical Aspects of Telemedicine and Second Annual Mayo Telemedicine Symposium.

East Carolina University School of Medicine

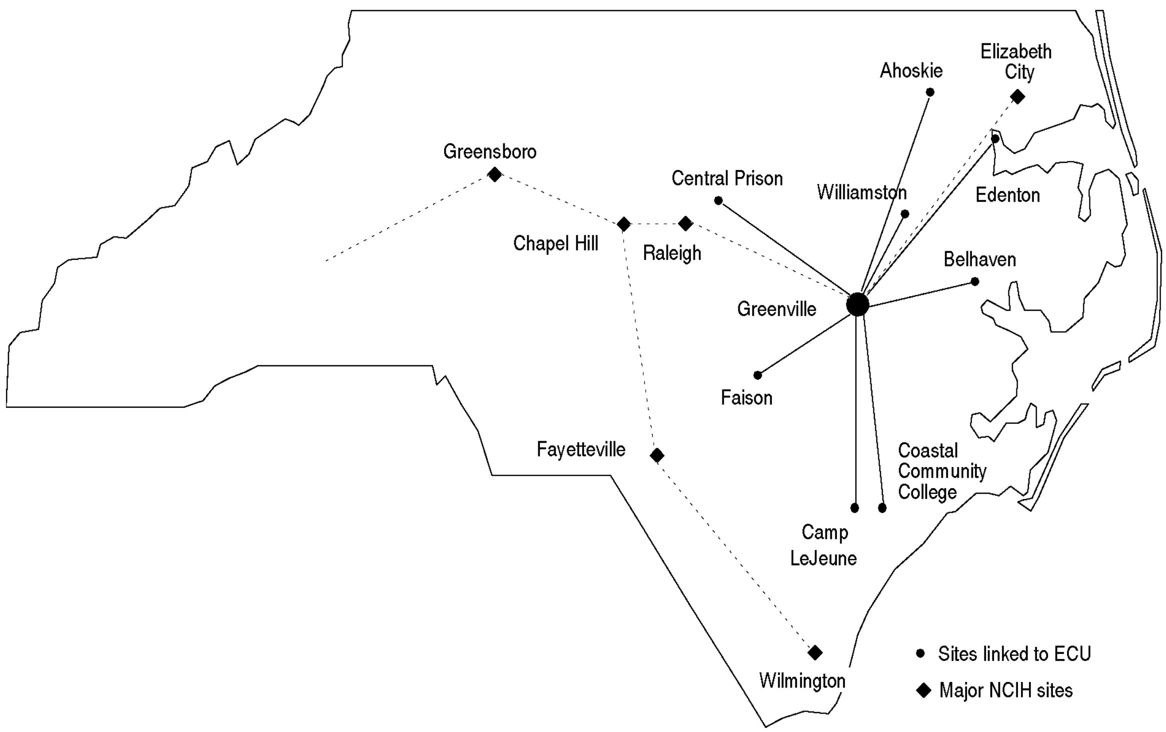
East Carolina University (ECU) performs telemedicine consultations to the largest prison in North Carolina and two rural hospitals.[38] Physicians see and talk to the patients via the telemedicine link and then diagnose and prescribe medications when necessary. A digital stethoscope, a graphics camera, and a miniature, handheld dermatology camera are used to aid in patient examinations. The working model developed for the prison system is now being expanded to six rural hospitals and a large naval hospital (see figure 5-2). A unique aspect of the ECU program is the hybrid communications network and hardware that have been integrated. With the addition of an asynchronous transfer mode (ATM) network, this will be

[36] T.E. Kottke and M.A. Trapp, "The Pine Ridge Indian Reservation/Mayo Clinic/NASA Telemedicine Project: A Feasibility Study," presented at the Second International Conference on the Medical Aspects of Telemedicine and Second Annual Mayo Telemedicine Symposium, Rochester, MN, Apr. 6-9, 1995. See also U.S. Congress, Office of Technology Assessment, *Telecommunications Technology and Native Americans: Opportunities and Challenges,* OTA-ITC-621 (Washington, DC: U.S. Government Printing Office, August 1995).

[37] E.G. Tangalos, Mayo Clinic/Mayo Foundation, Rochester, MN, "Hearing on Telemedicine: An Information Highway To Save Lives," held by the Subcommittee on Investigations and Oversight, Committee on Science, Space, and Technology, U.S. House of Representatives, May 2, 1994, pp. 12-13.

[38] Information from East Carolina University School of Medicine, "Telemedicine," brochure, August 1995; and David Balch, Director, Rural Eastern Carolina Health Network, personal communication, Aug. 15, 1995.

FIGURE 5-2: East Carolina University Telemedicine Network



SOURCE: East Carolina University, Greenville, NC, 1995.

the only telemedicine program in the world operating integrated T1 line microwave and ATM links. Current Federal support includes grants from HCFA, the National Telecommunications and Information Administration (NTIA), and the Office of Rural Health Policy (ORHP).

ECU recently conducted a demonstration clinic at a conference in California in which 84 people were seen in three days via a live ATM link to ECU. Conference participants were given the opportunity to have a consulting specialist at ECU listen to their heart beat, examine their ears, look at a skin lesion, or explore some other medical problem of interest. Two-way video, audio, and data were transmitted between the sites.

The Rural Eastern Carolina Health Network (REACH-TV) (consisting of the ECU School of Medicine, Pitt County Memorial Hospital, Eastern AHEC, and the Center for Health Sciences Communication) focuses on telemedicine, teleconferencing/distance learning, and applied research interactive information environments.

RODEO NET Project

The mission of RODEO NET (Rural Options for Development and Educational Opportunities Network) is "to pioneer advances in improving the delivery of human services by connecting people using appropriate communication technologies."[39] In 1991, the Eastern Oregon Human Services Consortium was awarded a three-year grant of approximately $700,000 by the Rural Health Outreach Grant Program of the Office of Rural Health Policy (Health Resources and Services Administration) for the purpose of demonstrating an innovative model of mental health care in a rural area. RODEO NET uses three networks of Oregon ED-NET, which was created by the State of Oregon in 1989. Network I provides live, interactive one-way video, two-way audio services to 45 "receive" sites in eastern Oregon. Network II provides two-way video, audio, and data services using digitally compressed video technology in 10 studios. COMPASS is a local "dial-up" computer data network that provides a variety of information services. These include user-friendly access to local, national, and international databases and the Internet; government and academic libraries; bulletin boards; electronic mail; and computer-conferencing services.

RODEO NET currently uses all three networks to train mental health providers in eastern Oregon. For example, both professional and paraprofessional staff who work with children and adolescents who have severe emotional disturbances and their families participate in a certificate program to upgrade staff qualifications. Individual training is also provided.

In addition to training, RODEO NET provides crisis response using Network II to enable personnel to access the on-call psychiatrist at the Eastern Oregon Psychiatric Center in Pendleton to help deal with persons suffering extreme emotional or behavioral turmoil. Such a response system often saves the time and money required to transport an individual and keeps that person in the community. RODEO NET provides ongoing clinics for medication management and case consultations on an ongoing or as needed basis, reducing the number of admissions to acute care facilities. Interviews for preadmission, predischarge, and transfers are now accomplished via Network II, and precommitment and psychiatric review board hearings are conducted using interactive TV. The project also plans to work with consumer groups to help them create their own computer networking conferences within the COMPASS system.

Teleradiology and Telepathology

The use of telecommunications to transmit medical images is quite well developed and widespread. A teleradiology system acquires radiographic images at one location and transmits them to one or more remote sites, where they are displayed on an interactive display system and/or converted to hard copy.[40] Transmissions might include CAT scans, MRIs, or x-ray images. CAT scans and MRIs originate in digital form, but a film digitizer must be used to convert conventional radiographs from film to digital form. Teleradiology systems often employ a wide area network.

Teleradiology systems transmit images from one hospital to another, from an imaging center to a hospital, or from an imaging center or hospital to a radiologist's office or home. Each requires different technologies and communication links and each site has different requirements.[41] For example, a radiologist who is on call may review an image in his or her office or at home, but at a later time will also review the original image before making a final diagnosis. In this instance, a lower image resolution, requiring less expensive equipment, may be acceptable. A higher quality image is required if the radiologist is making a final interpretation without seeing the original image, as

[39] Description taken from "RODEO NET Project Summary," Oct. 25, 1993; and Cathy Britain, Program Manager, RODEO NET, personal communication, June 1995.

[40] For an in-depth description of teleradiology, see S. Batnitzky et al., "Teleradiology: An Assessment," *Radiology*, vol. 177, 1990.

[41] S.J. Dwyer, III, et al., "Wide Area Network Strategies for Teleradiology Systems," *RadioGraphics*, vol. 12, No. 3, May 1993, p. 569.

in the case of a request for a second opinion or a hospital that contracts for its radiological interpretations.[42]

In its study for HCFA, the Center for Health Policy Research found that, with some exceptions, radiology using telecommunications is feasible.[43] For providers, training in the use of the equipment appears to be a critical component, particularly learning to manipulate and interpret images using a video image on a monitor. Preliminary research suggests, however, that in most cases radiologists prefer conventional films and view boxes to teleradiology because reading them is less time-consuming and perhaps because they are more familiar with them.[44] The American College of Radiologists is currently evaluating equipment standards and practice parameters.

The field of medical imaging offers one of the most fertile grounds for the application of advanced computer and communications technologies. All-digital systems, known as picture archiving and communications systems (PACS), now offer imaging of sufficient quality for primary diagnosis in radiology, although their high costs are a barrier to diffusion. The University of Virginia operates a PACS system that it plans to hook into two remote sites, at distances of four and 10 miles, using a T1 telecommunications line. Further expansion is planned based on the experience with the two sites.[45]

The use of telecommunications for telepathology is also well established. Because of the need for high-quality imaging, the requirements of pathology call for equipment that is more sophisticated than is required for other telemedicine applications.[46] Early research findings suggest that telemedicine allows frozen sections of tissue specimens to be analyzed accurately.[47] An example of a telepathology program is the Arizona-International Telemedicine Network (AITN), established at the University of Arizona in 1993. Its goals are to provide consultation services, use telepathology in quality assurance programs, participate in research on the development of telepathology systems, and examine the impact of telepathology services on the practice of medicine, including patient outcomes. The network involves five locations in Arizona and one each in Mexico and China.[48]

Home-Based Health Services

In addition to using telecommunications to deliver health services from one medical facility to another, there is also the potential to use it to deliver services to people in their homes.[49] In some ways, electronic "house calls" represent a move back to a health care system that is more home-centered rather than hospital-centered.[50] Using a variety of technologies—including telephone, computers, monitoring devices, and interactive video—telemedicine could reduce or eliminate patient travel, resulting in lower costs for the patient and perhaps making a hospital or clinic visit unnecessary. This could be particularly helpful to people whose mobility is limited or who may not be well enough to travel. The elderly face particu-

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[42] Batnitzky, op. cit., footnote 40, p. 15.

[43] Grigsby et al., Report 1, op. cit., footnote 12, p. 2.13.

[44] Grigsby et al., Report 4, op. cit., 8, p. 2.3.

[45] *Healthcare Telecom Report*, Sept. 12, 1994, pp. 5-6.

[46] Grigsby et al., Report 1, op. cit., footnote 12, p. 2.6.

[47] Grigsby et al., Report 4, op. cit., footnote 8, p. 2.3.

[48] A.K. Bhattacharyya et al., "Case Triage Model for the Practice of Telepathology," *Telemedicine Journal*, vol. 1, No. 1, spring 1995, pp. 9-17.

[49] See also the section on consumer health informatics in ch. 1.

[50] Mary Gardiner Jones, "Electronic House Calls: 21st Century Healthcare Services for Consumers," *Proceedings of the Mayo Telemedicine Symposium*, Oct. 1-3, 1993, p. 39.

lar challenges in meeting their need for services, and advanced telecommunications—particularly two-way video to the home—could ultimately provide them a full range of services.[51]

Home-based telemedicine could be particularly effective for followup care and for monitoring chronic illnesses, such as asthma or diabetes. Monitoring allows preventive measures to be taken before problems get so severe that hospitalization becomes necessary. Telemetry devices at home that connect to a computer—to provide electrocardiograms or blood-pressure readings, for example—could alert the patient's physician that treatment is necessary. Such a system could provide a more cost-effective method of care by reducing medical visits for conditions that are not severe.

Several demonstrations are currently under way related to home delivery of services. For example, in several months, Eastern Carolina University (ECU) will begin home trials for about six patients (initially) for remote cardiac rehabilitation using telephone, cable TV, and telemetry units. Using one-way video and two-way audio, a physician will monitor a patient at home while the patient rides a stationary bicycle. Patients will see the physician on their cable TV and will be able to converse with him or her.[52] This will permit real-time monitoring of their vital signs by the medical center. In addition, ECU and Economic Growth Strategies, Inc., in conjunction with Smart House, has created a health demonstration house. Health House will use interactive communications to provide monitoring, diagnosis, and information products and services.

In collaboration with the Center for Total Access at Fort Gordon and the Georgia Tech Research Institute, the Medical College of Georgia also is planning to place equipment in 25 homes to monitor patients who have frequent hospitalizations or emergency room visits. A similar system will be placed in a large nursing home, and into the home of the nursing home's medical director, to avoid unnecessary admissions to the hospital. The Harvard Community Health Plan in Burlington, Massachusetts, operated a Triage and Education System by placing computer terminals in 150 homes. Patients used the system to get customized health information and guidance based on responses to a questionnaire they completed on the screen. It enabled patients to manage common illnesses or injuries and monitor chronic health conditions. The project was deemed a success, but was discontinued because funds were unavailable to finance it when the demonstration ended.[53]

The Comprehensive Health Enhancement Support System (CHESS) uses an interactive computer system to provide information, social support, and problem-solving tools for people living with AIDS and HIV infection. CHESS was developed at the University of Wisconsin-Madison under a grant from the W.K. Kellogg Foundation. The system provides information, referrals to service providers, patient support in making difficult decisions, and networking with experts and others facing the same concerns. When computers were placed in homes for three to six months, their use was extremely heavy. Subjects who used CHESS reported a significantly higher quality of life in several dimensions, including social support and cognitive functioning. Users also reported significant reductions in some types of health care costs.[54] CHESS has also been used in a study of eight African-American women with breast cancer who lived in impoverished areas of inner-city

[51] Mary Gardiner Jones, "Meeting the Home Health Care Needs of the Elderly in the 21st Century Through Telecommunications: Report and Recommendations," Consumer Interest Research Institute, Washington, DC, Mar. 10, 1995, p. 6.

[52] *Healthcare Telecom Report*, vol. 2, No. 7, Mar. 28, 1994, p. 1.

[53] Site visit, Harvard Community Health Plan, 1994. Most users liked the system, and HCHP noted a 15 percent increase in the use of self-care to treat health problems, a 14 percent increase in appropriate level of care decisions, and a 5 percent reduction in health center visits.

[54] D.H. Gustafson et al., "The Use and Impact of a Computer-Based Support System for People Living with AIDS and HIV Infection," n.d.

Chicago. It was very well received, extensively used, and produced feelings of acceptance, motivation, understanding, and relief among participants.[55]

Delivering health services directly or providing needed information does not always require the user to have sophisticated equipment. The Connect System at Cleveland State University uses a computer and voice mail system to monitor drug-using pregnant patients, patients in drug treatment, and mothers of newborns. This system is for nonemergencies, and patients access it using a touchtone telephone and a password. It is used to communicate with caregivers, and the computer calls the patient if there is a message waiting. Those without a telephone can call in on a regular basis to collect messages. There is also a Community Health Rap line that will find an expert to answer questions. Telephone Pals will connect patients with others who share a common health condition. Home Monitoring allows a clinician to call a child's parent at regular intervals to ask a series of questions. Answers are sent directly to the clinician, who will contact the parents if there is a need for action. Appointment and medication reminders are also sent. Research showed that sending reminders for immunizations resulted in 82 percent of patients in the experimental group keeping their appointments, compared with 69 percent for the control group. The resulting immunization rates were 68 percent for the experimental group, compared with 45.5 percent for the control group. This is in a community in which only 4 percent graduated high school and 40 percent owned their own telephone (12 percent were both homeless and phoneless).[56]

Other Sites

Telemedicine offers safety, security, and cost advantages in delivering services to correctional facilities. For example, since 1992, the East Carolina University (ECU) School of Medicine has provided consulting services to the Central Prison in Raleigh, North Carolina, a top-security prison.[57] The prison doctor is able to consult via telecommunications with specialists at ECU, thus avoiding the need to transport inmates or bring in specialists. Consultants were reluctant to visit the prison, and the cost of transporting an inmate to the hospital ranged from $700 to $5,000, depending on the amount of security required.

In Texas, the University of Texas Medical Branch at Galveston has seen 40 to 62 patients a week from the prison population in Phase 1 of a program that began in October 1994. Their goal is 100 patients per week by the end of 1995.[58] Patients are usually presented by physician assistants. The Texas prison system is looking at telemedicine as a way to reduce referrals to the state's tertiary care centers, such as the one at Galveston, which are overburdened with inmate referrals. The Medical College of Georgia also is connected to correctional facilities, and inmates who previously needed to be transported for health care can now be treated at the prison using telemedicine.[59]

It seems clear that the delivery of health services using telecommunications is possible in any

[55] F.M. McTavish et al., "CHESS: An Interactive Computer System for Women with Breast Cancer Piloted with an Under-served Population," n.d.

[56] F. Alemi, Health Administration Program, Cleveland State University, Cleveland, Ohio, personal communication, May 11, 1995.

[57] East Carolina University School of Medicine and the Center for Health Sciences Communication, World Wide Web site home page: <URL: http://www.telemed.med.ecu.edu/>.

[58] R.M. Brecht, "Implementation of Telemedicine Into the Texas Prison System," presented at the Second International Conference on the Medical Aspects of Telemedicine and Second Mayo Telemedicine Symposium, Rochester, MN, Apr. 7, 1995.

[59] J. Sanders, testimony, hearing of the House Committee on Science, Space, and Technology, Subcommittee on Investigations and Oversight, May 2, 1994.

number of settings, including school clinics and nursing homes. In addition to rural areas, experiments are taking place in urban areas as well. An example is at Stanford University in California, where a pilot project is under way to connect an urban clinic serving the poor, a large multispecialty group practice, and a nursing home.[60] Telemedicine's potential to respond in emergency situations, such as natural disasters or military deployments, has already been demonstrated.[61] Decisions concerning potential applications clearly will be based on the usual criteria of how they affect health care costs, access, and quality.

Telemedicine Projects in Other Countries

A number of other countries, particularly those with remote or isolated areas, currently use telecommunications to deliver health services. The characteristics of these programs tend to reflect both the health care and telecommunications policies of the individual country.

For example, in Norway, the health sector has been chosen by the government as one of the main areas for the national plan for information technology.[62] Remote areas and severe winter weather conditions make the delivery of health care difficult. The University Hospital of Tromso, with the support of Norwegian Telecom Research, has been using telemedicine since 1988 for remote diagnosis in Northern Norway for radiology; pathology; dermatology; cardiology; ear, nose and throat; and psychiatry. The system is also used extensively for distance education for physicians and nurses, as well as training in use of the technology. This is a coordinated research and development project with an interdisciplinary research group based in Tromso. Cooperation with institutions and personnel in the regional health service is encouraged. Local research institutions participate and local industry is involved in developing the technology.[63] The telemedicine network is expected eventually to expand to Oslo and additional remote areas of Norway. Plans are also under way to link up with the Mayo Clinic and Johns Hopkins University Hospital in Baltimore, Maryland, for consultations.[64]

In Canada, the oldest and best-known use of telemedicine is at the Memorial University of Newfoundland where its Telemedicine Centre has operated since 1975. The Centre operates a dedicated audio network with 54 sites in health centers and the remainder in community colleges, high schools, university campuses, and government buildings. It provides both health programs (continuing health education, medical data transfer, community health education programs, and health professional meetings) and a wide range of distance education programs and administrative meetings for government and others.[65] Another telemedicine program in Western Canada links Drumheller Regional Health Complex with the University of Calgary and adjoining Foothills Hospital. This program was developed in partnership with Alberta Government Telephones and Calgary-based Hughes Aircraft, which is providing the hardware and software.[66]

South Australia established a Telemedicine Project in June 1991 to examine the potential role of telemedicine in health services delivery. It is a

[60] Bob Holmes, "Medicine Cruises the Infobahn," *Stanford Medicine*, spring 1995, pp. 20-23.

[61] J.B. Crowther and R. Poropatich, "Telemedicine in the U.S. Army: Case Reports from Somalia and Croatia," *Telemedicine Journal*, vol. 1, No. 1, spring 1995, pp. 73-80.

[62] B.J. Nymo and B. Engum, "Telemedicine To Improve the Quality, Availability and Effectiveness of the Health Service in Rural Regions," paper presented at "Seminar on the Regional Impact of Advanced Telecommunication Services," Kiruna, June 19-21, 1990, p. 1.

[63] Ibid., p. 4.

[64] *Healthcare Telecom Report*, July 18, 1994, p. 8.

[65] Memorial University of Newfoundland, Telemedicine Centre, Information Sheet, 1993.

[66] *Calgary Herald*, "Long-Distance Healing," June 27, 1993, p. A1.

collaborative effort of the Economic Development Authority of South Australia, the South Australian Health Commission, MFP Australia, and Telecom Australia.[67] The project was established between the Royal Adelaide Hospital, South Australia's largest teaching hospital with more than 800 beds and a full range of specialist services, and South Australia's largest country hospital in Whyalla, situated 400 kilometres northwest of Adelaide. The Whyalla Hospital has 150 beds, services a town of 27,000 people, and has a limited range of specialist services. From September 1992 to June 1993, a total of 190 telemedicine sessions were held, divided between education, clinical, administration, and demonstration and training sessions. A study of the project reported that clinical use was most successful for psychiatry, dermatology, and geriatric assessment. Postgraduate medical education and administrative education were also very successful. The project proved less successful for physiotherapy, occupational therapy, speech pathology, and dentistry. The study also concluded that telemedicine services will be most successful where they complement and enhance existing health services.

TELEMEDICINE ISSUES

Like all applications of new technologies, there are barriers to widespread diffusion of telemedicine.[68] Some of the problems are related to the technology, but most can be attributed to other factors.

Reimbursement for Services

A critical issue for telemedicine is whether and how it will be reimbursed by Medicare/Medicaid and other third-party payers. In rural areas, up to 40 percent of physicians' patient base consists of Medicare/Medicaid patients.[69] As one congressman testified at a 1994 hearing on rural health care:

> Telemedicine is particularly important to rural health delivery systems. . . However, without the assurance of payment for telemedicine services, the full potential of telemedical technology will never be realized. . . This administrative roadblock prevents the development and expansion of these systems in rural America.[70]

HCFA, the federal agency responsible for Medicare/Medicaid reimbursement of services, has been under pressure to reimburse for services delivered using telemedicine, and is considering what its policy should be. Traditionally, physicians have not been reimbursed for consultations using telecommunications (i.e., the telephone). Current rules for reimbursement require face-to-face contact (defined as in the same room) between physician and patient. Services that do not involve direct interaction with the patient, such as teleradiology, telepathology, or EKG testing, are also reimbursed;[71] however, consultations in which there is interaction between patient and consultant using videoconferencing are not.[72] Aetna, the Medicare carrier in Georgia, currently covers telemedicine consults at the Dodge County Hospital, part of the Medical College of Georgia's telemedicine system. This policy does not apply to new sites in Georgia.

To assist HCFA in its decisionmaking, the agency commissioned a study of the primary factors to consider in any reimbursement policy. The researchers outlined three principal consider-

[67] "South Australian Pilot Telemedicine Project," Project Team Evaluation Report, November 1993, p. 2.

[68] For a discussion of barriers to implementation, see J.H. Sanders and R.L. Bashshur, "Challenges to the Implementation of Telemedicine," *Telemedicine Journal*, vol. 1, No. 2, summer 1995.

[69] *BNA's Health Care Policy Report*, vol. 2, Feb. 28, 1994, p. 418.

[70] Pat Roberts, (R-KS), hearing before the Committee on Ways and Means, Subcommittee on Health, House of Representatives, U.S. Congress, Feb. 7, 1994.

[71] Office of Rural Health Policy, op. cit., footnote 14, p. 6.

[72] Ibid.

ations: 1) the adequacy of the technology, 2) medical effectiveness, and 3) the appropriateness of the applications.[73] The report concluded that it would be reasonable to proceed with reimbursement for some telemedicine services—those that are widely accepted as effective; those that are probably effective, but with unknown effects on the health care system (with some restrictions placed on reimbursement); and applications that require basic research (evaluated for reimbursement on a case-by-case basis).[74] Coverage might also be restricted to certain geographic areas, institutions, or applications. In addition to this recently completed project, HCFA is currently supporting several demonstration projects that will help in its decision process. The agency also has funded a telemedicine evaluation project, to be conducted by researchers at the University of Michigan, and a data collection project at the Telemedicine Research Center in Portland, Oregon.

At a May 1994 hearing on "Telemedicine: An Information Highway To Save Lives," a HCFA official testified:

> Because of our limited experience with delivery of telemedical services in the real world, we would like to proceed with caution. However, I can say with confidence, that through the use of pilot projects undertaken by both the Government and private industry, we will be able to learn the best approach to provide effective and efficient health care services for our beneficiaries. HCFA envisions accessible health care being provided through the use of telemedicine and other emerging technologies but it must be based on solid data so that the quality of health care provided is not compromised.[75]

It is unlikely that HCFA will move ahead without a clearer understanding of all the issues. Research currently under way should address some of the questions that the agency would want answered before proposing a uniform reimbursement policy for telemedicine. In the meantime, some experiments could be tried that would further the decisionmaking process, particularly with respect to costs. HCFA is currently seeking a Medicare waiver from the Office of Management and Budget that would allow the agency to provide reimbursement for physician services rendered via telemedicine for pilot projects in Iowa, Georgia, West Virginia, and North Carolina.

HCFA will continue to be concerned about telemedicine's safety and effectiveness, quality of care, practice standards, and the impact on physician distribution. However, the agency will also be concerned about any increase in Medicare spending that could result from reimbursement for telemedicine services. At a time when reductions in the growth of Medicare are being proposed, there will be reluctance to initiate policies that could increase costs by increasing access to services.

Lack of Research/Experience

Another barrier to telemedicine is the lack of research demonstrating its safety and efficacy, clinical utility, and cost-effectiveness. This is a problem for potential users, payers, and policymakers. No one knows for certain which medical conditions are best suited to the use of telemedicine. For example, believing that the "hands-on" experience is critical for initial patient examinations, some providers feel that telemedicine works better for followup care than for an initial visit. Clearly, some procedures are better suited to the use of interactive video than others in terms of the patient's comfort level. Research on patient satisfaction with telemedicine is limited, but results indicate that in general they like it.

Early experiments in telemedicine were terminated before they produced answers concerning its cost, impact on access, and effects on quality of

[73] Grigsby et al., Report 1, op. cit., footnote 12, p. i.

[74] Grigsby et al., Report 4, op. cit., footnote 8, p. 5.1

[75] Helen L. Smits, Deputy Administrator, Health Care Financing Administration, statement at a hearing at the National Institutes of Health before the Committee on Science, Space and Technology, U.S. House of Representatives, May 2, 1994, p. 13.

care.[76] Those projects did not end because they failed to achieve their objectives. Instead, the reasons included: 1) lack of familiarity and limited experience with the systems, 2) lack of institutional commitments to sustain them when outside funding ran out, 3) lack of incentives for physicians to use the systems, 4) limitations of the technology, and 5) poor system planning and design.[77]

In its request for proposals for an exploratory evaluation of telemedicine, the Office of Rural Health Policy listed four primary objectives:

1. to determine the current status of telemedicine in rural health with respect to the number and types of systems in operation, levels of technology employed, types of specialty services provided, utilization of services, costs, and patient and provider acceptance;
2. to explore the effects of telemedicine on access to care, practitioner isolation, and the development of health care networks;
3. to explore the organizational factors (at facility, network, community, and state levels) that aid or impede the successful development and implementation of telemedicine systems; and
4. to develop, test, and refine data collection instruments that may be used in subsequent evaluation efforts.[78]

The results of this exploratory evaluation and other research under way should lay the groundwork for future research projects designed to answer the many questions concerning the effectiveness of telemedicine. Evaluation tools will clarify what telemedicine technologies are most appropriate and which health care services are best suited to remote consultation.[79] The National Library of Medicine, with some support also from HCFA and the Department of Veterans Affairs, is currently sponsoring a study by the Institute of Medicine that will try to establish clear evaluation criteria by which the appropriateness, effectiveness, acceptability, and other aspects of telemedicine might be rigorously measured and assessed. (See also appendix D.)

Several organizations have formed to promote and coordinate telemedicine research activities and share research strategies. Examples are the National Consortium for Telemedicine Evaluation (see box 5-1) and the Clinical Telemedicine Cooperative Group (see box 5-2). The American Telemedicine Association also promotes research as part of a comprehensive agenda for telemedicine.

Telecommunications Infrastructure

The technology exists to provide a wide variety of telemedicine services over regular telephone lines. For example, the teledermatology program at the Oregon Health Sciences University (supported by NLM's High Performance Computing and Communications initiative) uses still images over standard phone lines to transmit skin images. In many rural areas, however, the telecommunications infrastructure does not provide a medical facility with sufficient bandwidth to carry the necessary signals for interactive video telecon-

[76] Bashshur, op. cit., footnote 11.

[77] Ibid., p. 6.

[78] Office of Rural Health Policy, Health Resources and Services Administration, Public Health Service, Department of Health & Human Services, Request for Proposal No. HRSA 240-OA-22(4) for "Exploratory Evaluation of the Rural Application of Telemedicine," 1995, p. 9.

[79] D.A. Perednia, "Evaluating the Use of Telemedicine for Mental Health Applications," June 1994, pp. 8-9.

BOX 5-1: National Consortium for Telemedicine Evaluation

The National Consortium for Telemedicine Evaluation (NCTE) was organized in 1993 at the University of Michigan, School of Public Health, Department of Health Management and Policy for the purpose of conducting multistate, multisite evaluation of telemedicine systems. The evaluation is focused on accessibility, cost, and quality. The consortium serves two specific objectives: 1) to assist in the evaluation of individual telemedicine programs/projects as prototype systems of care involving specific configurations of technology (high end, low end), manpower (MD and non-MD providers), organization (organized and unorganized, integrated networks), and clinical applications (specific diagnostic services, full service, full-time service). To date, participants in the Consortium include: NASA, Medical College of Georgia, University of West Virginia, MD-TV, University of Kentucky, Louisiana Health Care Authority, and Mid-Nebraska Telemedicine System. The Consortium is developing detailed methodologies for telemedicine evaluation, including sample design and data collection protocols.

SOURCE: National Consortium for Telemedicine Evaluation, Department of Health Management and Policy, School of Public Health, University of Michigan, Ann Arbor, MI.

sultations.[80] The cost of the telecommunications links required for telemedicine represents a major barrier to its broader use. Often new lines must be laid and new tariffs developed. If a single facility has to absorb the full costs of the transmission services, the costs may be prohibitive. In addition to laying a new line for broadband service, it may also be necessary for the communications carrier to install a digital switch to ensure that the quality of the compressed video signals is acceptable.

Boundaries were established after the breakup of AT&T that made telephone calls placed outside the local access transport area much cheaper than those placed within the same service area.[81] The high cost of connectivity between local and long-distance carriers is a difficult hurdle for telemedicine systems to overcome.[82] To lower transmission costs, some have suggested that an *essential service rate* be set for local governments, hospitals, and educational facilities that would provide a basic level of service at guaranteed prices that are not based on distance.[83] In some cases, cooperative efforts among telemedicine providers, state agencies, and telephone companies have resulted in negotiated rates that are more affordable for the providers.[84] Implementing telemedicine projects generally is easier in states like Pennsylvania, North Carolina, Georgia, Kansas, and Iowa where statewide networks already exist. As the number of statewide networks increases,

[80] For an in-depth discussion of the rural communication infrastructure, see U.S. Congress, Office of Technology Assessment, op. cit., footnote 9. For further discussion of the communication infrastructure, see U.S. Congress, Office of Technology Assessment, *Critical Connections: Communication for the Future*, OTA-CIT-407 (Washington, DC: U.S. Government Printing Office, January 1990). For a description of broadband network technology, see U.S. Congress, Office of Technology Assessment, *Advanced Network Technology*, OTA-BP-TCT-101 (Washington, DC: U.S. Government Printing Office, June 1993), ch. 3. For an in-depth discussion of the role wireless technologies will play in the emerging NII, see U.S. Congress, Office of Technology Assessment, *Wireless Technologies and the National Information Infrastructure*, OTA-ITC-622 (Washington, DC: U.S. Government Printing Office, July 1995).

[81] Office of Rural Health Policy, op. cit., footnote 14, pp. 4-5. The report cited the example of the Texas MedNet Project, whose 1992 monthly transmission costs were $27 per mile within the same local telephone service area, and $5 per mile between service areas.

[82] E.G. Tangalos, “Telemedicine Outcomes: What We Know and What We Don’t,” paper presented at the Rural Telemedicine Workshop, Office of Rural Health Policy, Washington, DC, Nov. 3-5, 1993, p. 4.

[83] Office of Rural Health Policy, op. cit., footnote 14, p. 17.

[84] Dena S. Puskin and Jay H. Sanders, “Telemedicine Infrastructure Development,” *Journal of Medical Systems*, vol. 19, No. 2, 1995, p. 2.

BOX 5-2: Clinical Telemedicine Cooperative Group Organized by the Telemedicine Research Center (TRC) Oregon Health Sciences University

The *Clinical Telemedicine Cooperative Group* (CTCG) is a not-for-profit, independent medical research corporation with offices in Portland, Oregon, and Kansas City, Kansas. CTCG members share common telemedicine research protocols, data collection instruments, and testing methodologies. By coordinating research efforts, members are able to perform statistically valid telemedicine research faster, and at a lower cost, than would otherwise be possible. Expertise in computer systems, research design, imaging, statistical analysis, engineering, and specific medical expertise is available to CTCG members through TRC staff and affiliates. The CTCG network is based on successful community-based research cooperatives—models that demonstrate the advantages and validity of large-scale, multi-centered trials in clinical research. Pilot funding for the CTCG was provided by the Health Care Financing Administration.

SOURCES: D.A. Perednia, "Telemedicine System Evaluation and a Collaborative Model for Multi-centered Research, *Journal of Medical Systems*, vol. 19, No. 3, 1995; and J. Kadel, Member Information Coordinator, CTCG, Oregon Health Sciences University, Portland, OR, personal communication, July 11, 1994.

more and more uses will be found for telemedicine in both rural and urban areas.

In rural areas, hospitals, schools, government, and other community groups can aggregate demand and share a network to help spread the system costs. This can only be accomplished, however, when residents are involved in planning and developing a system and have a sense of ownership in it. In an earlier study, OTA suggested that Rural Area Networks would allow rural communities to customize networks to their own needs, while achieving economies of scale and scope[85] (see figure 5-3). By sharing in the creation of such a network, rural communities would be able to enjoy some of the benefits of their urban counterparts. A system of "bandwidth on demand", in which users pay only for the time they use on the system, would greatly reduce the costs of telemedicine and obviate the need for a dedicated communications line. Such service could be provided using an advanced switching technology such as asynchronous transfer mode, which can support many different kinds of services. To ensure that systems are interoperable, technology standards will be essential for communication providers.[86] Many of these issues are currently being addressed in the context of the Administration's NII initiative, particularly by members of the Information Infrastructure Task Force (IITF).

Delivering health care to the home is increasingly important for people who need convalescent or chronic care. A public network that can provide two-way video, high speed data transfer, and graphics is required before a wide range of health services can be delivered directly to the home. Some telephone companies are beginning to respond to this recognized need by devising strategies to implement such advanced services, and home services are figuring prominently in NII discussions.

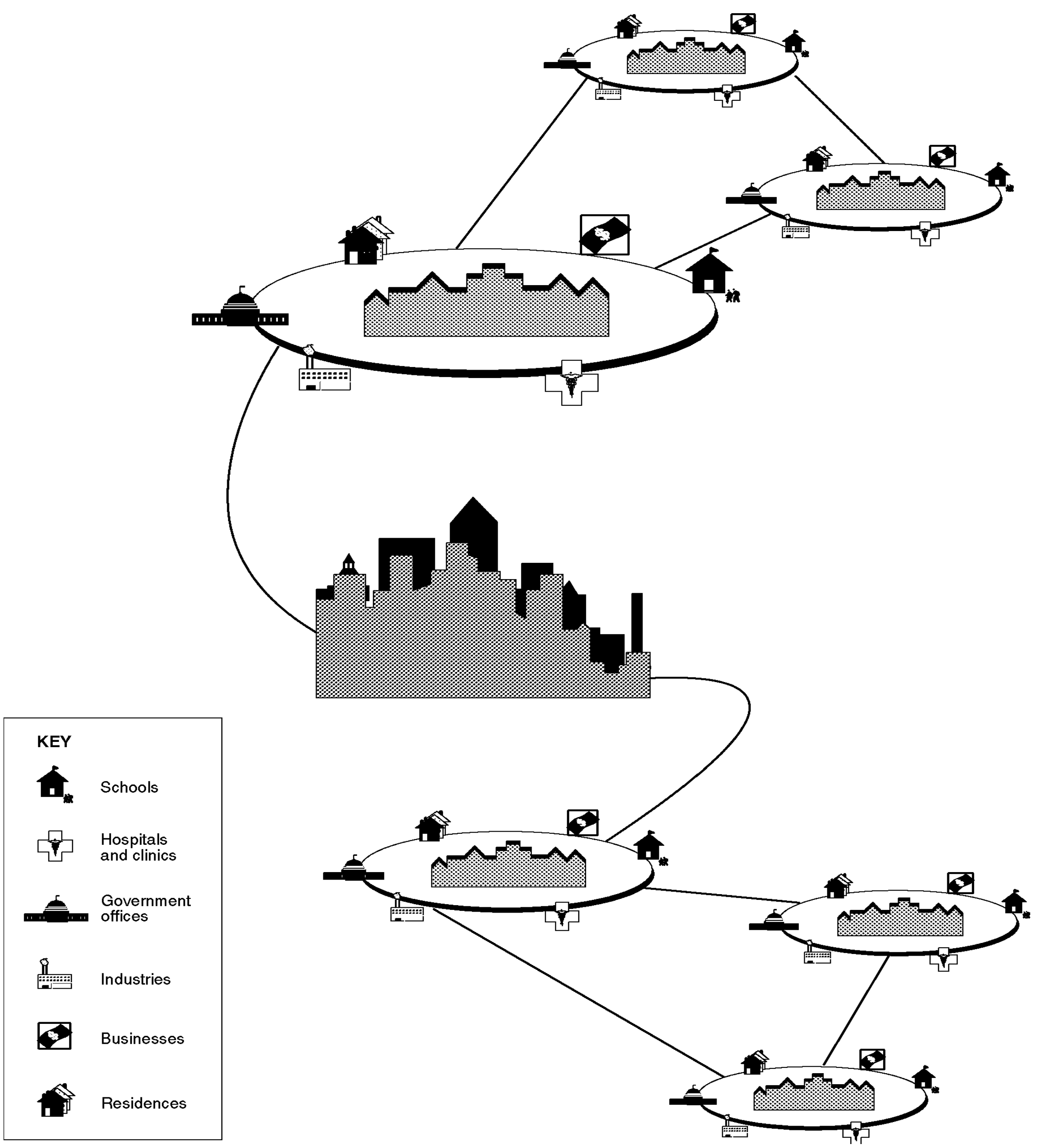
Legal/Regulatory

Remote diagnosis and treatment across state lines could bring differing laws and regulations into conflict. Telemedicine raises a number of legal issues related to privacy/confidentiality, licensing

[85] U.S. Congress, Office of Technology Assessment, op. cit., footnote 9, p. 59.

[86] For discussions of technology standards, see chs. 1 and 2. See also U.S. Congress, Office of Technology Assessment, *Global Standards: Building Blocks for the Future*, TCT-512 (Washington, DC: U.S. Government Printing Office, March 1992).

FIGURE 5-3: Rural Area Networks



A Rural Area Network would be designed to foster the deployment of advanced technology to rural areas in an economically viable manner by pooling the communication needs of a community's many users—especially businesses, educational institutions, health providers, and local government offices.

SOURCE: U.S. Congress, Office of Technology Assessment, *Rural America at the Crossroads: Networking for the Future,* OTA-TCT-471 (Washington, DC: U.S. Government Printing Office, April 1991), p. 83.

and credentialing, and liability that could represent significant barriers to its broader diffusion.

Privacy and Confidentiality

Privacy in health care information has been protected in two ways: 1) in the historical ethical obligations of the health care provider to maintain the confidentiality of medical information, and 2) in a legal right to privacy, both generally and specifically, in health information. *Confidentiality* involves control over who has access to information. Other terms frequently used in privacy protection discussions are integrity and security. *Integrity* assures that information and programs are changed only in a specified and authorized manner, that computer resources operate correctly, and that the data in them are not subject to unauthorized changes. A system meeting standards for access allows authorized users access to information resources on an ongoing basis.[87] *Security* refers to the framework within which an organization establishes needed levels of information security to achieve, among other things, the confidentiality goals.[88]

The use of telecommunications to deliver medical care may pose additional risks to the privacy of patients and their records. For example, the creation of a videotape of a consultation might pose a new privacy threat for the patient unless appropriate safeguards to control access to it are built into the process. The issue of who has access to this information will need to be considered and resolved in advance. Depending on the nature of the examination, the patient may also have privacy concerns in terms of who is actually present in each location during the consultation. Nonmedical personnel, such as a technician or facilitator, may be needed to assist in the consultation.

If a videotaped consultation becomes part of the patient's medical record, it would be treated like other videotaped information on the patient (e.g., an angiographic procedure, for example). In these cases, the usual privacy laws would apply. State laws governing the transmission and retrieval of patient medical records vary, and officials are concerned about user verification and access, authentication, security, and data integrity.

A previous OTA study found that the present system of protecting health care information offers a patchwork of codes; state laws of varying scope; and federal laws applicable to only limited kinds of information, or information maintained specifically by the federal government.[89] The present legal scheme does not provide consistent, comprehensive protection for privacy in health care information, whether it exists in a paper or computerized environment. Clearly the privacy implications for telemedicine will continue to receive careful scrutiny. Vice President Gore has recently asked the Department of Health and Human Services (DHHS) to develop model institu- tional privacy policies and model state laws for health information in the context of the NII.[90] This activity is to be coordinated with the activities of the IITF in the privacy area.

Physician Licensing

Physicians must be licensed by the states in which they practice. Telecommunication facilitates consultations without respect to state borders and could conceivably require consultants to be licensed in a number of states. This would be impractical and is likely to constrain the broader diffusion of telemedicine programs. In July 1994, the State of Kansas passed legislation requiring

[87] C.P. Pfleeger, *Security in Computing* (Englewood Cliffs, NJ: Prentice Hall, Inc. 1989), pp. 5-6.

[88] Ibid., p. 90.

[89] U.S. Congress, Office of Technology Assessment, *Protecting Privacy in Computerized Medical Information*, OTA-TCT-576 (Washington, DC: U.S. Government Printing Office, September 1993), pp. 12-13.

[90] Vice President Al Gore, memorandum to Donna Shalala, Secretary of Health and Human Services, Mar. 8, 1995.

that out-of-state physicians who provide consultations using telemedicine be licensed in Kansas.

The licensing problem for telemedicine could be addressed by the implementation of national licensing standards or the classification of physicians practicing telemedicine as consulting physicians, thereby circumventing state rules. For a start, such a national license could be provided to physicians who provide consultations to *underserved* populations. A precedent exists for physicians serving in the military, the Department of Veterans Affairs, the Indian Health Service, and the Public Health Service.[91] Another way to address the problem of licensing is to place the overall responsibility for the patient's care in the hands of the referring physician and view a consultant in a different state as making recommendations only. A novel approach unique to telemedicine would be to consider that the patient is being "transported" electronically to the consultant, thus obviating the need for the specialist to be licensed in the patient's home state.[92]

The issue of credentialing arises with telemedicine in terms of the use of consultants. In the Medical College of Georgia program, the Joint Commission on Accreditation of Hospitals (JCAHO) has determined that hospital credentials are not a problem for the consulting physician as long as all physician orders are written by the referring physician. The Federation of Boards of State Medical Examiners has established a task force to deal with the problem of providing interstate telehealth care, while preserving state licensure, credentialing, and monitoring of health care professionals.[93]

Liability

The liability implications of telemedicine are unclear. At least two aspects of telemedicine could pose liability problems. One is the fact that, in a remote consultation, the specialist does not perform a hands-on examination, which could be regarded as delivering less than adequate care. The second aspect is that the use of compressed video, in which repetitious information is eliminated as the data are converted from analog to digital and back, may raise the issue of diagnosing with less than complete information.[94] On the other hand, telemedicine may, in fact, decrease the threat of malpractice suits by providing better recordkeeping and databases, and the fact that taping the consultations will automatically provide proof of the encounter. Tapes could also help to prove the innocence of providers who are falsely accused.

Consulting physicians could reduce their liability by adhering to practice guidelines for various telemedicine applications. Such guidelines would need to be established by national health professional associations.[95] Another way of limiting liability would be to protect physicians and medical centers that provide telemedicine consultations to the underserved under the doctrine of *sovereign immunity*, which might take the form of a cap on economic damages or some other hold-harmless protection.[96] Liability considerations for telemedicine must, of course, be viewed in the context of ensuring the patient adequate recourse in cases of actual negligence.

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[91] Sanders and Bashshur, op. cit., footnote 68.

[92] Ibid.

[93] J. Preston, M.D., President, American Telemedicine Association, personal communication, May 14, 1995.

[94] Office of Rural Health Policy, op. cit., footnote 14, pp. 8-9.

[95] Ibid., p. 9.

[96] Ibid.

Development Costs/Financing

The costs of developing a telemedicine project can be high. These costs include telecommunication charges, equipment costs, technical support, training, and administrative support. Many small communities operating on their own will be unable to afford these costs. Telemedicine lends itself to cost-sharing as a way of financing projects as well as assembling the expertise necessary to make it successful. For example, the Medical College of Georgia project is a partnership that includes private industry, the state government, the Governor's office, academia, and, most importantly, the primary health care facilities. There are many other examples of groups working together to share the expense of building a system. Within communities, systems that are too costly for health applications alone can be shared with educational, local government, social, and community services to make the investment feasible.

One suggestion for small rural health care facilities is to lease a system for three to five years. The revenue generated by the anticipated increase in bed census and ambulatory care activity could be used to offset the leasing costs. Some facilities may still need government support in the form of a loan for start-up purposes before they could assume the costs of leasing a system.[97]

Technological and Implementation Issues

In implementing a telemedicine project, it is important to first define its objectives, and then select the appropriate technology to meet those needs.[98] The focus should be on how telemedicine can contribute to better clinical decisionmaking and patient care. Depending on what the project is designed to achieve, the technology might range from a touchtone telephone to a sophisticated multimedia system. This points to the need for careful planning in advance and a clear understanding of the project goals. Experience suggests the need for a flexible, open system that can easily be adapted to advances in technology. The complexity and sophistication of the technology selected will depend on what it is required to do. Transmission speed, image resolution, storage capacity, mobility, and ease of use are important considerations.

Those who will be using the system must be involved in its design from the beginning. Once implemented, onsite technical assistance is necessary to ensure that any technological problems can be immediately addressed and rectified. It is important that the system be conveniently located so providers can access it easily. Adequate training must be provided, and the presence of a facilitator will ensure that consultations run smoothly. As desktop multimedia telemedicine platforms become available to place in the health care provider's office, issues of cost, location, convenience, and the operational and maintenance difficulties of telemedicine will diminish significantly.

One of the barriers to telemedicine is the lack of technical standards. To achieve an integrated network of providers, the ability to interconnect using uniform standards will be essential. (Technical standards are discussed in detail in chapter 2.)

Earlier telemedicine demonstration projects often did not survive when funding ended. Some also ceased to function when individuals who had spearheaded the projects left. Some recent federal grants made for telemedicine demonstration projects are building in safeguards to ensure that projects have the ability to continue beyond the pilot stage. Some researchers suggest that relying on any government funding can be a potential impediment to implementation. Administrators will need to be convinced that telemedicine consultations will provide the possibility of generating

[97] J.H. Sanders, "Telemedicine: Challenges to Implementation," paper presented at the Rural Telemedicine Workshop sponsored by the Office of Rural Health Policy, Nov. 3-5, 1993, p. 9.

[98] D.S. Puskin, "Telecommunications in Rural America: Opportunities and Challenges for the Health Care System," *Annals of the New York Academy of Sciences*, vol. 670, Dec. 17, 1992, pp. 71-72.

revenue to cover their costs. Assuming reimbursement is available for services delivered using telemedicine, a telemedicine system should only be initiated if the economics can support its operation.[99]

Human Infrastructure

While issues related to technology are important and often get most of the attention, it is also apparent that organizational, management, and human factors also play a critical role in implementing a telemedicine system. As one telemedicine user points out:

> In the final analysis, it will be the human component at each end of the system—not the technology—that will determine whether it is successful or not.[100]

A family physician who worked in a hospital that had installed a little-used teleradiology system commented that "the personnel part of the equation is far more complex and difficult than the technology part of the equation."[101] For example, the nature of the relationship between the referring and consulting physicians may be a key factor in whether or not a system is fully used. Existing referral relationships between providers may need to be altered when telemedicine is introduced, which could cause some dislocations and affect its use.[102]

How well the system is organized, managed, and maintained, as well as whether or not it is conveniently located, will help to determine its rate of use. Several telemedicine programs have reported that scheduling can be a major problem. Because time is an important factor to busy professionals, they are likely to be more responsive to using telemedicine if scheduling is efficient and convenient. This problem may be resolved when the telemedicine technology eventually reaches the physician's desktop.

Resistance to change is often a problem when new technologies are introduced. Health care professionals are no exception, and many will not be interested in or willing to participate in telemedicine. Some will feel threatened by the introduction of technology into their practice. However, as one telemedicine pioneer put it:

> Telemedicine does not replace the physician or relegate him to a less important role. Telemedicine depends upon him and his special abilities, and it offers him a new way to practice medicine. Through an interactive telemedicine system, the fundamental doctor-patient relationship not only can be preserved, but potentially augmented, enhanced and more critically focused.[103]

Nevertheless, telemedicine will change the way providers practice. Some practitioners will miss the hands-on aspects of examining a patient that has been such an integral part of their medical training and experience.[104] Some may also have concerns about the quality of the image or the ability to make an accurate diagnosis based on the available equipment.[105]

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[99] J.H. Sanders, Professor of Medicine, Medical College of Georgia, personal communication, May 1995.

[100] Office of Rural Health Policy, op. cit., footnote 14, p. 13.

[101] Tom Dean, quoted in "Is Telemedicine the Answer to Rural Health's Problems?" *Rural Health News*, vol. 1, No. 2, spring 1994, p. 9.

[102] P. Whitten and T. Franken, "A Survey of Rural Primary Care Practitioners' Attitudes and Perceptions of Telemedicine," abstract book, Second International Conference on the Medical Aspects of Telemedicine and Second Annual Mayo Telemedicine Symposium, April 1995, p. 6.

[103] K.T. Bird, "Telemedicine: Concept and Practice," in R.L. Bashshur, P.A. Armstrong, and Z.I. Youssef (eds.), *Telemedicine: Explorations in the Use of Telecommunications in Health Care* (Springfield, IL: Charles C. Thomas, 1975), p. 90.

[104] Researchers at the Georgia Institute of Technology are working on a project to design a glove that could be worn by the consultant that would mimic the hands-on experience.

[105] Grigsby et al., Report 4, op. cit., footnote 8, p. 7.2.

BOX 5-3: American Telemedicine Association

The American Telemedicine Association (ATA) was incorporated in 1993 to promote professional, ethical, and equitable improvement in health care delivery through telecommunications technology and to enhance broad-based community telecommunications applications. The Association will: 1) promote telemedical research and education; 2) assist in the development of telemedical policy and standards; 3) provide education to public and professional organizations; 4) interact with worldwide communication systems; 5) serve as a clearinghouse for telemedical information and services; and 6) support local health care system initiatives in telemedicine, especially in medically underserved areas. In November 1994, the Board of Directors adopted a set of telemedicine policy priorities focused on practice guidelines, privacy, liability, reimbursement, medical licensure, national disasters, technology development, the national telecommunications infrastructure, research and demonstrations, and interactive distance learning.

ATA affords a structured forum for clinicians, technologists, research bodies, and public policy institutions. It has provided leadership in consumer advocacy for reimbursement, provided an emergency response structure that incorporated guidance from those at the site in a recent national disaster, stimulated educational and political action with organized medicine, initiated research and teaching recommendations for medical schools by national medical leaders, and provided testimony before Congress.

SOURCES: American Telemedicine Association information sheet, n.d.; American Telemedicine Association Policy Priorities, November 1994; and Jane Preston, President, American Telemedicine Association, personal communication, May 14, 1995.

TELEMEDICINE POLICY OPTIONS

There is ongoing activity and interest in telemedicine at the federal level in both the executive and legislative branches. A community of people interested in telemedicine—including representatives from federal agencies, Congress, telemedicine users, researchers, and vendors—meet in a variety of forums. Hearings have been held, seminars have been conducted, and demonstrations of telemedicine have been provided. At the same time, the number of organizations, conferences, newsletters, and journals related to telemedicine is rapidly proliferating, and online information and discussion groups have helped to inform people about its potential (see appendix E).

Responsibility for telemedicine policy is shared among federal, state, and local lawmakers, and many of the decisions affecting the diffusion of telemedicine are influenced largely by the private sector. Groups such as the American Telemedicine Association have provided leadership in consumer advocacy for reimbursement, stimulated educational and political action with organized medicine, initiated research and teaching recommendations for medical schools, and testified before Congress (see box 5-3). Federal efforts to reform both health care and telecommunications, each traveling its separate path, will have an impact on telemedicine's progress. As noted by one telecommunications expert:

> . . . Telemedicine barely rated a blip on the radar screen when Congress debated new telecommunications legislation last year. This omission is all the more remarkable in [that] . . . the other major legislative initiative in the 103d Congress was improving Americans' access to health care while simultaneously controlling health care costs . . . Congress dealt with communications in one hearing room and health care in another [and] failed to connect the two together.[106]

[106] Newton W. Minow, Director, The Annenberg Washington Program, "Telecommunications, Medicine and the Public Interest," speech given at the Second International Conference on the Medical Aspects of Telemedicine and Second Annual Mayo Telemedicine Symposium, Rochester, MN, Apr. 8, 1995.

Aspects of telecommunications reform related to universal service, health care, and tariffs are relevant to telemedicine. Health care reform initiatives center on reducing costs and improving access and quality. These goals reflect the trends toward managed care, new competitive strategies on the part of health care providers, and the move toward outpatient care and away from large inpatient facilities.

Federal telecommunications policymakers involved in reform initiatives have an important role to play in ensuring that proposed legislation supports the delivery of health care using telecommunications. The Snowe-Rockefeller amendment to the Telecommunications Competition and Deregulation Act of 1995, S. 652, supports access to the NII for schools, libraries, and rural health care providers. Section 253 of the Act on Universal Service calls for actions that will benefit consumers in rural and high-cost telecommunication areas. In Congress, both the House/Senate Ad Hoc Committee on Telemedicine and Health Care Informatics and the Congressional Rural Caucus continue to explore the potential of telemedicine to meet the needs of their constituents. A telemedicine conference held at Airlie House in Virginia, in August 1994, was requested by the Ad Hoc Committee, and a report was recently released that sets out a policy agenda for telemedicine over the next several years.[107]

Telemedicine is considered an integral part of the Administration's NII planning efforts. A key player is the Information Infrastructure Task Force, a forum where both telecommunications and health care needs converge. Telemedicine is being addressed by a task force subgroup, and considerable progress has already been made toward formulating telemedicine strategies. The National Telecommunications and Information Administration is helping to fund telemedicine demonstration projects through its Telecommunications and Information Infrastructure Assistance Program. The National Information Infrastructure Testbed, a nonprofit consortium, has provided telemedicine demonstrations as part of its goal of advancing the NII (see box 5-4). Along with NII activities, federal agencies such as the Office of Rural Health Policy, the Rural Utilities Service, the National Library of Medicine, the Department of Defense, the Department of Veterans Affairs, the Agency for Health Care Policy and Research, and the Health Care Financing Administration support telemedicine in various ways (see appendix D).

Telemedicine is likely to proceed with or without federal support. However, federal government support will be required to guarantee that telemedicine benefits those who need it most—people living in rural locations, inner city areas, and Native American communities that the private sector is likely to bypass for more lucrative areas. In a time of fiscal constraints, any federal funding provided will need to be carefully monitored to ensure it is being used wisely. If Congress wishes to encourage the diffusion of telemedicine, it can have the most impact in the areas of research funding and reimbursement for telemedicine services. The two are closely connected, in that formulating a reimbursement policy is dependent on obtaining satisfactory answers to many of the questions raised about telemedicine.

■ Federal Funding for Telemedicine Research

One option for Congress is to continue to provide funding for telemedicine demonstration and evaluation projects. Telemedicine research currently under way is critical to answering many of the questions about its efficacy and effectiveness. Proposed funding cutbacks could adversely affect these efforts, many of which are just getting started. Requiring matching funds or other con-

[107] Bashshur et al. (eds.), *Working Conference on Telemedicine Policy for the NII*, sponsored by the Health Information and Application Working Group of the IITF Committee on Applications and Technology and the Senate/House Ad Hoc Steering Committee on Telemedicine and Health Care Informatics, coordinated by the Center for Public Service Communications (Washington, DC: May 1995).

BOX 5-4: National Information Infrastructure Testbed

The National Information Infrastructure Testbed (NIIT) is a nonprofit consortium of over 50 members formed by industry with participation by academic institutions and government agencies to accelerate the development of a National Information Infrastructure (NII). Members participate in a series of application-focused demonstration projects designed to assess the technological, operational, and policy issues associated with creating an NII. NIIT's Healthcare Working Group consists of organizations such as AT&T, Hewlett-Packard, Hughes Aircraft Co., Jet Propulsion Laboratory, Lawrence Livermore National Laboratory, Network Systems Corp., Pacific Bell, Polaroid Corp., Sandia National Laboratories, SunOptics Communications, University of Southern California (USC) Medical Center, the USC-Advanced Biotechnical Consortium, and WilTel. In September 1994, the NIIT presented a nationwide demonstration via satellite to congressional and Administration staff in Washington, DC. The demonstration was based on a simulated medical emergency using teleconsultation, 3-D imaging, and real-time collaboration in the diagnosis and treatment of a patient.[1]

SOURCE: Background materials provided by the National Information Infrastructure Testbed, Sept. 20, 1994.

[1]Background materials provided by the National Information Infrastructure Testbed, Sept. 20, 1994.

tributions from those applying for federal grants is one way of leveraging investments in telemedicine projects. This mechanism necessitates a major investment and commitment on the part of the grantees, which helps ensure that projects will continue after federal funding ceases. Innovative approaches to funding should be considered wherever possible to get the most out of scarce financial resources.

Until recently, there was little or no coordination of telemedicine activities among federal agencies. Mechanisms are now in place through the telemedicine working group of the Administration's Information Infrastructure Task Force to monitor and coordinate federal support of telemedicine, which is essential in the current climate of budget cutbacks and fiscal constraint. Representatives of federal agencies have been meeting regularly for over a year in an effort to share information and begin to coordinate telemedicine funding activities.

Current federal funding for telemedicine is heavily weighted toward rural communities. Because telemedicine could provide a partial solution to the severe problems faced by some inner-city health care providers, this also would be a fertile area for federal support, perhaps in cooperation with private sector organizations. Funding for telemedicine demonstrations in other areas, such as public health or geriatrics, could also provide valuable information to Congress and the Administration about its potential value in improving health care delivery.

Fostering Cooperative Strategies

To reduce the cost barriers of implementing telemedicine, *Congress could provide incentives to encourage cooperative efforts and consortia.* In many small communities, it makes economic sense for groups to share the costs of implementing, operating, and maintaining a telecommunications network. For example, schools, medical clinics, libraries, social service agencies, and others who would benefit from improved information services may need to join forces to share the costs of a system. Federal funding could be designed to encourage and reward such cooperative efforts.

The U.S. military and NASA have been leaders in research related to telemedicine applications. The military has devised ways to use telecommunications to deliver health care to remote areas, whether for battlefield or peacekeeping opera-

BOX 5-5: Telemedicine Information Exchange

The *Telemedicine Information Exchange* (TIE) was launched in February 1995 by the Telemedicine Research Center (TRC) at the Oregon Health Sciences University in Portland, Oregon. Begun with demonstration funding from the Health Care Financing Administration and several private corporations, TIE provides a comprehensive telemedicine clearinghouse that is easy to use, easily accessible, comprehensive, and continuously maintained. TIE uses available health care information resources, and currently benefits those directly or indirectly affected by telemedicine, including health care providers, individuals, community and economic development leaders, and rural-based corporations. The databases include: complete bibliographic information, listing of active telemedicine programs, legislative and funding information, upcoming meetings, and relevant product and services. Updated weekly, TIE is available to users online, 24 hours-per-day, through use of computer modems, toll-free 800 number services in the continental United States (1-800-555-5TIE), and the Internet System via World Wide Web Client Access: <URL: http//tie.telemed.org/ >.

SOURCE: D.A. Perednia, Oregon Health Sciences University, personal communication, May 9, 1995.

tions. In some cases, the military is cooperating with civilian health care personnel to deliver telemedicine services. For example, Eisenhower Medical Center is working with the Medical College of Georgia to develop the "electronic housecall." In addition, the Army's health care system in Georgia will utilize the civilian telemedicine infrastructure. Walter Reed Army Medical Center works with North and South Carolina in collaborative telemedicine projects. In a pilot project, the Naval Hospital at Camp Lejeune will link East Carolina University using asynchronous transfer mode technology, focusing on emergency care and teleradiology.[108] The military and the Department of Veterans Affairs have health facilities throughout the country, and could be encouraged to cooperate with local civilian groups in setting up a telemedicine system. Wherever possible, cooperative efforts could be fostered to spread the federal expertise as broadly as possible and take advantage of economies of scale and scope.

Disseminating Research Results

In many cases, the people who might benefit most from telemedicine applications know very little about them. The recent increase in seminars and meetings on the subject, especially those that offer continuing medical education credits and research presentations, is beginning to fill some of the knowledge gap. Online databases are also helpful in spreading information about telemedicine. However, as government-supported research results become available, it is important that agencies disseminate these as widely as possible to providers in rural and other underserved areas. The electronic clearinghouse concept would be a useful vehicle to educate potential users, although in many cases those with the greatest need to know may not have the means to access electronic databases.

Congress might wish to ensure that mechanisms exist to widely disseminate research results and other information about telemedicine. This could be done by a federal agency within DHHS, such as the National Library of Medicine or the Office of Rural Health Policy.

One of the original goals of the IITF's telemedicine working group was to prepare an online database of federal telemedicine projects. When this is complete, and if it is kept current, it should pro-

[108] From East Carolina University School of Medicine World Wide Web home page <URL:http://www.telemed.med.ecu.edu/>.

vide information that will track federal spending on telemedicine. An electronic clearinghouse of information concerning telemedicine would greatly facilitate the sharing of all types of information related to telemedicine. A viable alternative to a federal clearinghouse would provide support for a private-sector group, such as the Telemedicine Information Exchange (TIE) network operated by the Telemedicine Research Center at the Oregon Health Sciences University (see box 5-5). This option would avoid duplication of effort, although a database of federal activities might still be desirable. The major problem with any online database is keeping it up to date. Sufficient staff and financial support would be required to do this, whether in the public or private sectors.

Reimbursing for Telemedicine Services

Because the data that would support a uniform reimbursement policy for telemedicine consultations are not yet available, HCFA is moving slowly and deliberately in accumulating the necessary information on which to base a sound decision. This seems a prudent strategy. Experimenting with reimbursement in certain demonstration sites will provide valuable insights that will eventually enable the agency to craft a careful policy based on actual results. *Congress may wish to ensure that adequate funding is provided to support those experiments.* As the results of these experiments become available, *Congress may wish to provide oversight and conduct hearings* to determine if further action is required.