

# Telemedicine in the 1990s: Issues and Opportunities

Bennett Thomas

Telemedicine is not new. In fact, croup in a child was diagnosed by telephone in 1897, and x-rays were transmitted by phone in the 1940s. Yet, many telemedicine programs failed in the 1970s and 1980s after a short period of operation, primarily because of poor quality images, high equipment costs, and staff training problems. However, improved technology with digital data transmission, greater bandwidths, and high-capacity communications links have led to renewed interest in telemedicine.

Medical practitioners and administrators are searching for ways to provide accessible, cost-effective medical services and education to patients and staff in hard-to-reach areas. High telecommunications costs and inadequate infrastructure continue to be problems, but it is also the cultural and human factors that are presenting some of the biggest obstacles to the acceptance and implementation of telemedicine today.

Robert A. Fink, author of *The Tao of the Internet*, says there has been a huge growth in the use of online communication in medicine in the developed world, particularly in the United States. In some areas, the transmission of case histories, images, and other medical data have become almost routine, especially in the transport of seriously ill or injured patients to tertiary medical centers. Physicians in outlying hospitals have access to specialists and medical centers with advanced technology via a simple computer and modem connection. The transfer of complex information, including full-resolution MRI and CT scans, can now be a rapid and seamless procedure. But Fink cautions, "The availability of the finest advances in global communication

cannot surmount centuries of tradition and cultural differences.... As with other problems in this world, it still comes down to the 'human factor.' "

The author has interviewed both medical practitioners and patients of telemedicine in various geographically remote areas around the world about their successes and problems. The following case studies offer some of their insights into the issues and opportunities in telemedicine today.

## Newfoundland: 380 Kilometers Offshore

The Hibernia oil platform is 380 kilometers off the rugged coast of Newfoundland and is subject to severe North Atlantic storms. While serious injuries are rare, the most typical problems are back pain, infections, or stress-related injuries as a result of being so isolated. Hibernia asked Memorial's Telemedicine Center to provide health care for their workers. Satellites provide telecommunications to the platform, which means there is sufficient bandwidth to transmit e-mail, video clips, and still pictures; EEGs are sent by fax.

Despite the availability of the communications technology, 95% of all medical communications with Hibernia are still by telephone, according to Dr. Gary Tarrant. He says that, although a problem such as difficulty in moving a joint could be studied using video clips, most images are sent as still pictures because video clips can take 20 to 30 minutes to download. With serious health problems, the patient is usually evacuated by helicopter. "We tend to err on the side of playing it safe," says Tarrant.

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“And we also want to keep the bed on the rig empty and available for another worker.”

According to Memorial’s medical director, Dr. Carl Robbins, the patients are generally happy with the care they have received. For telemedicine to be successful, “people must be comfortable with the technology to the point where it becomes invisible,” says Robbins. “It’s not the camera, it’s people we’re trying to treat.” Robbins adds that using the technology must become second nature, and that telemedicine “can never replace traditional medicine or be the same as having a doctor in the room.”

Dr. Barter has been involved in offshore telemedicine since the 1980s. “It was fairly rustic in those days, and even a small picture took 15 minutes to download from the satellite.” But, says Barter, the technology has vastly improved. “When I’m notified that they are going to send a picture, by the time I get downstairs to the computer, it’s ready to download. That takes anywhere from 3 to 15 minutes, but a 15-minute file would probably contain 10 to 12 pictures.” He admits that pictures obtained this way greatly assist in making diagnoses. “Certain conditions can easily be identified by looking at them directly, and to do that from a distance using telemedicine is really beneficial.” He cautions that the medic in the field needs some expertise to take the pictures, and he believes telemedicine will benefit the whole country. “We have such a vast country with small pockets of population [that] I’m sure it’s going to be a benefit for the next 100 years.”

Telemedicine in Newfoundland has survived longer than most telemedicine systems worldwide because it used ordinary phone lines and insisted that each service pay for itself. Newfoundland is able to provide teleradiology and medical and surgical consultations to most of the island. Additionally, it can provide consultations to the Hibernia oil rig and to an Inuit village on the Labrador coast. Apart from radiology, the physicians provide the service free of charge to distant locations.

Further expansion is contingent upon the Newfoundland government authorizing

payment for additional telemedicine consultations. Says Tom McCormack, senior policy analyst for the Deputy Minister of Health of Manitoba, “We don’t start thinking about dollar figures until we have hard data that we can translate into a sustainable process.... Government moves slowly in shifting dollars from one area to another.”

### Telemedicine on the High Plains

The Washington, Wyoming, Alaska, Montana, and Idaho (WWAMI) telemedicine network covers more than one-fourth of the United States. The terrain is rugged, and the climate varies from mild temperatures along the Pacific coast to extreme heat and cold in Alaska and on the plains of eastern Montana. The nation’s highest mountain chains (the Rocky Mountains, the Cascade Mountain Range, and the Alaska and Brooks Ranges) create natural barriers for many of the communities outside urban centers. The state of Wyoming has only half a million people, but must provide health care for an area larger than the United Kingdom. The University of Washington Medical Center in Seattle is the region’s only tertiary medical care center. To help meet the medical needs of healthcare providers and patients in these remote areas, WWAMI offers a 24-hour, toll-free telephone consulting and referral service, interactive clinical consultations, and staff education by videoconference.

“Practitioner isolation is geographic, meteorological, and professional as many rural healthcare facilities in our vast five-state region are hundreds of miles from other medical centers and are subject to unpredictable weather conditions,” says Tara Cannava of WWAMI. She adds that this isolation is a major challenge to the availability of quality medical care in remote areas of the region. “Patients often have to travel great distances to seek specialty care not available within the community. Often, this means an expensive plane flight or helicopter medivac.”

“Our satisfaction rates have been very high,” says Cannava. “Patients are pleased with the technology and the increased access to care.” Physicians and their patients

are very responsive to the use of telemedicine for consulting with specialists, says Sherrilynne Fuller, Head of the Division of Biomedical Informatics at the University of Washington. "Often, the telemedicine consultation allows the patient to avoid a lengthy trip to Seattle or another city to see a specialist. In telepsychiatry, some patients prefer the interaction with a distant psychiatrist rather than being in the same room."

To improve the integration of telemedicine consultations into the workflow, says Fuller, "We have begun scheduling 'standing' clinics, e.g., on Friday morning, a dermatology specialist is available for telemedicine 'visits' by patients and their referring physicians across the regions. Referring physicians can schedule their patients in advance, and the specialists can efficiently do a sequence."

Fuller says the biggest challenges to telemedicine are:

- The cost and availability of wide bandwidth and high-speed connections.
- Reimbursement for the specialists.
- Licensing physicians for practice across state lines.

Radiology consultations by telemedicine have been reimbursed for years, but insurers say other forms of telemedicine are experimental and are not covered.

Destyne Taft of the Alaska Telemedicine project says that, in Alaska, cultural issues are important because 42 languages are spoken. Another problem is that, although nearly everyone has television, many residents are not yet comfortable with computers. "Alaska Natives have also been abused by government experiments in the past, so there is some trepidation to introducing new medical procedures. This is generally alleviated after seeing that it is just a picture, perhaps of the inside of the ear, that is transmitted through the computer for a doctor to see. Nevertheless, we see some resistance."

Taft says another problem is the relationship of Indian Health Services to other health organizations. "We at Providence are

working with a very open system that will allow virtually anyone to have access, and then have choices as to where to send an image, for example. Teleradiology could be sent to the native medical center or to a private facility. But there is some resistance to this, and that amounts to trust—another human element in the telemedicine equation."

Taft concludes, "The biggest challenge is definitely on the human rather than technological side. The capabilities are here, but the human barriers need to be overcome. Fear, trust, and cooperation all amount to people working with people. We have faith this will work out and continue to plan for open systems that will serve anyone, anywhere. But then, we work for nuns! We can afford to embrace this view."

St. Peter's Hospital in Montana specializes in telemental health. "Generally, patients respond very well to the technology," says Nancy Cobble. "They are the ones who would have to travel if the technology were not available." Cobble says that if there are problems, it is almost always due to the telephone lines. "During times of high usage, signals don't go through quite as rapidly, and you get some anomalies in the picture and sound." The high cost of telephone lines is a problem. "It can be very pricey, and providing more care with fewer dollars is always a challenge."

The High Plains Rural Health Network provides videoconferencing and teleradiology for Colorado, Kansas, and Nebraska. Jennifer White says the advantages of telemedicine in her region are that patients, staff, and administrators avoid travel, and rural doctors can talk to other doctors and obtain continuing medical education credits. White says she would recommend telemedicine to all rural patients, but the telecommunications infrastructure continues to be a major problem: "The cost of telecommunications is extreme! It is difficult to get the network installed promptly in some rural regions."

Amy Wilhelm at Mercy Health in Iowa says, "I would recommend telemedicine to all our patients because of the cost savings

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and the ability to be in a familiar setting.” Her colleague Heidi Mitchell says for rural patients: “It saves some patients gas costs for traveling. And in emergency cases, it’s great because if the patient needs to see a specialist, it’s not an hour’s drive anymore.”

“I would recommend telemedicine to other health systems,” says Kathi Schuster of Ringgold County Hospital in Iowa. “Telemedicine psychiatric, dermatology, and neurology specialty clinics negate the need for patients to drive to Des Moines. We also provide continuing medical education programs for nurses, physicians, and emergency technicians.” Schuster says that funding is their biggest problem. “What our elderly population wants is to come to the local hospital rather than drive 90 miles to Des Moines. However, Medicare payments to the specialist are less than if the specialist sees the patient in person.”

**Spacebridge to Russia**

NASA’s “Spacebridge to Russia” project enables doctors in Russia and the United States to discuss medical cases on the Internet using store-and-forward technology. “The store-and-forward mechanism is sufficient for the majority of medical cases that do not involve trauma,” says Paul G. Mallasch of NASA’s Lewis Research Center. According to Mallasch,

The patient record is the main focus of the Web page, but we also provide online help, a database of medical and technical participants, Web-based system administration, e-mail notifications of new records and technical information, and real-time audio and videoconferencing using freely available Multicast Backbone (Mbone) tools.

He adds that NASA has a long relationship of working closely with Russia, and that they found the Russians very cooperative and technically savvy. “I communicated not only with the physicians, but the computer and network folks easily.” However, Internet connections were difficult because the

connection is heavily used and transferring large multimedia files takes a long time. Yale and Moscow Universities have used the Spacebridge to teach students: “A doctor would post an interesting or unique case, then have students log on to the system and post their diagnoses online as homework.”

The University Hospital of Tromsø (UHT) in Norway brings telemedicine to both the Norwegian Arctic and to the Archangelsk region of northern Russia. Tove Soerensen says UHT helps the Russians by sharing information and experiences from projects in the north of Norway and by translating into Russian the Norwegian VIDA System (Video Image Acquisition and Analyzing)—a PC-based still image system which uses simple modem technology. They also give general support on hardware, software, organization, communication, and evaluation.

Interactive audio now connects the main hospital in Archangelsk to rural hospitals. For 19 critically ill patients, 55 teleconsultations permitted them to stay in their home areas, thus avoiding transport to Archangelsk or a medical team being sent from Archangelsk to the local hospital.

Soerensen says the biggest challenges are the unreliable Russian telecommunications and transport infrastructure, the climate, the scattered population, and the financial situation in Russia. Soerensen does not recommend telemedicine for all rural patients. “There are no rural patients, but patients living in rural areas. These patients have different needs which must be met in different ways.”

**State-of-the-Art Telemedicine in Germany**

The University of Oldenburg in Germany uses state-of-the-art videoconferencing technology for the Weser-Ems Region. Their preference is ISDN (Integrated Services Digital Network) because, with a transmission rate of 2 × 64 Kb/s, it is an inexpensive network and is available nationwide. In comparison, ATM (asynchronous transfer mode) provides much wider bandwidths, from 25 Mb/s to 622 Mb/s, but the extra

bandwidth is very expensive and is not available nationwide, says Sandra von Gehlen of the Weser-Ems Telemedicine Network.

Von Gehlen says videoconferencing is possible throughout Germany, which enables the physician in the remote location to both examine the patient and control the technology. "Moving and still images, images from microscopes, and text documents can be transmitted, and the quality and magnification of particular areas of images, including those from cameras on microscopes, can be improved by controlling cameras remotely."

She says that images are transmitted to the doctors at other locations in the standard DICOM (Digital Imaging and Communications in Medicine) format. All the doctors then have the images on their personal computers, and the conference organizers at the University of Oldenburg facilitate CSCW (computer supported cooperative work). "All communication partners work with the same patient data. Every part of the data is cooperatively opened by one of them. You can point with the mouse on images, images can be annotated, and the gray scale windowing of an image can be changed. This is done by the WYSIWIS (what you see is what I see) method." If many large digitized images need to be sent via the network, they must be transmitted the night before a computer-supported conference takes place.

When video cameras are used, their image resolution is limited to  $352 \times 288$  pixels because most hospitals do not archive their images in digital form and most do not possess scanners to digitize the films, says Von Gehlen. Transmission by video camera is considerably slower and less effective than the DICOM format. "If you use a video camera to transmit medical images, it takes a few seconds until the artifacts are dissolved." Thus, for some hospitals it is easier to view the films on a light box and take a picture by video camera of the light box. "The video camera does have the advantage. A spontaneous conference can be held without preparation, whereas it takes time to digitize

films and send images to the conference partner if you are using low-bandwidth ISDN."

Marco Eichelberg, also of the University of Oldenburg, says that if a still image is transmitted over a 128 Kb/s link with a video compression device (codec), it is five to 10 seconds before the image stops changing because video codecs use a progressive compression technique. Images transferred this way cannot be used to make a primary diagnosis, such as in radiology. However, the cases of cancer patients are often presented from a regional hospital to the cancer center: "The images are mostly used to underline the discussion between the two oncologists (one a subspecialist and one an oncologist seeking advice). If a detail is not clearly visible in the transmission, the expert can simply ask the remotely located physician to zoom the camera into more detail or to describe what he sees himself. In this scenario, we have found the images to be quite useful."

Eichelberg says that the Weser-Ems Telemedicine Network is 99.9% reliable, with hardly any failures. He adds that videoconferencing is possible throughout Germany: "ISDN is available everywhere, even on the smallest islands and most remote areas of the country."

They also experimented with high-speed communications, but their cost is prohibitive, according to Eichelberg. "We have also experimented with ATM-based videoconference networks. I would say that you can use videoconferencing technology, even for primary diagnoses, especially for all-cine modalities (ultrasound and angiography). But you won't be able to afford that in the long term—at least, not in Germany."

### **Treating Epidemics in Third World Nations**

Professor Praveen Aggarwal sent the following message on September 23, 1996 via SatelLife to ProMed, an electronic conference on emerging diseases that operates 24 hours a day, 365 days a year: "We are facing a near epidemic of dengue hemorrhagic fever in Delhi... Despite

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managing these patients on the lines stated in textbooks, many of our patients are dying. I wonder whether we are erring somewhere in diagnosis and management of these patients.”

The next day a team from the World Health Organization’s (WHO) Southeast Asia office visited Dr. Aggarwal, bringing with them two new reports on managing dengue hemorrhagic fever. Physicians from Rio de Janeiro and Bangkok who had treated dengue epidemics sent him advice by e-mail.

Dr. Bernard Lown, a renowned cardiologist, founded both SatelLife and the Nobel-prize winning organization International Physicians for the Prevention of Nuclear War. He realized that physicians in the developed world could communicate by phone, fax, and e-mail, while half of the world’s population had never made a phone call. Dr. Lown found that a combination of low earth orbit satellites and phone lines could “store and forward” e-mails inexpensively.

SatelLife is a non-profit organization trying to solve the “information poverty” problem in third world nations. Dr. Ramnik Xavier, SatelLife’s chief medical adviser, says, “Physicians who return to their home communities suffer from lack of access to medical information. If they want to do research they have to move away, causing a local brain drain.” Leela McCullough, SatelLife’s information director, says that SatelLife is “an information broker, seeking out information...relevant to the developing world.”

Dr. Xavier scans 25 journals a month and summarizes relevant information for the electronic newsletter *HealthNet News*, which is updated daily. According to McCullough “the Internet offers more medical information than *HealthNet*, but relatively little of it is generated in or relevant to poorer countries. And it is much more difficult and expensive to access than *HealthNet*.”

The WHO estimates that 94% of AIDS patients live in developing nations. SatelLife includes ProCAARE (Program for Collaboration Against AIDS and Related Epidemics)

which has links to Harvard University, the Uganda Viral Research Institute, the European AIDS Commission, and the All-India Institute of Medical Sciences. It also provides E-Drug—a conference on essential drugs, medication guidelines, and new medications. A doctor in Pakistan who inquired about home care for patients with HIV received e-mail advice from doctors in Puerto Rico and Zambia and did not require advice from anyone in the developed world.

### Conclusion

Telemedicine has great potential for providing technically advanced medical care to rural and remote areas of the world. Unfortunately, many telemedicine projects have foundered because either they were not financially viable or they did not have widespread support from the patients, physicians, and administrators involved. Advice by phone is still the simplest and longest-used form of telemedicine, and all advances need to be compared with phone advice for ease-of-use and cost-effectiveness.

Telemedicine has reached across the boundaries of countries and continents to provide medical care. The main barriers to the introduction of telemedicine continue to be money to install and operate the systems and the attitudes of participants. Physicians are concerned about the extra time required for telemedicine consultations and the change from a face-to-face patient relationship to one that is distant. Administrators are concerned about the costs of introducing yet another form of medical service.

There are few studies of patient attitudes, but those in remote areas, the elderly, and others who find it difficult to travel are enthusiastic. When governments and administrators agree to fund more telemedicine services, there are enough enthusiastic patients and physicians to provide a wide array of multi-disciplinary services geographically. nto