What is Telemedicine?

April 1998

As the health care system continues to change and adapt to the new realities associated with finance and management restructuring, the technological side of patient care also has changed. Telemedicine is a new word found in the constantly changing vocabulary of the American health care system. But what is telemedicine? Telemedicine is the use of electronic information and communication technologies to provide and support health care when distance separates the participants. It is a system that connects primary care physicians, providers, specialists and patients. Telemedicine is not a new concept. It has existed for a number of years in the form of the telephone and fax machines. In recent years, with the improvements made in access, technology, and communications systems, telemedicine has expanded and, in a time of limited resources, has become a feasible alternative for smaller and rural medical facilities to provide routine and specialized services. Particularly in rural areas, it offers the potential of both improved access to care and improved quality of care.

Applications of Telemedicine

The primary applications of telemedicine are clinical, educational, administrative, and research. Clinical applications include initial patient evaluations, diagnosis (telediagnosis), and consultation (teleconsultation). Physician supervision of non-physicians and monitoring of patient status are possible. Continuing education for professionals is available, as is patient and community education (tele-education). Administrative uses, such as conferences, scheduling, and utilization and quality review may be provided. Research is enhanced by aggregation of data from multiple sources and coordination.

Telemedicine allows access to the wealth of information available on the Internet. This allows information to be at the touch of a finger. The availability of e-mail allows an efficient mechanism of communication between consulting and primary physicians. Communication between facilities is enhanced.

Transmission and Equipment

Text, images, and sound are transmitted. Text includes EKG results (heart tracings), lab results and patient records. Images range from still photographs to full motion imagery. Radiological images, slides and graphics may be transmitted, as well as voice and chest sounds. Transmission may be done in one of two methods: Real-time or Store and Forward. Real-time transmission is utilized when immediate feedback is essential. Emergency triage, interactive treating situations and meetings are a few examples. When immediate feedback is not required, store and forward may be implemented. Data is stored, forwarded and accessed at the hub at a scheduled time or
at the convenience of the hub personnel. This is less costly as data can be compressed and batched for transmission. Transmission equipment varies according to the transmission mode, analog or digital, and the means of transporting the mode, satellite or terrestrial. There are two transmission modes. The first is analog, which is the transmitting of waves, similar to television broadcasts. Its advantages include high resolution and familiarity. The high expense associated with transmission, large size, and complexity of required hardware are disadvantages. The digital mode utilizes the transmission in the form of "bits". Transmission costs, smaller equipment, simplicity of operation, ease of interface, (including the storage and revival systems for image and data) are several benefits of this mode. The digital mode is preferred due to cost, usability, and expansion potential.

The transmission mode may be transported via satellite or terrestrial media. Terrestrial modes include microwave, fiber-optic, and conditioned copper cables. Satellite transmission allows a full motion broadcast quality picture. Most satellites transmit analog signals. Signals may be transported on C-Band or KU-Band. The C-Band is often utilized by local telephone companies, requiring coordination of availability. The KU-Band, utilized by television stations, is more widely available.

Satellite transmissions have no boundary restrictions. It allows transmission of large amounts of information. It is ideal for sending visual information to multiple locations. The disadvantage is the cost. It is approximately eight times as expensive as terrestrial transmission. The cost may be as high as $450 per hour for prime time use to $250 per hour for non-prime time.

Terrestrial transmission is less expensive to operate on an hourly basis but is limited to areas that are linked to the appropriate line. Video transmission normally requires a bandwidth (carrying capacity) of 90 million bits per second (Mbps). A telephone call requires 64 thousand bits per second. The fastest speed available with current digital technology is 1.54 Mbps. This requires a bandwidth commonly referred to as T1. T1 consists of 24 voice channels which may be combined with higher bandwidth as needed. The higher the bandwidth, the better the image quality. Higher cost is the trade off for better image quality.

Fiber-optics are available from long distance and local telephone companies. Optical fibers consist of strands of hair-thin glass and uses light to transmit telecommunication signals. They may be leased as a dedicated line or on-demand basis. Optical-fiber has a wide bandwidth allowing for choices of transmission speed. Due to cost constraints, T1 line is not available in all areas. Satellite transmission requires an up-link to the satellite and a down- link to the location. The KU-Band satellite dish is relatively small and portable on a truck. The C-Band satellite dish is large and not very portable. If the satellite transmission is digital, equipment is needed at each site to translate analog signal to digital.

The CODEC (Coder,DECoder) is the heart of the system. The CODEC transforms the analog signal (the picture) picked up by the video camera to a digital signal and compresses it from transmission to the distant site. Another CODEC, at the distant site, transforms the digital signal for viewing on the video monitor. The CODEC, a computer, needs enough memory to transmit and store text and images, such as patient records and educational material.
Each site requires a camera to transmit live images. At each site a speaker and monitor are required so users can see and hear each other. In addition, a site requires a multiplexer, a device that allows two or more signals to be sent over the same path. A CSU/DSU (Channel Services Unit/Data Services Unit) converter is needed to interface to the T1 service. A wide variety of medical devices (e.g. cardiac monitors) are available for the remote sites.

Benefits of Telemedicine

Telemedicine allows patients to receive medical care in their own community. This increases the financial viability of rural medical facilities and strengthens the rural economy by keeping the flow of resources in local communities. Telemedicine assists in providing specialty care services to rural areas and provides more efficient use of medical resources which may lessen the amount of travel time for both patients and the specialist. Continuity of patient care is enhanced when the patient, primary care physician, specialist and family members are involved during a consultation. Should the patient be required to be transferred to an urban facility, they have already met the physician who will be caring for them.

Physicians and on-site care providers benefit as they receive quick and efficient consultations. The sense of isolation experienced by rural physicians is also reduced. The formation of health care networks between rural and urban facilities provide benefits to both. Urban based facilities provide accessibility of health care to rural areas. However, there are telemedicine networks where the excess capacity of rural facilities can be tapped into to benefit urban patients. It is possible that during peak times rural physicians may be accessed via telemedicine to provide more timely care to patients waiting in congested urban emergency rooms.

Challenges of Telemedicine

Several obstacles remain with regard to the effectiveness of telemedicine. Legal issues regarding physician licensing, liability, and patient confidentiality exist. As physicians are licensed by states, this presents a legal problem when physician consults cross state lines. It is necessary in order to fully benefit from telemedicine that states engage in interstate provision of service. Currently, interstate agreements vary greatly. Several states maintain that physicians must be licensed in both the sending and receiving states. Other states have entered reciprocity agreements with neighbors.

Liability is an obstacle in providing telemedicine. There is debate related to which physician would be liable for a poor patient outcome, the primary care or the consulting physician. In the case of a poor outcome, it is not clear if the patient should file suit in the residing state or in the state the practitioner is located.

Cost is a significant barrier to access. It has been estimated that the startup cost for a rural facility can be $100,000. In addition to start up costs, consideration must be given to the charge by the consultation team. This may range from $75-250 per hour, depending on the type and number of consultants involved. Transmission charges can be costly. Some progress has been
made in this area with the passage of the Telecommunication Competition and Deregulation Act of 1996. As of January 1, 1998, the Federal Communications Commission (FCC) and states can require affordable, quality communication services. Included is an amendment requiring public and non-profit rural health care providers access to telecommunication service at prices comparable to those paid by urban customers. The rules specifically authorizes discounted rates for telecommunication distant charges, toll-free access to the Internet, and telecommunication services of bandwidth up to and including Mbps (T-1).

Reimbursement has been another obstacle in providing telemedicine services. Medicaid covers telemedicine consultation in only ten states. Medicare will reimburse for telemedicine services provided in rural counties that are designated as health professional shortage areas. This Medicare provision, authored by North Dakota Senator Kent Conrad, was part of the Balanced Budget Act of 1997. Most commercial payers do not cover routine telemedicine consultation.

Physician reluctance and patient apprehension are also obstacles. Some rural physicians fear the loss of patients to urban facilities. The public and physicians worry about the impersonality of telemedicine.

Please contact the UND Center for Rural Health for a reference list.