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Telemedicine and the delivery of health services to veterans with multiple sclerosis

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Abstract—Telemedicine involves the provision of health care and sharing of medical knowledge using telecommunications technologies. Preventive, diagnostic, and therapeutic services, as well as patient education and assistance with self-management of health, can be provided via telemedicine. The Veterans Health Administration (VHA) has a wide range of telemedicine capabilities. Given limitations on studying its effectiveness, telemedicine is often applied to new patient populations without explicit evaluation of efficacy. Evaluating the potential use of telemedicine services through supporting literature from other disorders may be possible. This paper discusses applying telemedicine to the care of individuals with multiple sclerosis (MS) when few published evaluations exist in MS. In this paper, we (1) provide a background on the use of telemedicine in the private sector and in the VHA, (2) discuss the use of current telemedicine literature to management of individuals with MS, and (3) review the strengths and limitations of telemedicine as a care delivery vehicle.

Key words: cost-benefit analysis, health services, MS, multiple sclerosis, review, telemedicine, translation, veterans.

INTRODUCTION

Telemedicine has been described as "the use of electronic information and communications technology to provide and support health care when distance separates the participants" [1]. Although this definition can include conventional telephone use, telemedicine typically refers to more recent telecommunications systems, such as interactive video conferencing, store-and-forward image techniques, remote medical record access, and remote patient monitoring.

Abbreviations: BBA = Balanced Budget Act, CBOC = Community-Based Outpatient Clinic, CPRS = Computerized Patient Record System, CT = computed tomography, DSL = digital subscriber line, EKG = electrocardiogram, EMR = electronic medical record, FDA = Food and Drug Administration, FSMB = Federation of State Medical Boards, HCFA = Health Care Financing Administration, HIPAA = Health Insurance Portability and Accountability Act, ICD = Implantable Cardioverter Defibrillator, IOM = Institute of Medicine, MRI = magnetic resonance imaging, MS = multiple sclerosis, NMSS = National Multiple Sclerosis Society, PC = personal computer, POTS = Plain Old Telephone Service, PVAMC = Portland Veterans Affairs Medical Center, SCI = spinal cord injury, VA = Veterans Affairs, VAPSHCS = Veterans Affairs of Puget Sound Health Care System, VHA = Veterans Health Administration, VISN = Veterans Integrated Service Network.

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Telemedicine was first used in the 1950s and developed in parallel with a budding telecommunications industry. Between the 1950s and 1970s, experimental grant-funded telemedicine programs could be found in a diverse range of settings, including Native American reservations, psychiatric hospitals, prison systems, and medical schools [1,2]. Of all the telemedicine programs established before 1986, none has survived [3], generally reflecting their inability to maintain financial self-sufficiency and/or demonstrate efficacy.

The last 10 years have seen explosive growth in telecommunications for video and data transmission. Store-and-forward technology, defined as the process of storing images or data and forwarding them to a provider for review, was virtually unused before 1995. Refer to **Table 1** for a description of terminology. After 1995, however, the number of store-and-forward teleconsultations increased from less than 2,000 in 1996 to almost 12,000 in 1997 and 27,000 in 1998. Total private sector teleconsultations have more than doubled each year from 1995 to 1998, reaching

Table 1.
Forms of telemedicine with description of terminology.

Characteristic	Teledermatology and Teleradiology Applications	Live Conferencing such as Cancer Care	Home-Based Support	Home-Based Record Access or Training
Timing: Real time vs. “stored and forwarded” to others for analysis. In real time, participating parties are connected at the same point in time. In store-and-forward telemedicine, one party stores an image or data for later review by others.	Most frequently store and forward. Created by local cameras or imaging devices and sent to specialists for review.	Real time to allow for discussions and review of images.	Real time with store and forward for select images, such as skin checks.	Real time or stored.
Type of Transmission: Sharing of text, still images, video, interactive telemetry, and data.	Still images and/or video stored.	Video. Some centers allow for sharing of MRIs, CTs, and other medical images.	Most commonly video, but data can be transmitted such as diabetes info or heart sounds over some devices.	Data with streaming video for education; seldom live video.
Orientation: Audience for telemedicine can be oriented toward the professional or nonprofessional.	Professional.	Mostly professional. Can use conferencing to support patient or family conference.	Nonprofessional unless home-based care-provider training.	Nonprofessional.
Point of Delivery: The hospital or tertiary center to community clinics or home.	Tertiary care centers.	Tertiary care centers.	Home. Often for patients with reduced access to community.	Home.
Medium of Transmission: Medium such as plain old telephone service (POTS), internet, digital subscriber lines (DSL), cable modem, or high hospital networks.	Depends upon bandwidth needs. Higher bandwidths can support high-quality (resolution) images, CT, and MRI; lower bandwidth connections can only support low-image quality.	For sharing of images, high-bandwidth connections from 126 to 764 kB/s. Some low-resolution conferences where audio and video only can be accomplished over POTS.	Most commonly POTS; potentially replaced by DSL and cable as access to these services improves.	POTS.

90,000 consultations in the United States in 1998 [4]. See **Figure 1** [5].

This growth has been fueled by both increased bandwidth capacity over standard telephone networks and by the sharp decline in the cost of devices that can capture, store, and transmit images and other digital data. Costs for a telemedicine workstation capable of performing interactive video conferencing have dropped from $50,000 to $100,000 in the mid-1990s to under $10,000 in 1999. At the same time, these devices have higher quality and greater versatility [3,4]. This improved access to technology has led to advances such as low-cost personal computer (PC)-based video conferencing; electronic home-monitoring systems; electronic medical record (EMR) systems, capable of advanced imaging; worldwide web-based patient education; and even web-based electronic medical records available to patients. High-capacity digital networks, improved switching technology, and a rapid growth in computer-accessible medical records have also increased interest in technology that can extend the boundaries of typical medical service delivery.

Finally, the increased interest in telemedicine services have also been fueled by the economic landscape of increasing managed care, decreasing medicare reimbursements for home care, and a general trend toward more patient-oriented health care. Legislation such as the recent passage of the Telecommunications Act of 1996 has helped finance the delivery of high-bandwidth connections to rural populations. With many of the technological issues resolved, the growth of telemedicine is now primarily limited by concerns about licensure, financial and reimbursement issues, security and confidentiality issues, and liability and logistic concerns [6].

Telemedicine has also seen significant growth within the Veterans Health Administration (VHA). The VHA is one of the largest health care organizations in the United States and provides services to 172 medical centers, 551 ambulatory care and community-based outpatient clinics, 131 nursing homes, 40 domiciliaries, and 73 comprehensive homecare programs. It cares for approximately 3.6 million veterans annually. The VHA is faced with the challenge of serving a growing number of aging veterans with complex and chronic diseases and reduced resources. Veterans are older than the general population,

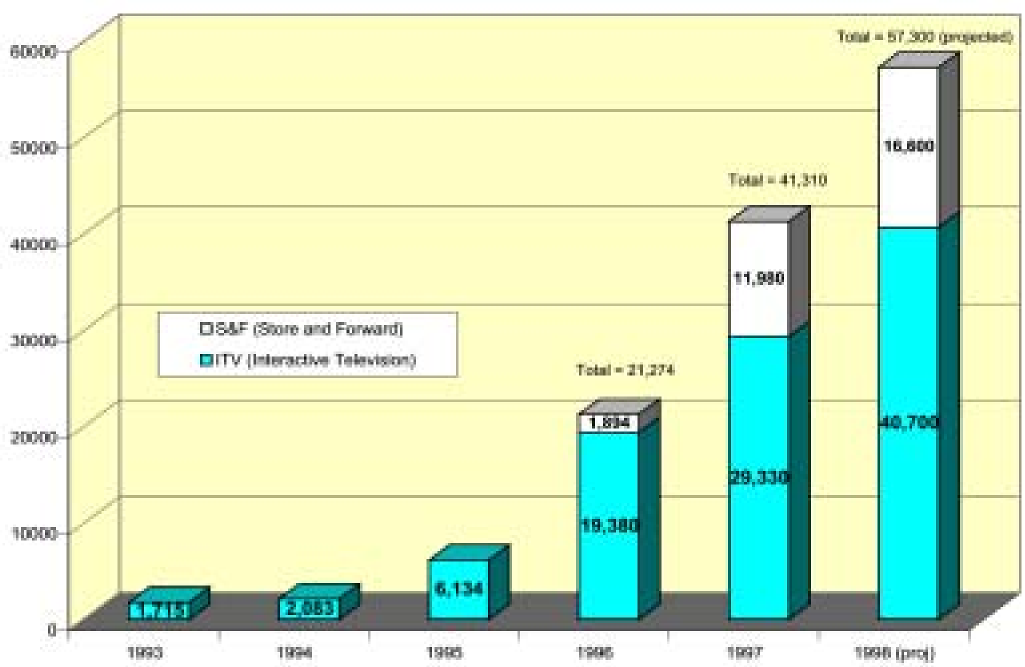

Figure 1.
Number of teleconsultations, 1993–1998 (U.S. only). Reprinted with permission. *Source*: Allen A, Grigsby B. 5th annual program survey—Consultation activity in 35 specialties. Telemed Today 1998;6(5 Pt 2):18–19.

with close to 40 percent over the age of 65 (compared to 17 percent of the general population), greater than 70 percent with incomes less than $20,000 (compared to 30 percent in the general population) and 50 percent traveling more than 25 miles for care [7,8]. Veterans also report substantially worse health status. For example, a recent study found that for seven of the eight scales of societal role limitations because of physical problems, bodily pain, health perceptions, vitality, and mental health, veterans scored considerably lower than age-matched nonveteran controls [9].

In addition to disability, veterans are challenged by geography in obtaining care. Veterans who reside in Veterans Integrated Service Network (VISN) 20 are particularly susceptible to distance barriers, as shown in **Figure 2**. VISN 20 comprises one-fifth of the landmass of the United States, covering 788,500 square miles and serving almost 160,000 veterans. It includes two tertiary care hubs: Veterans Affairs of Puget Sound Health Care System (VAPSHCS) and the Portland Veterans Affairs Medical Center (PVAMC). The VAPSHCS hub provides primary and specialty care to veterans in five medical centers in three states (Washington, Idaho, and Alaska). Anchorage is 2,500 land miles and 1,500 air miles from VAPSHCS. Facilities in the entire VISN 20 are on average between 150 and 500 miles apart. Geographic spread, mountainous terrain, hazardous winter weather conditions, and congested traffic in the cities create challenges for the delivery of consistent services for veterans. Given the geographic and demographic diversity of veterans in the VISN 20 region, use of telemedicine is an appealing mechanism to improve access and quality.

METHODS

Evaluation of Effectiveness of Telemedicine

Before the adoption of new technologies into routine clinical use, most devices are required by the U.S. Food and Drug Administration (FDA) to be evaluated for safety and efficacy. Telemedicine devices, with the exception of some wireless medical telemetry devices, are not routinely regulated but require a premarket notification (510 k) that will be subject to review by divisions of the FDA. There is growing acceptance that telemedicine programs and techniques should be evaluated as to their relative efficacy when applied to new populations or to treat new medical disorders [10]. The Institute of Medicine (IOM) developed a minimum specification standard for evaluation of a telemedicine program that assesses domains of quality, access, cost, and acceptability [1]. The IOM defines quality to be "the degree to

Figure 2.
Geographic distribution of sites in the VHA VISN 20 telemedicine network.

which health services . . . increase the likelihood of desired health outcomes." Access is defined as "the timely receipt of appropriate health care." Evaluation of the cost domain could be assessed with cost-effectiveness or cost-benefit analyses. Acceptability includes factors such as provider and patient satisfaction and perceptions. The IOM framework was central to the 1997 Health Care Financing Administration (HCFA) telemedicine payment demonstration program, which attempted to justify expanding further reimbursement [11]. This framework is useful for assessing a telemedicine intervention by researchers, clinicians, consumers, health plans, policy makers, and patients.

Anecdotal and quasi-experimental studies support the use of telemedicine; however, few empirical or controlled trials address safety, efficacy, and cost. In 2002, 5 years after the IOM report was published, a systematic review by Hailey et al. of the published literature examining telemedicine applications still shows limited scientific justification for their application in health care [12]. This review reports that of the 1,323 articles surveyed, the majority had significant methodological limitations. For example, less than 5 percent (66 papers) of the published telemedicine literature reported valid comparison groups, and few of these had follow-up data on clinical outcomes or health status of patients as a result of telemedicine interventions. Of these 66 studies, 41 were cost or economic analyses, 11 were randomized clinical trials, and 44 were deemed sufficient to influence policy decisions. Over three-quarters of the studies reviewed suggested that telemedicine had advantages over the alternative approach. The particular advantages of the telemedicine approach varied according to the type of application. For example, studies on telemedicine used for medical consultation showed gains in efficiency and costs. Studies looking at the outcomes of home care telemedicine generally suggested gains in clinical outcomes and costs. Burn treatment and ophthalmology telemedicine programs showed advantages in terms of patient convenience in reducing travel, which, in turn, reduced travel costs. The most compelling evidence on the efficacy of telemedicine was given by the studies on teleradiology, telemental health, and home care telemedicine [12], based on the strength of study design and the number of studies providing evidence in multiple IOM domains [10,13].

Research in telemedicine has been limited in part because of the lack of financial and human resources. Potential clinical sources of funding are reluctant to fund telemedicine because it appears to be in the research realm. Research sources are reluctant to provide funding because proposals appear to address a clinical need. In addition, the studies themselves are difficult to design and perform. Potential industry support is spent on advancing technology rather than demonstrating the effectiveness of an existing technology. Junior faculty are often most familiar with the applications of the technology, yet are not necessarily mentored to perform telemedicine research because of a risky funding base and an incorrect perception that telemedicine research is not as valued as other basic research or clinical efforts. Limited resources slow the incorporation of potentially valid new delivery mechanisms into clinical practice.

The VHA has evaluated telemedicine programs using mostly observational studies to assess all four of the domains (mentioned earlier) specified by IOM. Small studies evaluating cost reductions for specific programs have been performed. One example is the Implantable Cardioverter Defibrillator (ICD) clinic via telemedicine in VISN 20. **Table 2** demonstrates cost savings from travel alone. Further cost reductions may result from improvements in quality of care and intangible benefits from patient-related improved outcomes and satisfaction. This study, like most cost studies, is limited in that indirect costs are not included. Examples of such indirect costs include reductions in such expenditures as cost of delayed diagnosis or costs incurred by family members. More thorough evaluations of cost are limited in the VA for the same reasons as in private industry: limited financial and administrative support.

Even with funding, researchers must address numerous design issues to perform scientifically valid and clinically meaningful studies. The specific research question and intervention must be carefully considered. Even though the IOM provides a valuable framework, finding

Table 2.
Travel cost savings data, ICD clinic, January to December 1999.

Initiating Site	Number of Patients	Travel Cost ($)	Total Travel Savings ($)
A	78	114.00	8,892.00
B	60	326.00	19,560.00
C	34	106.00	3,604.00
D	15	38.00	570.00
Totals	187	N/A	$32,626.00

valid and reliable outcome measures is difficult. Studies with relatively concrete diagnostic assessments, such as skin wound staging or radiology assessments, are typically more feasible than evaluation of somewhat more complex clinical questions, such as assessing fall risk, fatigue, and other issues where assessment criteria are imprecise and interrater reliability is low. The Alberta Heritage Foundation for Medical Research and the Finnish Office for Health Care Technology Assessment have provided some suggestions on optimal design of telemedicine studies that address some of these challenges [13,14]. Despite the financial and methodological challenges, good clinical research in the field of telemedicine does exist and this research can be applied to related clinical programs.

Roine et al. and Hailey et al. indicate that telemedicine programs often start without a definitive evaluation of efficacy or effectiveness for that particular application or population [10,12,13]. While the FDA does not require such evaluation, systemic evaluations can improve the quality of care by applying telemedicine in the most appropriate settings. Evaluations can also assist policy makers and health care administrators demonstrate the cost benefits and cost-effectiveness of telemedicine. As just discussed, many challenges face those who set out to evaluate telemedicine approaches prior to any new implementation. Is it necessary to first prove efficacy in every new population of patients or any new medical disorder before applying telemedicine to improve access, cost, or efficacy? Roine et al. suggest that telemedicine should be considered a new technology and, as such, should be assessed as other new health care technologies and be compared to the alternatives on the basis of technical, clinical, economic ethical, legal, and organizational issues before implementation [10,12]. It is not necessary for these assessments to be tied to a diagnostic class of patients.

Using Literature To Apply Telemedicine to Populations with MS

In this section, the current literature in telemedicine is reviewed and applied to the care of individuals with multiple sclerosis (MS) with the assertion that such research can be translated without specific evaluations in this population.

Individuals with Multiple Sclerosis

MS is a complex progressive disease that can result in numerous secondary impairments, which lead to accumulated disability. Optimal treatment with disease modifying agents and prevention or treatment of impairments is key to minimizing disability. Addressing multiple impairments can be challenging during outpatient office visits, especially when a primary provider sees relatively few individuals with MS each year or when frequent contact with specialists is not practical. Both of these situations exist in the VHA. Telemedicine can extend traditional outpatient services.

Based on a needs-assessment study commissioned by the VHA in 2000, veterans with MS have significant barriers to care as a result of their disabilities [15–17]. The findings of this study indicate an overwhelming need for improved access [15]. For example, 20 percent of patients surveyed reported that parking, distance, or transportation significantly interfered with receiving treatment at the VA. Half of those surveyed reported they had a severe gait disability or were mobile only with a wheelchair. A third of veterans surveyed required help getting to all activities and another third never drove. Yet, only half of the individuals surveyed reported that they had a caregiver or family member to take them to the doctor. Twenty-percent report that they lived alone. Preliminary analyses suggest that the restrictions in mobility are inversely associated with treatment of MS and secondary impairments. Disabling conditions may be limiting access to specialty centers and optimal treatment.

Telemedicine Literature and Treatment of Individuals with MS

Telemedicine could improve access to services for individuals with MS who live a distance from specialty centers or have mobility problems that limit access in an urban environment. In this section, the literature on the use of telemedicine that pertains to impairments seen in individuals who have MS is reviewed. In instances where the literature is of sufficient quality and supports the use of telemedicine, we support applying this technology to benefit this population. Treating decubitus ulcers, depression, and mobility impairments in MS are among those most challenging. Well-designed studies already exist in the telemedicine literature that evaluate the management of these conditions using telemedicine in other diseases. Health services issues, such as improving access and quality and cost of care, have also been well studied, and the conclusions are generally applicable to the management of MS. Translating existing work to the management of MS may have numerous clinical and financial benefits.

Skin and Wound Care

Given the sensory deficits often seen in MS, impairments such as decubitus ulcers are common. Decubitus ulcers are caused by excessive pressure and may be associated with other impairments, such as spasticity and neurogenic bladder and bowel. Treatment involves removing pressure and treatment of other underlying conditions. Ineffective treatment can result in sepsis and death [18–20]. “The hardship” of frequent travel often deters effective follow-up. Given this problem, telemedicine has often been used to monitor people with decubitus ulcers who require frequent dressing changes or who are at high risk for cellulitis or osteomyelitis. Moreover, many other skin problems can be avoided and treated effectively via telemedicine. The IOM domain of quality has been addressed in several studies and strongly supports the use of telemedicine to skin impairments [21–29]. It is anticipated that future changes in technology that increase resolution, color contrast, will further enhance our existing ability to monitor and manage impairments of skin using telemedicine [23].

Frequent virtual visits may also enhance usual care and improve access and quality of care. In a study comparing individuals with decubitus ulcers receiving standard home care to a group receiving home care plus frequent telemedicine visits by a nurse, Kobza and Scheurich found that the healing rate for all grades of ulcer (except grade III) improved by adding frequent telemedicine visits [29]. On the basis of cost, an estimated 70 and 80 percent of home care costs are attributable to wound care [28]. This study demonstrated improvements in efficiency and profit margin with the use of telemedicine to augment in-home visits.

Mental Health

Depression, cognitive impairments, and mood disorders are frequent problems among individuals with MS. Lifetime prevalence of a major depressive episode in the MS population is roughly 50 percent [30–32]. This rate far exceeds rates found in samples of patients with medical or neurological disorders [33,34]. It has also been estimated that only a small percentage of persons with depression receive adequate treatment [35]. As well, Kazis et al. reported that veterans as a group scored far lower than age-matched nonveterans on measures of mental health status, particularly in younger age ranges [9]. In the VISN 20 MS care assessment discussed previously, 17 percent had met criteria for major depressive episode on self-report and 15 percent stated that they had not been able to obtain care when they needed it. Based on such statistics, increased access to mental health services in MS appears warranted.

Telemedicine is routinely used in the provision of mental health services and has supportive scientific evidence in the IOM domains of quality, access, and cost. In a program review, mental health was a component of 43 of 139 telemedicine programs surveyed and accounted for 18 percent of all telemedicine consultations [5]. Telemedicine appears to augment the use of antidepressants in outpatient management of depression [36]. A study compared a group receiving usual physician care to a group receiving usual care plus a nurse telehealth specialist and a third group using both usual care and telehealth with peer support. This study demonstrated a significant reduction in depressive symptoms, improved mental functioning, and treatment satisfaction in the telehealth groups. No additional gains were achieved by adding peer support, and medication adherence did not change with either intervention [36]. In the IOM domain of cost, Trott and Blignault assessed the delivery of a mental service by telemedicine and found over a $100,000 annual reduction in cost of care for 50 patients. The study also found significant reductions in need for travel and a 40 percent reduction in patient admissions as a result of the telemedicine intervention for mental health [37]. Doze et al. found that a telepsychiatry program for rural communities had a break-even cost point at roughly 396 consultations a year [38], and Hubble et al. demonstrated the ability to evaluate and manage the cognitive disorders in Parkinson’s dementia over long distances [39]. Treatment of depression and other cognitive impairments have been well documented in the literature as to their effectiveness, and it appears appropriate to translate these findings to an MS mental health program augmented by telemedicine.

Impairments Restricting Mobility

Loss of lower-limb sensation and motor function and spasticity can restrict mobility and cause gait disorders in persons with MS. In a study of 122,000 individuals with MS, 60 percent of them needed assistance with mobility [40]. In the VISN 20 Needs Analysis, almost half of those surveyed reported that they had a severe gait disability or were mobile only with a wheelchair. More than 10 percent of these individuals stated that they did not receive care for their mobility deficits when they felt they needed it. Frequent monitoring and adjustment are recommended to prevent secondary disabilities. Assessment and management are necessary to address spasticity changes and prevent contractures, as well as to treat impairments such as weakness and fatigue with appropriate assistive technology. Assistive technology, such as a cooling vest, ankle foot orthotic, cane, walker, or wheelchair, is useful to prevent disability in individuals with MS. Assistive technology in the home, such as adaptive bathroom equipment, environmental control systems, transfer lifts, and adaptive beds, can greatly enhance activities of daily living. To be effective, the assistive technology must address a specific impairment, be appropriately prescribed in the setting of a shared decision making between the individual and the clinician, and provide the individual with MS the necessary training and follow-up to enhance acceptance and use.

Using telemedicine, researchers have studied assessment and management of mobility disorders using the IOM domain of quality. Craig et al. reviewed aspects of the neurologic evaluation over telemedicine and determined that the reliability of the physical evaluation is "very good" for coordination, plantar, and deep tendon reflexes, but "fair to moderate" for assessing eye movement [41]. Telemedicine has been used successfully to assess and manage falls [42], as well as to assess and prescribe orthotic devices [43], assess remote falls [42], and successfully evaluate Parkinson's dementia over long distances [39]. Elements of the examination that involve eloquent or rapid motion are often hampered by insufficient frame rates or bandwidth.

In the IOM domain of acceptance, falls assessment has been evaluated in a pilot study conducted by VISN 20 to evaluate the feasibility of using telemedicine to assess fall risk amongst veterans residing in state homes operated by the VHA that are geographically distant from their tertiary care referral center. Polling staff assessed satisfaction and acceptance. Despite the staff's relative lack of technical knowledge and exposure to telemedicine, their attitudes toward accessing medical records remotely and using teleconferencing to present patients were positive. Subjective feedback indicated that the staff from the remote facilities felt that the program improved timeliness in scheduling specialty consultations, improved continuity of care through enhanced communication and exchange of patient information, and enhanced involvement of clinical staff in direct assessment of patient for early diagnosis.

Telemedicine holds great promise for evaluating movement disorders in a population such as MS, where these impairments result in substantial disabilities. Telemedicine may play a role in both in-home assessment and follow-up and in interfacility consultations.

Health Services

Telemedicine services can either be provided as a professional consultation service where a provider requests an opinion or an evaluation from another provider. Provider-to-provider consultation often occurs within the same health care system. Telemedicine is also used to support individuals in their homes either by providing home health care services or by transmitting health information to or from the patients' homes. Examples include patients' access of their medical records, ability to enter patient-related health care data, and linkage of devices, such as diabetic monitoring equipment or cardiac pacemakers [44,45]. Provider-to-provider telemedicine is used extensively in large health care organizations like the VHA where resources may exist within a network but may not be in geographic proximity to the patients. Telemedicine has been used and evaluated to treat isolated conditions that may occur as secondary impairments in people with MS. The use and evaluations of these programs in isolated settings may extrapolate to the comprehensive care of the individual with MS.

Telemedicine is changing not only the way services are delivered within an organization but also across organizations. For instance, the Stanford Medical Center provides teleconsultations services in cardiology and dermatology to regional providers, such as the San Jose Medical Group and the Drew Health Foundation [1]. This is advantageous to both: Stanford has developed a self-sustaining telemedicine program while regional clinics do not need to develop specialized tertiary care programs. In the VHA, telemedicine is being used commonly to share information between a tertiary center and another center within a regional network. Telemedicine and, in particular, telerehabilitation may play an increasing role by health care organizations to facilitate improved efficiency and access [46].

One can envision similar arrangements being developed across organizations for the management of individuals who have MS. Specialized centers that provide comprehensive services for MS are located in primarily large urban tertiary settings. People who do not live in these areas do not receive access, must be referred by a provider, or are self-referred. These individuals and family members travel a distance to receive a comprehensive evaluation and treatment plan. The individual with MS may be seen only at one point in time, with variable follow-up. Training is intense and follow-up materials include handouts and videotapes. Communication with the provider is often limited to a written report. Consider the value of a telemedicine network that crosses organizations to provide comprehensive services to individuals with MS and ongoing provider support. Such a system would link a center specializing in MS with a community-based health provider. While initial in-person evaluation might be necessary, telemedicine would permit virtual face-to-face discussion of diagnosis with the regular provider, on-line access to latest evidence-based treatments for MS and its secondary impairments, virtual home evaluation, virtual group treatment for mental health disorders, and caregiver and ongoing family training and support.

Given the number of emerging new medications, the many sequelae of MS, many providers voice the need for guidance in the ever-changing management of MS. The model of support to adopt telemedicine for providers potentially varies according to the structure of the particular health care organization and the organizational needs. Private health care systems might use a contractual arrangement for specialty consultations to tertiary care centers using telemedicine services.

Patient Support

Patient education, training, and support can potentially bring significant capability to individuals with MS to self-manage their disease. As with other medical conditions, a vast array of on-line Internet-based support exists, making health care among the top reasons individuals access on-line services. The increased prevalence of inexpensive video devices and high-bandwidth digital subscriber lines (DSLs) and cable modems provide the capability to develop video-based or email-based discussion forums and chat rooms. Large group webcasts or web-based video forums may evolve into more individualized interactive training via Internet or intranet networks. Organizations such as National Multiple Sclerosis Society (NMSS), MSWatch.com, and major center sites already include traditional educational materials such as text, PowerPoint presentations, and streaming video. Consider the value of a virtual in-home visit with transfer training and shared problem solving ways to maintain provider and patient education. Support groups using Plain Old Telephone Service (POTS)-based systems, Internet, or a community-based teleconference facility should be arranged to increase adherence in disease-modifying treatment or to provide mental health therapy for depression. In **Figure 3**, a social worker is running a caregiver support-group by live teleconferencing in VISN 20. People impacted by MS have indicated an acceptance of telemedicine for support.

Improving the support of patients in their homes can even take the form of organized electronic communication. Borowitz and Wyatt studied the experiences of a clinic using email to improve communication and support pediatric patients and their families. This study demonstrated that for their population, email proved to be an effective way to communicate basic information to patients and their families. Each email response took approximately 4 min [47]. A great potential exists to support the care of the individual with MS with virtual networks of unidirectional and bidirectional data and video transmitted over currently available media, including the telephone and the Internet.

Telehome Care

There are a number of examples in MS where home monitoring may confer an improvement in cost-effectiveness and quality of care. Such monitoring provides a valuable link to patients who have limited access to their communities, such as people with significant mobility impairments, cognitive problems, fatigue, pain, severe cardiac and pulmonary disorders, or skin lesions requiring pressure relief.

Figure 3.
Social worker running a caregiver support group by live teleconferencing.

Evidence also suggests that increased access to electronic means of communication and education will be well received among individuals with chronic and disabling diseases [48]. Many individuals with MS have other illnesses, such as diabetes, asthma, and heart disease. Kaiser Permanente conducted a quasi-experimental study to evaluate the use of remote video technology for home monitoring in home health care. The project, the Tele-Home Health Research project, evaluated patient satisfaction, quality of care, and cost savings. Total mean cost of care for patients enrolled in the telehome health-monitoring program dropped from $2,674 per patient to $1,948. These patients included the most complex of the populations. The savings were represented primarily by reduced hospital admissions and shorter visit times [49]. In a study of home monitoring and management of hypertension, in the domain of quality, it was found that a home blood pressure monitoring device that reported data to a physician weekly was successful in reducing patients' mean arterial pressure [50]. Columbia University is currently testing home telemedicine units for the management of diabetes using devices that will be capable of real-time videoconferencing, sending blood sugar data as well as web access to medical information. This project plans to measure domains of quality by measuring blood sugar control, acceptability by measuring patients capacity to learn the devices, and cost-effectiveness by comparing overall utilization costs to cost savings in improved care [44]. Another example of home-based telemedicine is the telerehabilitation program at Shepherd Center in Atlanta, Georgia, where people with spinal cord injury (SCI) receive care for pressure ulcers using teleconferencing units over telephone lines that provide both store and forward images and live interactive video [51].

Programming of intrathecal baclofen pumps in the home or in nonspecialty clinics promises improvements in access, acceptance, and possibly cost. This model of care is well established in the VHA's telecardiology/ICD clinic. The clinics set up throughout the region have had 187 clinical visits in 1999. Patients living outside the Portland area had to travel up to 8 hours each way for follow-up visits and acute care. In addition, there were long waiting times, up to 90 days, to get into the ICD clinic in Portland. This patient population, once fitted for a defibrillator, must be monitored quarterly for the duration of their life. The clinic used a live interactive video conferencing system. The clinic requires a cardiologist consultant at the initiating site and a trained nurse practitioner and vendor technician at the remote site. During clinic, a patient is asked to report any noticeable health issues or changes in physical condition. The patient is then monitored with the use of an interrogation machine. Where necessary, the ICD treatment plan is changed and the technician recalibrates the defibrillator. The patient visit lasts approximately 15 min and requires no travel.

DISCUSSION

Telemedicine and Veterans Health Administration

Telemedicine has long been recognized within the VHA as a mechanism to provide care to veterans who live at a distance. Telemedicine can also provide a mechanism for large health networks to deliver care more cost-effectively, taking advantage of economies of scale. For example, centers of clinical specialization can service entire regions that are connected by efficient information technology infrastructure. The network map of **Figure 2** indicates the complexity of VISN 20's communication infrastructure that supports multiple centers of specialization. The VHA has invested heavily in telecommunications and EMR technology to improve access to individuals limited by disability or geography. In VISN 20 alone, information technology capital information technology investment has been between $10 and $15 million a year to support new technologies such as an EMR system, video conferencing, medical imaging, and a large PC-based infrastructure. In addition, the VHA in 1997 formed the Telemedicine Strategic Health Group as part of a coordinated national effort to leverage telemedicine in improving service delivery. The charter for this group was to "improve access, coordination, continuity, and outcomes of health care for veterans through the use of electronic information and communications technologies to provide and support health care when distance separates the participants" [52]. In 1998, the VHA performed 250,000 consultations via telemedicine [53]. Of the 22 VHA regional VISNs, 18 have some form of telemedicine activity [53]. The VHA is a highly conducive environment for telemedicine programs by virtue of its organizational structure and the unique characteristics of the individuals it serves.

In the northwest region, VISN 20 began a formal oversight of telemedicine programs in 1998 when it established a Telemedicine Program Coordinator and Telemedicine Committee to address the organizational issues implicit in telemedicine adoption, which include security, standards for documentation and technology, and credentialing. The dedicated telemedicine coordinator provides support for clinicians who have a need to augment their clinical practice with telemedicine, but are unfamiliar with the technology. The first equipment purchased under this program were both desktop PC-based systems (Armada Cruiser 384 Executive Edition, VCON Corporation) and high-end systems designed for permanent installation in conference rooms designated for teleconferencing (VTEL Corporation). Installation occurred at each site in the VISN. During 1999, the first fully operational year for the VISN-20 telemedicine program, the two tertiary care centers and eight remote sites provided over 1,000 health care encounters using telemedicine. The program has expanded rapidly and now includes cardiology, dermatology, diabetes, geriatrics, MS, oncology, ophthalmology, pain, and SCI. **Table 3** lists the present VISN 20 telemedicine activities.

The VHA's powerful national EMR system (Computerized Patient Record System [CPRS]) has continually developed novel mechanisms for patients and providers to access it using Internet and intranet telecommunication technology. Over the same period that the VHA developed the Telemedicine Strategic Health Group, the VHA's EMR imaging task force (VistA Imaging) provided CPRS the capacity to store still images and videos attached to specific progress notes for veterans. The VHA's EMR can continuously capture both inpatient and outpatient encounters and medical orders. This record is accessible from regional primary care clinics, called Community-Based Outpatient Clinics (CBOCs) facilities, from regional VHA hospitals and nursing homes, and by VHA providers in private homes or other remote facilities, such as academic affiliates. The medical record houses multiple forms of medical images, such as scanned copies of paper documents (consent forms), internally generated radiographs (MRIs [magnetic resonance imaging], CTs [computed tomographies], plain films, etc.), still images (EKG [electrocardiogram] reports and photographs), and video images (swallow studies or videotaped patient exams. These images can be forwarded to health care providers off-site. **Figure 4** depicts CPRS and the process used to document decubitus ulcers in the VHA EMR. Records such as these are available to practitioners independent of location as long as CPRS access exists.

Facilities such as VAPSHCS are also developing expanded web sites for enhanced patient education and easy access to VHA educational materials or services. In addition, the VHA is developing a form of remote EMR access called Health eVet. This system will allow patients to access most portions of the medical record and update personal demographic information, review their medical history, and complete clinical assessments from home. Veterans can also notify their providers about changes in their conditions and obtain advice about management strategies. The Health eVet system will be used to assist patients and providers in home comanagement of conditions, such as diabetes and hypertension. This system is currently in beta test phase in several sites across the country.

Barriers to Telemedicine Adoption

Developing new telemedicine programs and networks requires effective evaluation methods as just discussed. Making a new telemedicine program effective also requires anticipation of some of the barriers such programs face when introduced into health care networks, especially those with limited exposure to intensive information technology. Some of these barriers are discussed and include financial constraints, as well as legal, cultural, technical, and administrative challenges.

Cost and Reimbursement

One of the most significant barriers to telemedicine implementation is cost. The start-up costs for telemedicine infrastructure are high. Despite a dramatic reduction in per-unit costs over the last 5 years, start-up investment and maintenance costs of a telemedicine network are still high relative to per-episode reimbursement. As well, technology becomes obsolete quickly. The systems of VCON and VTEL teleconferencing units purchased by VISN 20 of the VHA in 1997 are now becoming obsolete and are currently being replaced by newer devices. Providers and patients often need technical support to adopt the technology successfully, which is often provided as additional support staff.

Reimbursement mechanisms in private practice are still in evolution. Medicare has historically provided only limited reimbursement for services that did not include the traditional face-to-face contact between a patient and practitioner. A few exceptions are EKG or EEG interpretation,

Table 3.
VISN 20 telemedicine programs.

Program	Facilities	Equipment	Live or Store & Forward	Operational
Cancer Center: Educational Conference	Open to all NA VAMCs, currently SP, AK	VTEL	Live to multiple sites store & forward (Vista Radiology)	Yes
Cancer Center: Tumor Board	Open to all NA VAMCs, currently SP, AK	VTEL	Live, multiple sites possible	Yes
Cardiology: ICD	POR, SP, BOI, WAL, ROS	VCON	Live	Yes
Cardiology: Catheterization	PSHCS, AK, SP	VTEL	Live, multiple sites possible	Yes
Dermatology NA	PSHCS SEA & AM LK, available to more	Sony Mavica: digital-still camera	Store & forward	Yes
Diabetes Retinal Project	PSHCS: Anchorage, SP	Joslin Camera: Still images	Store & forward	Yes
Geriatrics WA State Soldiers Homes	Vet homes in Orting & Retsil, WA	VCON	Live	Yes
Multiple Sclerosis	PSHCS, BOI, AK, POR, SP, WAL	VCON, VTEL, Sony Mavica Cameras, Tanberg	Live, store & forward	Implementation and beta phase
Mental Health	PSHCS AK, BOI, SP, WAL, WHT	Polycom	Live	Yes, equipment is deployed and clinics are starting
Pain Management	PSHCS (SEA & AM LK), AK, POR, SP, ROS, WHT	VTEL	Live	Yes, February 21, 2002
SCI: Telehome Care	PSHCS to individual vet homes	American Telehome Care POTS equipment	Live, over phone lines	Yes
SCI: VISN-wide consultation	PSHCS AK, BOI, SP, POR, ROS, WAL, WHT, MT	VCON desktops VCON meeting connect	Live, group up to 8 VISN sites	Yes, virtual meet & greets and clinics are now on

AK = Alaska
BOI = Boise
ICD = Implantable Cardioverter Defibrillator
NA = Northern Alliance
POR = Portland
POTS = Plain Old Telephone Service
PSHCS = Puget Sound Health Care System (SEA = Seattle, AM LK = American Lake)
ROS = Roseburg
SCI = spinal cord injury
SP = Spokane
WA = Washington
WAL = Walla Walla
WHT = White City

teleradiology, and telepathology, depending on individual Medicare carrier policies. HCFA does not routinely reimburse for telemedicine consultations. Efforts to expand the reimbursement have been limited by the observation that "there is very little published, peer-reviewed scientific data available on when telemedicine use is medically appropriate" . . . and . . . "it is difficult to project potential cost implications" [54]. Medicare currently limits reimbursement of

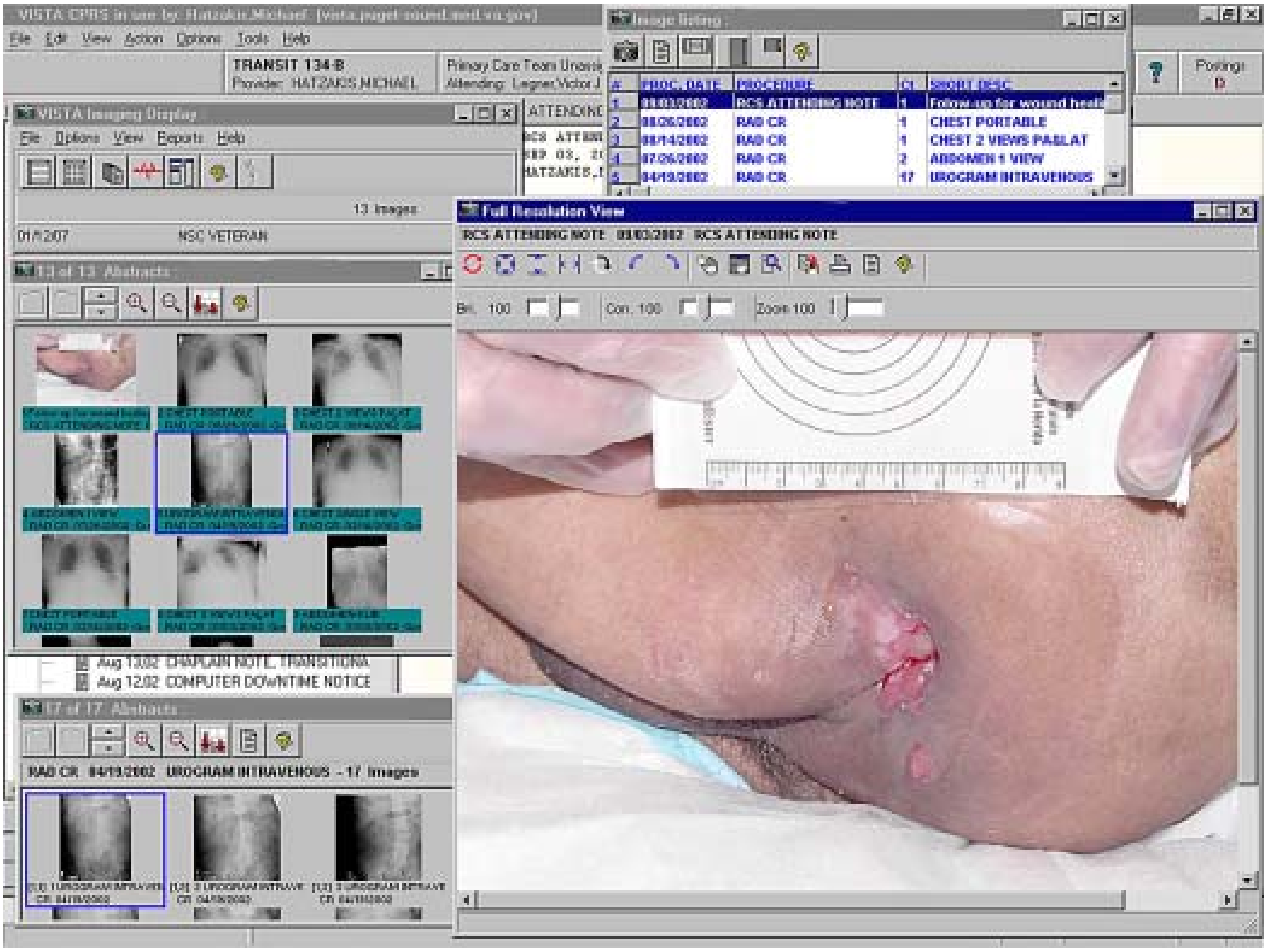

Figure 4.
Screen shot from CPRS and VistA Imaging.

telemedicine to professionals practicing in “Health Professional Shortage Areas” and further limited to live, not store-and-forward, face-to-face consultations as is described further in the following paragraphs. Regardless of the framework used, much more clinical study and political support will be necessary to expand Medicare and possibly other private insurer reimbursement [12].

As of January 1, 1999, congress has mandated HCFA to pay for telemedicine consultation services under the Balanced Budget Act (BBA). Reimbursement eligibility requirements are still restrictive though and limit telemedicine activities to “Rural Health Professional Shortage Areas” and to approved federal demonstration projects. The consulting telemedicine physicians were also limited to 75 percent of normal pay for their services yet HFCA reports consultant payment to the IRS at 100 percent. Most rural practitioners are not equipped to track such complex billing. HCFA also limited reimbursement to a small number of CPT codes under the BBA that greatly restricted the types of services for which practitioners could be reimbursed. HCFA reimbursement is also limited to cases where the eligible presenter must either be the referring physician or an employee of the referring physician. In many cases, the presenter is an employee of the local hospital or clinic. HCFA reimbursement does not generally reimburse for store-and-forward telemedicine except in cases of teleradiology and in the federal demonstration projects in

Alaska and Hawaii. HCFA has stated that the major concerns are based on the limited body of outcomes research looking at the cost-effectiveness of teleconsultations in the face of an unmanageable annual increase in current volume of services. Some relief for telemedicine providers can be found in recent Medicaid and private insurer policy changes. At least 20 state Medicaid programs, several state Blue Cross/Blue Shield plans, and other private insurers pay for select telemedicine services. Several states have recently passed laws that prohibit insurers from discriminating between regular medical and telemedicine services' reimbursement. These states include California, Texas, and Louisiana.

Given high start-up and maintenance costs in the face of uncertain reimbursement, unsurprisingly, telemedicine practice has occurred primarily within the contexts of federal demonstration projects, grants to rural practices, health care organizations where there is a system-wide or patient population-based cost benefit for providing these services, and those managed systems that will benefit from improved organizational efficiency, such as the VHA and Kaiser Permanente.

Legal

Significant legal barriers to adoption are a result of state-to-state accreditation and licensure requirements. Many telemedicine programs span several states, but the organization that regulates physician licensing, the Federation of State Medical Boards (FSMB), requires that "physicians who practice medicine across state lines without physically being located in the state where the patient encounter occurs either are required to have a full and unrestricted license in that state or are unregulated." Such restrictions have limited many telemedicine programs to intrastate communication or added the additional burden of multistate practitioner licensing. The FSMB has recognized the proliferation of practice of medicine across state lines as a result of routine, low technology practices, such as sending pathology slides from state to state or sending radiographs for second opinions. As a result of this movement, the FSMB has drafted legislation that proposes "establishment of a special license limited to the practice of medicine across state lines" for each state to use as model legislation for individual states to adopt. To date, only a handful of states have such legislation [55]. Since the FSMB proposed such legislation, the accreditation issue has grown even more problematic. As of 2002, 26 states have introduced licensure laws pertaining specifically to telemedicine that may make it more difficult for physicians to practice telemedicine across state lines [56].

The VHA, however, is not limited by interstate licensure limitations. Under the federal law, title 38 U.S.C. Sec. 7402 (b) (1) (C) states that "to be eligible for appointment to the positions in the administration" . . . "hold the degree of doctor of medicine or of doctor of osteopathy from a college or university approved by the Secretary, (B) have completed an internship satisfactory to the Secretary, and (C) be licensed to practice medicine, surgery, or osteopathy in a State." This federal statute allows a VA practitioner to practice in any state within the VHA system as long he or she holds a license in one state.

Malpractice concerns also attenuate the enthusiasm for telemedicine consultations. The legal liability of using a technology that, in many cases, is not considered the community standard for treating given disorders leaves open many liability concerns. There is movement to restrict telemedicine devices as medical equipment to be regulated by the FDA. The Federal Tort Claims Act has reduced the exposure of individual practitioners in the VHA. This process improves coverage of physicians who are practicing under the guidelines of their position within the VHA that in many cases include teleconferencing and telemedicine.

Privacy and HIPAA

Security and confidentiality concerns potentially increase the complexity of provision of care via telemedicine. As defined by the U.S. Department of Health and Human Services, "Privacy" is an individual's claim to control the use and disclosure of personal information. "Confidentiality" is a status accorded to information that indicates it is sensitive for stated reasons and therefore must be protected and access to it controlled. "Security" are the safeguards (administrative, technical, or physical) in an information system that protect it and its contents against unauthorized disclosure and limit access to authorized users in accordance with an established policy [57].

The Health Insurance Portability and Accountability Act of 1996 (HIPAA) defines standards and transaction sets for transmitting or handling electronic claims, remittance, and eligibility information and standards for assuring and protecting the privacy or security of patient-identifiable information. HIPAA regulations generally preempt state laws if the state laws are more lenient than HIPAA regulations. This becomes a more complex issue when service is provided across state lines; it becomes unclear which states' privacy laws or federal law prevails to protect privacy and confidentiality. Some of the specific issues may include the presence of nonclinical personnel in performing teleconsultations, such as camera operators, technicians, etc., or clinical personnel involved with the telemedicine interaction that may not be visible or observable by patients during a consultation or patient information that maybe stored outside of medical records used in the operation of a telemedicine program [58]. The needs for secure communication lines and secure means of documenting telemedicine interactions will increase the technical demands and ultimately the costs of delivering teleservices. In addition, patient and provider acceptance can hinge on whether the perceptions are that the interaction will be secure and confidential. Providers in the VHA and in the private sector typically take advantage of secured communication modes such as secure socket layer (SSL) or private key encryption (PKE) to share medical data and the EMR.

Cultural

The environment of provider and organizational "readiness" for new technologies often limits the speed with which new developments are embraced. This has been the case with new telemedicine programs as well as prior experience with computer-based applications within the VHA. The VHA has a long history of being an early adopter of computer-based applications from specific departmental applications to basic communication, such as internal organizational email. Implementing the electronic medical record, CPRS, was more widely accepted than in other health care organizations that have had less information technology exposure, and this has extended to the use of video conferencing. Telemedicine is a communication-information intervention that can change fundamental clinics process and challenge some basic beliefs held by many (such as all care is best delivered face-to-face, etc.).

Providers and patients are also concerned about privacy. The culture of the clinician-patient relationship is changed. Face-to-face real-time visits may be reserved for a particular type of interaction and virtual visits or electronic communication used for other visits. In-person interactions are generally preferable over electronic ones, unless the benefits are felt by the patients in the form of increased service, access, or convenience. In addition, technology in an organization involves a cultural shift in acceptance of new technologies. Individuals need to be trained for adoption of new techniques and technologies into their clinical practices. Lighting, presentation, and camera skills will all affect the quality of patient care over telemedicine, and these skills require training. Organizations that have in-house educational systems will likely themselves require training to provide telemedicine-specific education. Individual clinicians as well as entire organizations need to perceive great enough clinical benefits before embracing new ways of practicing medicine.

Technical

Matching the technical requirements to the specific applications are key to a successful telemedicine program implementation plan. IOM domains of quality and acceptability may be adversely affected if the correct combination of telemedicine specifications, such as timing, type of transmission, orientation, and medium of transmission, is not appropriate for the clinical application. For example, telepsychiatry and telemental health applications and those that require more intensive, detail-oriented interactive examinations generally require a moderate-to-high bandwidth that can transmit voice, sound, motion images, text, and documents. This is often on the order of 128 kB/s to 764 kB/s channel bandwidth. A thorough knowledge of the components of a physical examination are often required to appropriately choose the correct bandwidth. For example, any examination of neurologic disorders that involves spasticity or reflex assessment often necessitates high frame rates because of high speed of motion. Telephone (POTS) connections can be slow, video may be of low quality, and motion may appear choppy and discontinuous. This might not provide detail for analysis of movement disorders or may miss occasional words or emotional content of an interaction. Distance learning and training applications may also require these same bandwidths to successfully educate providers, caregivers, or patients. Dermatology, cardiology, and otolaryngology applications for which store-and-forward telemedicine is more prevalent may require lower bandwidths and less synchronous communication but a greater image quality.

A thorough knowledge of the channel characteristics is also necessary. For example, a channel may have sufficient bandwidth, but if teleconferencing applications are at a lower priority than other users of the network, then when demand increases, quality may be substantially degraded even with high channel bandwidth. As usage increases, bandwidth monitoring must occur to assure that certain applications, such as live-imaging conferences, do not degrade in quality when overall network traffic increases. In VISN 20, the network map in **Figure 2** shows the complexity of the network connections that must be maintained in a mature teleconferencing system used for telemedicine, administrative and financial data, an EMR, routine video conferencing, and communication of radiologic images. The VISN 20 network administrator monitors and regulates teleconferencing traffic. A good relationship with such a network administrator is essential for a successful program. For applications that require either multiple physical sites or connections to patients' homes, security of the given channel must be assured. HIPAA regulations require strict confidentiality and limited access to patient information, and as a result, secure communications channels must be used if patient information is being transmitted or collected. As discussed previously, HIPAA regulations and security issues may require coordination with administrators with expertise in medical confidentiality.

Many factors are implicit in the creation of medical images that often require specialists in medical imaging. Lighting, frame rates, and patient orientation can impair the quality of transmitted images. Appropriate color balancing for dermatology applications will be critical in appropriate diagnosis and may require preliminary provider-provider and provider-telemedicine reliability assessments to assure that the medium is not degrading the ability to diagnose. Proper sound quality is often limited by microphone location or ambient noise. The technical aspects of telemedicine have a large impact on quality, usability, and patient-provider acceptance. Knowledge of bandwidth, image generation, security, and the clinical needs are needed to assure that a particular application meets the clinical needs of the program.

CONCLUSION

Telemedicine has seen significant growth both in the private sector and in the VHA. Many challenges exist for organizations wishing to adopt telemedicine strategies to improve the care of their patients. Cultural, legal, and cost barriers limit general use in the private sector, although greater knowledge of these barriers has reduced their impact. Justifications on the basis of increased access, improved quality, and cost exist in the literature and are generally supportive of the effectiveness of this technology in treating diverse medical conditions. The VHA is well positioned to augment services with telemedicine, given the existing technology and managed care infrastructures. By improved care to veterans and surmounting other barriers, the VHA can develop and demonstrate new models of service delivery for the private sector. The VHA as a large integrated health care system is in an excellent position to implement the kind of organizational change that telemedicine represents; has more to gain from this as a largely capitated system that already takes responsibility for the majority of the costs of care for eligible veterans; already has a rich history of being a leader in computer technology implementation within health care and an extensive infrastructure in place; and works in an organizational, legal, and financial environment that mitigates many of the barriers existing at present in the private sector.

Telemedicine has a great deal to offer veterans, particularly those with complex medical conditions such as MS. Even though little has been published on the direct use of telemedicine with MS, a valid justification for the use of telemedicine in this population can be made on the basis of the strength of existing literature. Much has been published on the use of telemedicine to assess, intervene, monitor, and communicate with people with other complex conditions sharing impairments with MS. The positive findings from this body of literature as well as work being done with individuals with MS, suggest that this technology promises to improve access, enhance management of the diseases and associated symptoms, and positively impact the satisfaction of those affected by MS.

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