Telerehabilitation consultations for clients with neurologic diagnoses: Cases from rural Minnesota and American Samoa

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Abstract. Telerehabilitation is the provision of rehabilitation services at a distance using electronic information and communication technologies. This paper describes two clinical programs that utilize videoconferencing to provide rehabilitation specialist consultations to individuals living in remote areas. Needs assessments for the two areas revealed that local clinicians were interested in access to specialty consultation. Administrative processes and a data collection tool were developed for these programs. High speed videoconferencing that allows for real-time audio and video interaction was used. Each consultation includes the patient, the local caregivers and specialists from our facilities interacting via videoconferencing. A total of 117 telerehabilitation encounters have been completed. All consultations resulted in changes to the plan of care. Clinicians who participated in the projects consistently rated the clinical effectiveness of teleconsults as good or excellent. Thirty-eight consultations have been neurologic in nature. Of that set, 25 of the visits were initial assessments, and thirteen were follow-up visits. Two case studies of individuals with neurologic diagnoses are presented. Recommendations to others who are providing rehabilitation services via telehealth technologies are included. The authors conclude that the care of individuals with neurologic issues can be augmented and supported via specialty consultation using telehealth technology.

Keywords: Telerehabilitation, telehealth, consultation, physical therapy

1. Introduction

Telemedicine, as defined by the US Department of Commerce, is “the use of electronic communication and information technologies to provide or support clinical care at a distance.” [24] Telemedicine can involve a wide range of technologies including telephone, e-mail, facsimile, modem and video. It may be real time or store-and-forward for the transmission of text or graphic data, audio information, still images, short video clips or full-motion video. The focus of this article is on one of the more prevalent forms of telemedicine, the use of telecommunications technology to support the delivery of health services by means of two-way transmission of visual, audio and text data [15].

Since the mid-1990s the cost of videoconferencing technologies has rapidly decreased [10], making videoconferencing affordable to more rural or remote health care facilities. This fact, coupled with the rising cost of providing appropriate specialty health care services to people living in unserved or underserved communities, has been a driving force behind the growth of telemedicine. Worldwide, the business of telemedicine doubled from a $6.8 million industry in 1997 to a $13.8 million industry in 1998. Experts forecast that by 2010, at least fifteen percent of health care services worldwide will be provided via telemedicine [23].

Medical fields that rely heavily on technical diagnostics, such as radiology and cardiology, were the first to widely use telehealth technologies. Today, tele-
health technologies are used by many medical specialties across the continuum of care. Rehabilitation services are just beginning to be delivered via telehealth technologies. This new field, termed telerehabilitation, has been defined as the provision of rehabilitation services at a distance using electronic information and communication technologies [18]. Services delivered may include assessment, treatment, care coordination, patient and caregiver education, and consultation. Recently it was proposed that the concept of telerehabilitation include not only the delivery of medical services but also the support of independent living, via the Internet [19].

There are a small number of reports on the use of videoconferencing technologies specifically for individuals with neurologic diagnoses. In 2002, Clark et al. described a case in which an individual who suffered a stroke was managed for seventeen months by an interdisciplinary team that included a physical therapist, a speech language pathologist, a psychologist and a vocational therapist. The patient made measurable functional improvements with each discipline. Real-time interactive audio and video communications were conducted using the plain old telephone system (POTS) [6].

Telerehabilitation is also being done with the spinal cord population in the Veteran’s Administration system. Telehealth technologies have been used to provide a continuum of care to individuals with spinal cord injuries, from assessing the success of home visits during the initial rehabilitation stay, to providing consultation for annual physicals [20]. Since pressure ulcers are a common and costly complication from spinal cord injury, research has also been directed at wound care. In a study designed to track incidence of pressure sores in individuals with new spinal cord injuries, Phillips et al. compared groups of patients who received follow-up care via different technologies. Those who received scheduled video telehealth interventions (n = 12) reported 1.70 ulcers per year while those who received care via scheduled telephone consultations (n = 13) or standard patient-initiated help line calls (n = 10) reported 1.31 and 1.59 ulcers per year, respectively. The authors attributed this finding to an increased vigilance to skin issues by patients and staff using video technology. Therefore, they concluded that telehealth interventions might improve ulcer tracking and management [13].

In a later study, Philips et al. investigated follow-up care using different technologies. One hundred eleven individuals with spinal cord injury were recruited. Nine-week video or telephone interventions were compared to standard follow-up care. One year later [47], patients concluded the study. Those who completed the video or telephone interventions scored significantly better on the Quality of Well-Being Scale. Additionally, mean annual hospital stays were 3.00 days for the video group, 5.22 days for the telephone group and 7.95 days for the standard care group [14].

The literature is scant on the use of telehealth technology for individuals with traumatic brain injuries. One study, however, surveyed the perceived telerehabilitation needs of persons with acquired brain injury. Seventy-one respondents reported interest in services to improve memory, attention, problem solving and activities of daily living [17].

Most rehabilitation disciplines have utilized telehealth technologies. Physiatry services are being provided via telemedicine at the University of Tennessee Medical Center [5]. Outcomes of physical therapy specialty consultation via telehealth technologies have been positive regarding clinical outcomes and participant satisfaction [21]. Barriers and solutions for use of telehealth technology in the field of physical therapy have also been addressed [4]. Speech therapy has been effectively delivered to children with language and articulation problems [22]. Two occupational therapy assessments, the Kohlman Evaluation in Living Skills and the Canadian Occupational Performance Measure, were reported to have agreement when completed locally and via telehealth technology [7]. Mallagodi and Smith studied the level of agreement between assistive technology assessments completed in person or via telehealth technology. They found that all of the primary diagnosis and major problem identifications made during the telemedicine evaluations matched those made during the direct evaluations. The authors also postulated that many vocational rehabilitation tasks may be completed via telehealth technology [11]. Lemaire and Jeffreys reported agreement between orthotics assessments conducted in-person and using videoconferencing in 88% of cases [9].

As the body of medical knowledge continues to grow through clinical and laboratory research, as well as the growth of collective medical experience, areas of medical and rehabilitation superspecialties are emerging. This phenomenon is evident among physicians, and the model of clinical experts appears to be understood among the general public. For example, it is not uncommon for a patient to be referred by a general medical physician to a cardiologist, a neurologist or an oncologist. Rehabilitation professions are adopting this model as well. Physical therapists can earn
board certification in seven different areas of specialty. These areas include neurology, orthopedics, sports, pediatrics, geriatrics, cardiovascular and pulmonary, and clinical electrophysiology [2]. Occupational therapists can be certified in the areas of pediatrics, geriatrics and neurorehabilitation [1]. Speech language pathologists can be certified in swallowing and swallowing disorders. A number of other areas of specialty have been proposed [3]. One benefit of telerehabilitation is the ability to provide a link between general clinicians and specialists. Within our programs, specialists have not necessarily earned certification through their professional associations. Specialists, in this paper, are clinical staff that have extensive continuing education and experience in an area of practice and are regarded, at our large rehabilitation facility, as clinical experts.

This paper describes two clinical programs at Sister Kenny Rehabilitation Institute (SKRI) in Minneapolis, MN. Both programs provide rehabilitation consultation to individuals with limited access to specialists. One program, the Minnesota Telerehabilitation Initiative (MTI), serves patients and clinicians in rural Minnesota. The other program, the Pacific Rim Initiative (PRI), serves patients and clinicians on the island of American Samoa. Both service areas have a paucity of rehabilitation clinicians. A survey of Minnesota physical therapists found that 75% are working in metropolitan areas [12]. Only one rehabilitation professional, a physical therapist, is working on American Samoa.

2. Methods

The MTI and PRI programs utilize high-speed, real-time videoconferencing to deliver rehabilitation consultations to patients and their caregivers in remote areas. The following paragraphs describe our needs assessments, program processes, data collection tool and technologies utilized.

2.1. Needs assessment

The MTI staff conducted a telephone survey of rehabilitation managers at fourteen sites in the state of Minnesota that had high-speed videoconferencing capabilities. The PRI needs assessment took place via a site visit to four Pacific islands. Both needs assessments revealed that clinicians were interested in consultation with clinical specialists and continuing education using telehealth technology.

2.2. Program processes

Rehabilitation specialty consults are provided for persons at remote sites who are already in the care of a local rehabilitation professional. Sister Kenny Rehabilitation Institute, in Minneapolis, MN provides consultations for MTI. Sister Kenny Rehabilitation Institute and the National Rehabilitation Hospital in Washington D.C. provide consultations for PRI. Professionals involved in providing specialty services include physiatrists, physical therapists, occupational therapists, speech language pathologists, recreation specialists, equipment specialists and orthotists. A system for referral and scheduling has been developed for local therapists to request a consultation with a specialist. The local therapist remains the primary caregiver. A videoconference then occurs in which the local therapist, the specialist and the patient review the medical history, complete appropriate therapeutic procedures and collaborate on a plan of care. Each program runs a two-hour teleclinic every two weeks. One to four patients participate in each clinic. Initial evaluations are completed in sixty to ninety minutes, and thirty minutes are allotted for follow-up visits. Data collection is completed during the tele-encounters.

2.3. Data collection tool

Staff from these projects, including clinicians, researchers, health policy experts and information systems specialists, developed the data collection tool for telerehabilitation encounters. This tool contains 51 items and can be completed on paper or electronically. Information is gathered on patient demographics, encounter descriptors, patient problems, outcomes and technology. Coding from the International Classification of Function, the US Department of Labor Job Classification, the National Ambulatory Medicare Survey and Common Procedural Terminology, 4th edition is included. Table 1 lists examples of items by category. All data are entered into a database, and statistical analysis is completed.

2.4. Technology utilized

For the MTI, two sites typically participate in scheduled point-to-point telerehabilitation clinics. These sites include ELEAH Medical Center, which serves the Minnesota communities of Elbow Lake, Evansville, Ashby and Hoffman, and Sister Kenny Rehabilitation Institute in Minneapolis, MN. Each site utilizes a
Table 1

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<tr>
<th>Item Category</th>
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Polycom™ ViewStation set-top, appliance system that is capable of supporting connection rates of 384 kbps to 768 kbps over an Internet protocol (IP) network. The transmission rate is 30 frames per second, which produces a quality similar to that delivered by the National Television System Committee (NTSC) standard VideoCassette Recorder (VCR).

Due to the high transmission cost of T1 lines and lack of ISDN telecommunications services in rural Minnesota, MTI sites found it necessary to conduct teleclinics over an IP (H.323) video connection.

For teleclinics with American Samoa, three sites typically participate: Lyndon B. Johnson Tropical (LBJ) Medical Center in Pago Pago, American Samoa; Sister Kenny Rehabilitation Institute in Minneapolis, MN; and National Rehabilitation Hospital in Washington, DC. Each site uses a Polycom™ ViewStation capable of sustaining a real-time audio and video link.

The three conference streams are managed through a videoconferencing bridge operated by the State of Hawaii Telehealth Access Network (STAN) located in Honolulu. The stream to and from American Samoa is satellite mediated. Operating under a Memorandum of Understanding with the US National Telecommunications and Information Administration (NTIA), the National Oceanic and Atmospheric Administration (NOAA), and the National Aeronautics and Space Administration (NASA), PEACESAT is able to offer health and education related transmissions to the Pacific Island region via a repurposed government satellite.

The bridging technology allows either speaker-focused or continuous presence videoconferencing. In the former, the current video display is the person who is speaking. When a new person begins to speak, the video changes after a few seconds and displays the new speaker. This has been problematic in the teleclinic visits since most often, the clinician wants to speak to the client and simultaneously observe what the client is doing in response. The continuous presence mode eliminates this problem, but due to settings in the STAN bridge, this mode results in a smaller image of the client.

Both programs utilize a two-monitor system in which a local and remote image is always displayed. This is very useful for clinicians because they can see themselves from the same aspect as the patient sees them. Providers can monitor their visual signals to the client in a way not available in traditional in-person visits with clients. Table 2 summarizes the technology utilized in both programs.

3. Results

A total of 117 telerehabilitation encounters have been completed with 75 patients in our programs since their inception in October of 2000. Thirty-eight of those visits have been for individuals with neurologic diagnoses. Of that set 25 of the visits were for initial assessments, and 13 were follow-up visits. Table 3 includes a breakdown of the numbers of visits by program, type of diagnosis and visit type.

The age range of patients was 9 months to 86 years. Ages of participants, by decade, are listed in Table 4. Diagnoses of participants included cerebral vascular accident, Parkinson’s disease, spinal cord injury, cerebral palsy, spinal muscular atrophy, traumatic brain injury, amyotrophic lateral sclerosis, multiple sclerosis, muscular dystrophy and shoulder dystocia.
All consultations led to changes to the rehabilitation plan of care. These changes were the result of specialist recommendations regarding exercise programs, adaptive equipment, manual therapy, functional training, cognitive and swallowing interventions, positioning, wound care and medications. Sometimes, additional medical tests were suggested for diagnostic purposes. All of the patients seen in the MTI program (n = 26) reported good to excellent satisfaction with the visits. Twenty-three patients had positive clinical outcomes. Patients in the PRI program (n = 49) were not surveyed regarding satisfaction due to cultural issues creating a Rosenthal effect. Nineteen clinicians participated in the projects. Clinicians rated the clinical effectiveness of every specialty teleconsult as good or excellent.

The average mileage saved for MTI participants was 150 miles, one way. For individuals living in American Samoa, specialty rehabilitation services are not available. Specialty services may only be found off the island and could be accessed only when an individual can fund travel and medical expenses privately.

4. Case studies

4.1. Case study #1 – Balance and vestibular consult

‘George’ is a 48-year-old male from rural Minnesota who sustained a cervical strain during a motor vehicle accident several months prior to the teleconsult. Reportedly a vehicle failed to yield, and George broadsided it while driving 35–40 miles per hour. He was wearing his seatbelt, but his car did not have an air bag. Upon impact, George hit his head on the windshield and cracked the glass. He was referred to his local physical therapist in rural Minnesota for evaluation and treatment with a diagnosis of cervical strain. During his first visit, his therapist noted significant pain and decreased cervical range of motion and strength. She also noted dizziness during testing. She started the patient on some pain controlling modalities and began gentle range of motion and core stabilization exercises. She also contacted the MTI to request a consult to further investigate her patient’s dizziness.

A teleconsult was scheduled with a vestibular specialist, a physical therapist at Sister Kenny Rehabilitation Institute who has advanced training and experience treating patients with dizziness. During the consultation, she led the local therapist and George through a systematic evaluation. The specialist instructed the local therapist to complete several tests through verbal explanation and demonstration.

Postural control was assessed first by observing George’s responses to different situations designed to deprive him of specific sensory input. Testing varied the patient’s base of support (feet apart or together), visual input (eyes open or closed) and somatosensory input (stable or unstable standing surface). During testing with his eyes open, George swayed but did not lose his balance. When his system was challenged more by combining an unstable surface and eyes closed, George lost his balance. This indicated that George depended on his vision to be safe during mobility activities.

Head-eye coordination was tested next. Under the specialist’s direction, the local therapist tested smooth pursuit, or the ability to move one’s eyes smoothly while tracking the movement of an object. George was able to do this, but he complained of dizziness. The therapist then tested for saccades, normal eye movements used to track objects moving in quick, unpredictable patterns. George reported dizziness with this
test as well, and the local therapist observed nystagmus or extra oscillating eye movements. Additionally the vestibulo-ocular reflex was tested by having George focus on an object while attempting to move his head. George exhibited difficulty fixing his gaze on an object. He also exhibited some nystagmus when looking to the right and left. He was unable to complete vestibulo-ocular reflex testing because his dizziness became too severe.

The specialist then directed the local therapist through positional testing and motion provoked testing. This series of activities is designed to elicit vertigo, or the perception that the environment is spinning, by stimulating the various canals of the inner ear. George had negative responses to all positional changes, except for moving from supine to sitting up with his legs straight. George ranked his dizziness with this activity as 3 on a scale of 0 to 5. The specialist noted that this might not have been a truly positive finding because of George’s generalized symptoms. She also commented that a drop in George’s blood pressure could have induced the dizziness when he moved to a more vertical position. The vestibular specialist then led the local therapist through a test in which the patient, with eyes open, head turned and neck extended, moves from supine to sitting. The therapists watched for vertigo and rotatory nystagmus. Finally, the specialist directed the local therapist to complete the Hallpike Maneuver, a test in which the patient is moved quickly from long sitting to supine with his neck extended and rotated. Although George noted mild dizziness with these tests, they were not classically positive because vertigo and rotatory nystagmus were not elicited.

After completing this systematic assessment, the specialist concluded that the dizziness George was experiencing was likely due to central nervous system damage, presumably a result of his brain injury, which occurred during his car accident. She noted that George had postural control problems and head-eye coordination difficulty. She also recommended that George undergo further objective testing by an ear, nose and throat specialist or an audiologist to more definitively determine the source of George’s dizziness. These tests may include electonystagmography, posturography and/or rotatory chair testing. These tests were available at a medical center eighty miles away.

The specialist then made several recommendations for George’s plan of care. She suggested he begin a home program that challenged his balance and his head-eye coordination. She also commented to George that his dizziness might not resolve completely. She further explained that his prognosis depends on the plasticity of his central nervous system and his ability to compensate. Results of the additional tests recommended may give more insight into his prognosis.

The vestibular specialist also recommended an aerobic exercise program to increase the supply of oxygen to George’s brain. She talked with George about trying to avoid distractions in places where losing his balance would be particularly unsafe. She described some situations where George should be particularly careful and explained that settings in which more than one of his balance systems are challenged are particularly precarious. After she talked about ramps being particularly troublesome, George told her he’d just experienced this recently when entering his church. The church floor had a three-degree incline, and George almost fell when attending a wedding. As he relayed this, George seemed glad that someone was offering an explanation to him even without a certain prognosis. He said he was happy that someone was giving him some general guidelines and tips about how to deal with his dizziness. George described the clinical effectiveness of this encounter as excellent.

George lives 147 miles from Minneapolis. He noted that it would have taken him a whole day to go to an outpatient physical therapy visit in Minneapolis in person. During the teleconsult, George reported increased dizziness while watching the videoconferencing dis-
play. We suspect that this is due to the complicated visual input and perhaps the slight delay between the visual and audio signals. The initial consult was 75 minutes long. The local physical therapist reported that she received professional interaction and assistance with confirmation of the diagnosis, confirmation of the treatment plan and immediate problem solving. This therapist also rated the clinical effectiveness of the encounter as excellent.

Two weeks later the same participants gathered for a follow-up teleconsult. George had followed most of the specialist’s recommendations. He was no longer reporting dizziness with motions, and he displayed marked improvements in postural control and head-eye coordination. The specialist then provided the local therapist with some recommendations about how to progress George’s home program. The second teleconsult lasted thirty minutes. Both clinicians agreed that further teleconsultation was no longer necessary because the local therapist felt comfortable with George’s plan of care. The patient reported his satisfaction with the follow-up visit was excellent, and the clinicians noted that the clinical effectiveness was also excellent.

4.2. Case study #2 – Pediatric neurologic consult

‘Brian’ is a 9-year-old boy, who contracted Hemorrhagic Dengue Fever in August, 2001. Hemorrhagic Dengue Fever is a mosquito-borne viral infection marked by severe pains, inflammation of the air passages, painful swelling, cutaneous eruptions and hemorrhagic manifestations. It occurs sporadically or epidemically in regions including the Pacific islands. Brian and his family live on Tutuila, the main island in the US territory of American Samoa. He was hospitalized at LBJ Tropical Medical Center in Pago Pago, American Samoa, for an extended period of time and considered very ill. His residual problems included peripheral weakness, contractures of the hands and feet, shortness of breath and impaired speech and swallowing. Brian had not returned to school since the onset of his illness.

During the spring of 2002, Brian was receiving physical therapy services at LBJ. His therapist recommended he and his family participate in a rehabilitation teleclinic. His therapist used e-mail to inform the Pacific Rim Team about Brian’s medical history and to schedule him for a teleclinic.

Participants in the three-way videoconferencing encounter included: Brian, his sister and his therapist at LBJ, a physiatrist and nurse practitioner at National Rehabilitation Hospital in Washington D.C., and a physical therapist and speech language pathologist at Sister Kenny Rehabilitation Institute in Minneapolis, MN.

Assessment of gait and balance was completed by observation. The distant camera was adjusted to a wide angle to observe Brian’s gait and focused narrowly to observe his active ankle movements in sitting and standing. Brian walked with a wide base of support. He was unable to stand with his feet together, and single leg stance time was less than 1 second bilaterally. This is considerably less than the normal stance time of 60 seconds or greater. Brian was unable to touch his heels to the ground while standing. He walked on his toes and was able to walk independently only for short distances because he was limited by shortness of breath.

The team then evaluated range of motion and muscle tone. His local therapist assessed both of Brian’s upper and lower extremities. Again camera angle was adjusted so that all the distant clinicians could appreciate the full range of motion. His local clinician relayed the quality of end-feel and muscle tone using verbal description. Brian had severe bilateral wrist and finger flexor contractures with a springy end feel. When measured in full knee extension, his ankles were plantarflexed 34° on the right and 37° on the left. Hamstring shortness limited Brian’s straight leg raises to 45° bilaterally. Brian’s muscle tone was mildly hypertonic in the muscles where contractures were present. No clonus was noted. Brian’s strength was normal and symmetrical in shoulders, elbows and hips. A pattern of greater weakness, distally to proximally, was observed.

With cameras set for a full-face view of the participants, a speech and language assessment was conducted. The specialist interviewed Brian and his sister to obtain information about his cognitive and language skills. She found he had difficulty with word finding and problem solving. She also learned that Brian was unable to read. To complete her assessment of Brian’s oral motor control, the speech language pathologist simply demonstrated the sound or motion and asked Brian to copy her. She found that Brian had poor oral motor control, moderate dysarthria and difficulty swallowing. His sister reported that Brian coughed a lot at night, which was previously attributed to reflux.

The Pacific Rim Team made several recommendations for Brian’s continued care. These recommendations included having Brian try sleeping at a 30-degree angle at the waist, with a wedge under his trunk to prevent reflux. An aggressive upper and lower extremity range of motion program was recommended to restore range or prevent further development of contracture in
Brian’s hands and feet. Initially the team suggested obtaining custom positioning braces to maintain dorsiflexion at night. However, because these braces would be difficult to obtain and cost-prohibitive, high-top tennis shoes were recommended.

Since the services of a speech language pathologist are currently not available on American Samoa, the specialist recommended that his family read to him daily and practice naming objects. She also recommended returning to school and, if possible, receiving special education services to facilitate his cognitive and language development. The total time spent with Brian and his sister was 90 minutes. The speech language pathologist rated the clinical effectiveness of the encounter as good. Limitations she identified were a lack of evaluation and follow-up tools validated for care delivery via videoconferencing.

5. Discussion

Our experience with the MTI and PRI telerehabilitation projects has revealed several positive aspects of teleconsultation. Real-time discussion and planning among participants results in an effective team approach for the treatment of patients with rehabilitation needs. Patients benefit from participating in the process. Information and recommendations can be clarified immediately, if necessary. Patients receive individual, undivided attention with each consult. Therapists report that they enjoy building professional relationships across such large distances. Local therapists report they benefit from timely access to the latest, most pertinent information.

Research on low-bandwidth, internet-based videoconferencing consultations found that teleconsultations do not save time for health-care specialists [8]. Our experience affirms their findings. The actual time spent with the patient is similar for in-person or videoconferencing consultation. The clinicians who worked with this project noted, however, that the time spent in videoconferencing was more productive because both local clinician and specialist could work with the patients simultaneously, and both could gather information throughout the entire consultation. This is certainly not the case for consultation done in a traditional manner. In a traditional scenario, communication is mitigated with notes, and the patient is often relied upon to relay information. The concept of a team can be difficult to realize if the clinicians do not communicate directly. In this project, clinicians report that they receive professional support and education during the consultations. Patients state they appreciate the quality of the communication among their care providers.

When providing rehabilitation services at a distance we have found it valuable to consider individual differences related to culture. Both the MTI and PRI projects have allocated time and resources to help clinicians have a clearer understanding of the cultures in rural Minnesota and American Samoa and the ways in which those cultures can affect rehabilitation. In her keynote address at the Center for International Rehabilitation Research and Information Exchange, 2002 conference, Nora Ellen Groce, medical anthropologist, pointed out that not only do rehabilitation clinicians need to be sensitive to their patients’ cultures, but they also need to understand how their own culture impacts their practice [16]. The clinicians must recognize that culture pervades every aspect of the client interaction from how information is gathered to how goals are set and achieved. All of the telerehabilitation encounters have included play where the team, including the patients and their caregivers, seeks a comfortable level of communication and attempts to set goals with attention to the needs of the patient and the knowledge and experience of the clinical staff.

The Rehabilitation Engineering Research Center on Access to Telecommunications Technologies reported that consumers are intolerant of excessive delays or extended silences during audio communication [25]. We have found this to be the case with our teleconsults. We postulate that this is because standard telecommunications technology allows the general population to make real-time uninterrupted phone calls, therefore, this high quality service is expected using any technology that has an audio component. Our participants displayed a higher tolerance for interruptions in the video transmission. This may be due to the novelty of real-time video communications. In consultations using IP connectivity, satisfaction with the quality of communications increased markedly when audio over IP was muted, and a separate telephone line with a speakerphone was used.

A summary of the State of the Science Conference on Telerehabilitation and Applications of Virtual Reality in Rehabilitation includes a call for specialized training for practitioners using telehealth technologies [19]. While the following guidelines fall short of comprehensive training on telerehabilitation, we believe that these practical suggestions for providing consultation via telehealth technology may benefit clinicians. For each tele-encounter we suggest that all participants adhere to the following guidelines:
1) Respect all participants by being timely.
2) Wear clothing that will contrast with the background. Neutral, solid colors work best. Avoid checks, stripes and busy patterns.
3) Because transmission delays are common, pause to give others time to comment.
4) When all participants are in a connection, make introductions at all sites, even if some participants already know one another.
5) Take a few minutes to establish a comfortable rapport.
6) Speak and act naturally, using both verbal and non-verbal communication.
7) Have a plan to reestablish communication if the technology fails during a teleconsult.

Additional suggestions for the consultant include:
1) Know the level of training and experience of the local practitioners. Convey unremitting respect to the patient’s local care team.
2) Identify the patient’s functional problems and the local therapist’s concerns.
3) Make assessments systematic.
4) Keep all comments focused on the problem at hand. Be clear and concise with all instructions.
5) Consider each client’s knowledge, interest and learning style, and provide the appropriate amount of information.
6) Use references in the literature to answer questions about prognosis.
7) Keep the list of recommendations short.
8) Confirm that each participant has the same understanding of the recommendations to the plan of care.
9) Provide follow-up consultation to monitor patient progress, support local staff and encourage patient compliance.

At this time limited work has been done to establish the reliability and validity of standard rehabilitation assessments completed using telehealth technology. If telerehabilitation is to truly make an impact on those who have limited access to rehabilitation services, then clinicians must be able to complete standard tests remotely. The application of these assessments using videoconferencing should be explored. Additionally, other types of technologies, which may include sensors or innovative measurement solutions, may soon be developed to provide clinicians with more comprehensive information about the individuals that they are seeing remotely.

An important aspect that appears to be limiting the use of telehealth technology in rehabilitation is reimbursement. The complexity of this area is beyond the scope of this paper. However, continued research on telerehabilitation should be completed and presented to third party payers as evidence for efficacy.

Licensure is another issue that is being addressed. Currently most rehabilitation professionals must be licensed in the state in which the client resides to provide direct care via telerehabilitation. To enable rehabilitation clinicians to practice telerehabilitation, state licensing boards should consider reciprocity for the purposes of telehealth.

In conclusion, our experience indicates that the care of individuals with neurologic issues can be augmented and supported via specialty consultation using telehealth technology. We have also learned that patients with orthopedic problems can benefit from telerehabilitation. We recognize the need for continued exploration of the efficacy of specific interventions and models of treatment utilizing videoconferencing. We believe telehealth technologies used for specialist consultations have the potential to elevate the standard of care for individuals receiving rehabilitation services.

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References


[16] Providing Culturally Competent Disability Services to Persons Born in Other Countries, International Conference, Center for International Rehabilitation Research Information and Exchange (CIRRIE), May, 6–8, 2002.


[22] C. Scheideman-Miller, P. Clark, S. Smeltzer, A. Cloud, J. Carpenter, B. Hodge and D. Prouty, Two Year Results of a Pilot Study Delivering Speech Therapy to Students in a Rural Oklahoma School via Telemedicine, Publication pending.

