Rural Post –Acute Stroke Care Using Multidisciplinary Telerehabilitation

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Abstract
Stroke is the third leading cause of death in our country and is the leading cause of long-term adult disability. Comprehensive, coordinated rehabilitation services can reduce mortality and improve functional outcomes following stroke. In rural communities, however, the specialized services and supports needed by patients after stroke are often not available. An innovative alternative to deliver rehabilitation services is telerehabilitation. INTEGRIS Rural Facilities and INTEGRIS Jim Thorpe Rehabilitation Network collaboratively conducted case studies utilizing physical therapy, occupational therapy, neuropsychology and vocational rehabilitation for stroke survivors in rural communities 70 to 170 miles away from the specialists. Consultations were conducted using H320 video conferencing equipment over dedicated T-1 lines. The telerehabilitation applications, outcomes, service coordination, cost effectiveness, and lessons learned will be discussed.

1. Introduction

More than 51 million Americans live in rural areas, making up about 20 percent of the U.S. population. Geographical distance, rough terrain and inclement weather challenge rural citizens to get preventive or medical health care subsequent to an acute medical episode. Other barriers such as cultural and linguistic diversity make it difficult for service providers to assess and treat persons residing in rural areas. Challenges for rural residents and health care providers include: a high rate of poverty and a lower rate of health insurance; higher concerns by residents on issues of confidentiality; and often unwritten (perhaps unspoken) social codes in small rural areas.

People with disabilities are a small cohort. This is more prominent in sparsely populated areas where an individual could be the only person with a specific disability in an entire county. The need for specialty services of rural persons with disabilities is as great as their urban counterparts, however, only 10 percent of specialists practice in rural areas. Some hospitals have visiting specialist programs, but specialty services are limited and are not always available for more atypical medical cases. As a result, rural providers have either become more multi-skilled, or patients have had to travel—if possible—to remote metropolitan areas for appropriate care.

Telemedicine, the provision of health care and education over a distance, using telecommunications technology, has been around in different forms for decades. However, only in the last ten years have multiple healthcare providers adopted it to meet the needs of underserved populations, particularly in high need rural areas. According to the Association of Telemedicine Service Providers 1998 Report, from 1993 to 1997, the number of United States telemedicine providers grew from 10 to 132. The figures for telemedicine interactions have shown a similar growth, from 1,750 in 1993 to a projected 58,080 for 1998.

Teleradiology was the main application in the early years of telemedicine, now almost every area of healthcare is touched including continuing education, patient education, home care, emergency care, mental health, and cardiac monitoring. One innovative adaptation of telemedicine is telerehabilitation. Rehabilitation incorporates multiple professionals and interventions, all of which are designed to promote independence and quality of life of the patient and their family member. Telerehabilitation utilizes telecommunication for rehabilitation and includes multiple clinical applications of telemonitoring, teletraining, service coordination, direct clinical intervention and family/home support.

Telerehabilitation is gaining federal attention as demonstrated by significant research funding through a wide range of federal programs such as the National Institute on Disability and Rehabilitation Research (NIDRR) under the United States Department of Education, Office for the Advancement of Telehealth (OAT) under the Human Resource and Services Administration, and the Center for Disease Control.

Successful programs demonstrate ongoing expansion efforts and respond to the unique needs of each community they serve. A needs assessment of telemedicine applications was conducted by INTEGRIS Health at a remote rural hospital. This community has a high disability population and a history of limited specialized therapy resources. Although initial discussion revolved around speech/language pathology
interventions, it rapidly became apparent that other therapy applications are needed. Care of stroke survivors and their caregivers is a major area of concern. A literature review showed a predominance of routine maintenance and monitoring utilizing telecommunications. However, few programs addressed direct clinical interventions. The purpose of this study is to determine the feasibility and clinical effectiveness of providing rehabilitation services remotely.

2. Impact of stroke

Stroke is the common term for a cerebrovascular accident resulting from sudden loss of blood flow to the brain or bleeding inside the brain. Although stroke is the third leading cause of death in our country, mortality rates have been declining in recent decades. These factors, along with a growing geriatric population, are contributing to an increasing number of stroke survivors who are living with physical and cognitive residual deficits, making stroke one of the most prevalent and disabling chronic health conditions in the United States.

Stroke accounts for the greatest number of hospitalizations for neurological disease and is the admitting diagnosis for more than 50 percent of inpatients in United States rehabilitation units. According to data from the Health Care Financing Administration (HCFA), $3.7 billion was paid in 1995 to Medicare beneficiaries for stroke care.

Individuals 65 and older comprise 18 percent of the rural population. Stroke incidence/death rise significantly after age 65 and frequently require long-term specialized interventions. The specialized services and support needed by patients after stroke are often not available in rural communities. Many of these stroke survivors have been forced to move to metropolitan areas, leaving behind familiar surroundings and established social support systems. Changes in environment can increase anxiety and depression which, in turn, slows the rate of improvement for the patient. Innovative alternatives need to be explored to bring needed specialty services to rural patients and their caregivers.

Stroke recurrence is a paramount clinical and public health concern and is a significant complication of primary stroke. One-fourth of all strokes are recurrent which leads to an increase in health care costs, disability, and mortality. Yet most secondary strokes are preventable. Because of its associated physical and cognitive consequences, stroke is a disorder that can greatly compromise the quality of life of survivors and their caregivers. The majority of stroke survivors experience a restriction in their usual activities of daily living, particularly in the social domains, such as vocational activities and socialization outside the home.

Stroke affects not only the patient but also the family as a whole. The National Stroke Association estimates stroke touches the lives of four out of every five American families. Caregiver’s stress is a negative impact on stroke recovery and function. Family caregivers of stroke survivors experience more emotional distress, social inactivity and general ill health than non-caregivers.

Patients with stroke experience intensive acute inpatient rehabilitation from a myriad of rehabilitation specialists, but frequently have variable and limited post-acute outpatient rehabilitation services. Telerehabilitation interventions can help bridge the gap between inpatient and community based services.

3. Stroke rehabilitation: multidisciplinary approach

Evidence suggests that comprehensive, coordinated rehabilitation services can reduce mortality and improve functional outcomes following stroke. Long-term interventions are usually required to reduce the risk of a secondary stroke and achieve optimal physical and psychosocial recovery.

The Oklahoma State Department of Health Injury Prevention conducted a statewide Needs Assessment of rehabilitation professionals and individuals with stroke. The survey revealed significant gaps in post acute rehabilitation services. Comprehensive, coordinated rehabilitation services can reduce mortality and improve functional outcomes following stroke. The multidisciplinary team consists of professionals representing neuropsychology, physical therapy, occupational therapy, vocational rehabilitation and case management.

3.1 Neuropsychology

Neuropsychology is the study of the relationship between brain function and human behavior. Brain dysfunction causes alteration in behavior. It is essential that the neuropsychologist can clearly see as well as hear the patient since evaluations of brain function and dysfunction are made by observing behavior. The neuropsychological evaluation consists of reviewing an individual’s history, observing their behavior during the evaluation (e.g., eye contact, affect, motivation, speech, etc.), and assessing the individual’s cognitive and emotional status through a variety of standardized tests.

The neuropsychologist can provide information about how the person’s neuropsychological strengths and weaknesses may impact the person’s ability to
engage in a vocation, and their ability to function independently in different settings and complete advanced activities of daily living. Based upon the evaluation, recommendations can be made regarding the necessity for additional medical consultations and environmental accommodations.

3.2 Physical therapy

A physical therapy assessment determines the impact the stroke has had on the patient’s physical abilities as well as their thinking ability to plan, initiate, and complete a physical task safely and with good judgment. Modalities may be utilized for pain control along with exercise to increase range of motion resulting in increased function. The patient’s skin condition is evaluated for any areas prone to skin breakdown. The patient is asked to perform different functional tasks depending on their level of involvement. The physical tasks can include wheelchair mobility, transfers, standing, walking, and bed mobility. The therapist assesses the quality of movement, amount of assistance required and safety. Once the evaluation is completed goals, treatment plan, and estimated length of stay is developed with the treatment team. This format is followed in an ongoing treatment. This application necessitates the ability to clearly see reaction time in addition to gross and fine motor movements.

3.3. Occupational therapy

The occupational therapy evaluation includes an assessment of the person’s current limitations and abilities in self-care, leisure and work skills. In particular, the therapist examines the sensory-motor, psychosocial and cognitive abilities of the person. The occupational therapist uses functional tasks when possible during treatment to address the deficit areas that the person has as a result of the stroke. Various techniques are used by the therapist to assist the patient in the recovery process. Occupational therapists often recommend equipment (assistive technology) that will allow the person to regain independence with daily activities. The therapist must see the environment where the patient works/lives and be able to actively interact with them to optimize the therapy sessions.

3.4 Vocational Rehabilitation Services

After stroke, individuals may have a temporary or permanent disability that precludes or interferes with their ability to return to work. Vocational rehabilitation services addresses the evaluation of the person’s abilities, skills, interests and values as well as the use of assistive technology in the work place. Based on the evaluation, the counselor can assist these individuals with identification of vocational options including referrals to the appropriate community agencies. In addition, the vocational counselor can educate employers, supervisors and co-workers about stroke-related disabilities. This may include recommendations for work site adaptations and accommodations.

3.5 Case management

Case management is defined as a collaborative process which assesses, plans, implements, coordinates, monitors and evaluates the options and services to meet an individual’s health needs. Case management is a method of delivering patient care that emphasizes quality outcomes and efficient and cost-effective care.

The process of case management systemically identifies high-risk patients and assesses opportunities to coordinate and manage the patient’s total care to insure the best outcome. The primary goal of case management is to restore the patient to his/her achievable optimal level of health. The case manager serves as coordinator, facilitator, impartial advocate and educator, facilitating a smooth transition for the stroke survivor and their family between acute inpatient rehabilitation and community-based therapies.

4. Stroke telerehabilitation: technology is part of the solution

The Office of Rural Health Policy (ORHP) in 1991 studied innovative approaches to healthcare in rural communities in Alabama, Iowa, Oregon, Texas and Wisconsin. One of the common themes to success was the willingness to identify, develop and pursue non-conventional solutions.

The convergence of communications technology and medicine is revolutionizing the delivery of health care, resulting in telemedicine with all its variations. Telemedicine can be a non-conventional solution that addresses the rural hospital’s need to expand outpatient services to be economically viable, while simultaneously providing unique specialized services to the individual or small group of individuals. A collaborative study conducted by the United States Department of Agriculture and Department of Commerce projected that the availability of advanced telecommunications will become essential to the development of business, industry, shopping and trade as well as distance learning, telemedicine and telecommuting. This will allow physicians in rural America the same kind of access to sophisticated, data-intensive applications (such as three-dimensional...
imaging) previously only available to doctors connected by a local area network.

Increasingly, rural hospitals are establishing links with urban hospitals around telemedicine projects. Telemedicine, for purposes of this manuscript, refers to healthcare services being delivered over two-way interactive video in real time. Telemedicine is considered more essential in frontier areas, where distances to specialty services is greatest. Telemedicine increases access, achieves comparable or improved outcomes and can be cost effective. This integrated service concept increases the quality of life of stroke survivors and their families.

Telerehabilitation is an extremely versatile multidisciplinary medium used by allied health professionals to facilitate home/community–based rehabilitation. Telerehabilitation can be used to promote and maximize a well-planned transition of specialized stroke follow-up care and services to the survivors’ rural community.

Telerehabilitation can be used for provider-to-provider consultation (while patient is not present), provider-to-provider coaching (while patient is present), provider to patient intervention, and provider-to-caregiver instruction. Telemedicine interventions include education, case consultation, direct care (evaluations and follow-up), and peer support.

6. Stroke telerehabilitation: program development

There is a large amount of preparation to building a telerehabilitation program that goes beyond securing equipment and installing lines. The vision of such a program starts with the recognition of a need, which in turn evolves into the development of a business plan and proforma. Support from administrators, physicians and therapists needs to be secured. Unique problems/challenges like the logistics of where the interventions will take place, what technology needs to be utilized and what tools must be incorporated need to be addressed.

Once this is accomplished, funding sources need to be found for both start-up costs and for sustainability. Grants, third party payers, and service contracts are all potential sources. Seventeen states currently provide legislative support for telemedicine, and the numbers are increasing. Federal level legislation aimed at making Medicare interventions over telemedicine reimbursable is under consideration.

Health care providers unfamiliar with telemedicine often have reservations about providing what is considered a “hands-on” intervention via an audiovisual linkage. Demonstrations of the technology prior to project implementation are essential to help the provider become familiar with this mode of delivery and its applications. This includes rural therapists, metro therapists, and therapists serving on the state licensure boards. Publications and presentations serve to further inform health care providers and administration of telerehabilitation and lend to its credibility.

Confidentiality is a prime importance, with both technical and human issues. The telemedicine sessions ideally use encrypted video sent over a dedicated line. Providers as well as the patient/caregiver must sign agreements of confidentiality. Any related faxes are to be sent on secured lines.

Liability is a concern to health care providers and must also be addressed. Protocols for room setup, telemedicine consent forms, and telemedicine sessions are pre-proved by legal services prior to any telemedicine interventions. In addition, there are protocols for each specialty in place listing eligible patients, required records/tests, and items to be included for the interventions.

7. Stroke telerehabilitation pre-pilot

INTEGRIS Health received a three-year grant from the Office for the Advancement of Telehealth, Health Resources and Services Administration, Department of Health and Human Services to deliver specialty services to rural areas with telemedicine. A rural community served by telemedicine through this grant indicated a need for physical therapy. INTEGRIS Rural Facilities and INTEGRIS Jim Thorpe Rehabilitation Network worked collaboratively on a pre-pilot study to examine the feasibility of using telemedicine to help deliver physical therapy to areas where little or no therapy services were available.

The pre-pilot was highly controlled, with all foreseeable variables eliminated to make the telemedicine intervention the primary variable. Physical therapy was the primary therapy, with occupational therapy and neuropsychology included as part of the multidisciplinary approach.

Neuro-developmental treatment (NDT) is a strategy used for the management of patient with neurological impairments. Primarily, it is a process of inhibiting or preventing unwanted responses and facilitating more normal movement, which enables better functional abilities. The main aim of the NDT approach is to prevent compensation and to assist the patient to learn to incorporate both sides of all of the body in activities.

Utilization of the NDT approach for management of the stroke patient requires education and training of concepts and approaches of handling and can be delivered effectively by mentored therapists. Although “hands-on” intervention is always the preferred mode of patient management, this pre-pilot was based on the assumption that telemedicine could be used as a “long-
distance” system to provide a valuable link for patients whom otherwise would receive delayed or fragmented rehabilitation services.

7.1 Pilot Study Preparation

A 62 year-old rural male sustained a cerebrovascular accident (CVA) and lost functional ability for all self-care. He became totally dependent with transfers and locomotion. Prior to the CVA, the patient was in good health without any debilitating medical conditions except for minor arthritis. He worked and farmed on a full-time basis before his stroke.

The survivor received acute inpatient services at a rehabilitation hospital in Oklahoma City. The patient received NDT while in acute inpatient rehabilitation as his primary physical therapy intervention. The patient was to return to his home community 117 miles away from Oklahoma City, and receive physical therapy outpatient services at a rehabilitation facility 37 miles away from his home. The physical therapist in the rural site was competent in traditional orthopedic therapy, but had little exposure to Neuro-Developmental Treatment (NDT) or stroke therapy. The rural hospital administrator was contacted about participating in a proposed physical telerehabilitation project and to secure permission to proceed at the site. Once permission was given, the therapists at the rural site were contacted. The rural therapist agreed to learn more about telemedicine and consider participating in a pre-pilot study.

Relationships between the therapists and the patient needed to be built prior to beginning outpatient therapy. The telemedicine network was set up in a Hub and Spoke configuration. The rural (spoke) therapist came to Oklahoma City to meet the patient and the metro (hub) therapist. This was an essential step that not only familiarized the patient and therapists with each other, but also helped to establish how the pre-pilot project was to be conducted. Pilot projects inherently have unforeseen difficulties. Positive relationships between all the participants promoted the problem-solving process as challenges presented themselves.

Since telerehabilitation is such a new application, extensive education and information is critical for successful implementation. The therapists, patient and caregiver were introduced to the concept of telemedicine while the patient was still in the rehab hospital. Reassurances were made that there would be a physical therapist at the rural site for the duration of the study. The patient signed a telemedicine consent form that was acknowledgement that a session might be disrupted by technological failure.

Compliance with state licensure laws was a high priority. Before beginning the project, an educational/informational presentation was made to the state physical therapy licensure board. An introduction to telerehabilitation was made, and the purpose and utility of the pilot outlined.

Prior to the pre-pilot, physical telerehabilitation protocols were created including eligible patient guidelines, a listing of medical records to be available prior to the session, and items to be available in the spoke site room during therapy sessions. Copies of physician scripts and medical records were given to both spoke and hub site providers.

7.2 Technology

At the heart of INTEGRIS Baptist Medical Center is a state of the art Data Center with over 100 servers providing access to 200 different clinical and non-clinical applications. INTEGRIS Baptist Medical Center is the hub site for the INTEGRIS Telehealth System. Data and Video services are distributed across the INTEGRIS Wide Area Network, which provides connections to 60 spoke locations throughout the state and also access to specific extranets throughout the nation.

The core of this system is a Newbridge 3645 carrier grade switch. This switch provides the capability to port voice, video and data through various bandwidths to remote locations. This site also houses a VTEL/EZENIA 320 standards based video bridge capable of direct connection to INTEGRIS sites, as well as an EZENIA 320/323 gateway/gatekeeper. This provides the capability to provide either H320 or H323 connectivity throughout the network. Capabilities to connect nationally and internationally are provided by an ISDN Primary Rate Interface and inverse multiplexer. T1 circuits to another metropolitan hospital and eight rural hospitals accommodate permanent connections for video spoke locations.

The Network is also equipped with a T1 interface to the state of Oklahoma’s telecommunication network (OneNet), which provides connectivity to every school in the state. INTEGRIS Southwest Medical Center and Jim Thorpe Rehabilitation Hospital are located on the same campus in Southwest Oklahoma City. The capabilities of the two are intertwined and serviced by the same infrastructure, via H320/H323 video units with connections to our video bridge at INTEGRIS Baptist Medical Center. Data is served to this campus via an OC3 Wide Area Link and Gigabit Local Area Network.

All of the above hospital locations are connected to the INTEGRIS Telehealth System via T1 connections.
and have H320 videoconference units connected to back
to the video bridge at INTEGRIS Baptist Medical
Center. All sites have e-mail capabilities and Internet
access. INTEGRIS sites all have Local Area Networks
capable of delivering Ethernet 10/100 MB data services
to the desktop.

INTEGRIS Clinton Regional Hospital was the
nearest spoke location to the patient. Clinton utilized its
videoconference (H320) capabilities to connect to
Southwest Medical Center via the INTEGRIS
Telehealth Network. VTEL videoconference units with
a room camera and monitor were used at both sites. The
spoke conference room camera focused on a physical
therapy table set up in the center of the room. The video
systems are capable of delivering 30 frames/second,
which provided the resolution to observe subtle motions
such as hand tremors.

The H320 standard allows both local and remote
camera controls from either site. This enabled the hub
physical therapist to move the room camera and follow
the patient as he walked or switch to a fixed position
camera for localized area observations.

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<tr>
<th>Table 1. Outcome Report</th>
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<td><strong>Functional Independence Measure Scores</strong></td>
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7.3 Physical therapy sessions

Three physical therapy sessions per week were provided by the spoke therapist for a total of twelve weeks. One session each week was facilitated by the hub physical therapist that specialized in stroke rehabilitation and NDT. Sessions were over dedicated T-1 lines between the spoke and hub hospitals. The spoke site conference room was set up with a therapy table and assorted items such as chairs, tables and weights. Consultations were conducted using H320 video conferencing equipment over dedicated T-1 lines.

The spoke physical therapist served as a coach during the first stage of the pre-pilot. The first session began with the spoke therapist administering physical therapy as the hub therapist acclimated to the technology and assessed how well he could see the patient’s fine and gross motor movements. Mid-way in the session, the hub therapist began coaching the spoke therapist on exercises given previously to the patient while in the rehabilitation hospital. Sessions between the physical therapists continued for eight weeks.

The second stage of the pre-pilot focused on instructing the family caregiver on how to assist the subject with his activities in the home. The spoke physical therapist was present in the room to help make sure proper support was given to the patient. The hub site therapist instructed the family caregiver, in this case the patient’s wife, on how to assist the subject with activities in the home. Two weekly sessions were devoted to working with the spouse.

The final stage was to use a physical therapy assistant at the rural site and included four telerehabilitation sessions. Sessions were conducted with a physical therapy assistant under the assumption that a physical therapy assistant is more likely to be the primary therapist in the most underserved areas.

An additional camera (ELMO) was occasionally used at the hub site. This smaller camera could give a close up view of a smaller section of the body, such as the hand or knee. The hub therapist could demonstrate an exercise or technique on a volunteer at the hub site to help the spoke therapist and patient better understand what was expected. Future studies will probably include a second camera at the spoke site, but one that can follow the patient more easily as they ambulate.

4 Physical therapy outcomes

The primary positive outcome for the patient was his ability to ambulate with an assistive device and participate in community activities. (Table 1) The patient depended less on his caregiver for physical
mobility and transference, lessening the burden of care for his wife. Telemedicine enabled the patient to receive specialized services without the additional burden of long periods of travel.

Satisfaction with telemedicine as a mode of physical therapy delivery was given first to the subject and his wife, then later to the therapists. An interview was conducted with the subject and his wife at the end of the study. Satisfaction with the use of telemedicine was high, and the patient and his wife expressed that they were grateful for the opportunity to participate in this study. (Figure 1)

The therapists found the audio and visual image quality of the telecommunication equipment was sufficient for providing information about the patient’s movement ability and for visualizing the rural therapist’s physical contacts as well as processing verbal information between the two sites.

There were some problems initially with seeing the patient movements. It was decided that either pants with a stripe down the side or shorts made it easier to see the patient as he walked and transferred. Light colors (not white) were the choice for shirts, making the arm movements easier to follow. The camera couldn’t be remotely controlled initially. The telemedicine coordinator had to be in the room to adjust the camera, following the patient and therapist as they walked around the room or went to the far wall for an exercise. The fluorescent lighting needed to be supplemented for more accurate evaluations.

The therapists and personnel at the hub and spoke sites expressed extreme satisfaction with the clarity of the video, the effectiveness of using this approach for patient assessment and instruction, and for feedback with specific physical cueing/handling. The remote site staff also indicated that they increased their practical understanding and application of the NDT approach to stroke treatment.

7.5. Cost analysis

This telerehabilitation system seems to be an effective modality for providing physical therapy and has promise to mitigate the shortages and delays in supplying physical therapy to underserved rural areas. Telerehabilitation costs associated with this type of higher level technology are considerable if used only for one case.

Equipment costs for high-end technology can be $4,000 to $50,000 depending on brand and options. Initial installations of internal and external lines are additional costs. Line lease costs can range from $400 to $4,000 per month depending on distance. Telemedicine coordinators are required at both ends of the connections, and network service engineers are needed for the system to continue service. The current state of healthcare reimbursement would not substantiate this program for a single patient, but if used in conjunction with other clinical, educational and administrative applications, cost is disbursed, and this does become a viable option.

8. Future directions

Reimbursement legislation at the state and federal level needs to be pursued for continued interest and participation by therapists. The incorporation of both high and low technology as needed by the patients, requested by physicians, and dictated by the lack of services in the area needs to be considered. Utilization of less expensive technology enables providers to reach patients in the home and has been shown to be suitable for some home applications.

Managed care’s increase in demands is a main reason why clinical based outcome research is so vital. As payers’ criterion becomes more stringent, only those treatments supported by research will be reimbursed. Formal research needs to be continued to assess the efficacy and efficiency of expanding telerehabilitation.

References


