EVALUATION OF A TELEREHABILITATION CONSULTATION MODEL FOR REMOTE WHEELCHAIR PRESCRIPTION

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The purpose of this project was to determine the effectiveness of a telerehabilitation (TR) consultation model to prescribe and procure an appropriate wheeled mobility and seating (WMS) device at a remotely located site. The availability of practitioners with specific expertise in this area was limited particularly in Westerns Pennsylvania. A telerehabilitation service delivery model was developed for a series of studies based on a current model implemented at the Center for Assistive Technology at the University of Pittsburgh Medical Center (CAT-UPMC). In a multi-center non-randomized clinical trial, 96 participants were evaluated: 50 In-Person (IP) at the CAT-UPMC and 46 TR participants at remote sites. The performance-based Functioning Everyday with a Wheelchair-Capacity (FEW-C) tool demonstrated excellent inter-rater reliability coefficients (ICC 2,k = 0.91) and good internal consistency measured by Cronbach's alphas with correlations ranging between 0.82 to 0.91 among the 46 TR participants. Results indicated that using a TR consultation model, a significant improvement in mean differences was observed for the each of the self-report Functioning Everyday with a Wheelchair (FEW) items and for the average FEW scores at the remotely sites. Effect size calculations indicated that nine of the ten items on the FEW as well as the total FEW had very large effect sizes (Cohen's $d >$ 0.80), indicating the effectiveness of not only the new WMS device but the TR assessment as well. A significant relationship was found between the self-report FEW and performance-based FEW-C tools at baseline measured by Spearman rho's correlations. A significant difference

($p<0.001$) was found for participants previous WMS device evaluation and prescription process compared to their current TR WMS device evaluation and prescription scores as well as patient satisfaction regarding the impact of the technology. The findings based on confidence intervals of post FEW scores indicated that TR was non-inferior to the standard IP care at CAT-UPMC. Telerehabilitation services resulted in decreased travel for participants, improved access to specialized services, education benefits for generalist practitioners, and service stabilization at the remote sites. A TR consultation model offers new alternative and effective opportunities to provide rehabilitation services in clinical settings, especially in rural or underserved locations.

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1.0 TELEREHABILITATION INTRODUCTION

Telecommunications technologies are changing ways we think, act, and communicate worldwide and within the healthcare system as well. As in any area of technology, definitions of healthcare and telecommunication continue to change and adjust to the changes in language use and developing concepts. The distinction between telehealth and telemedicine provides just such an example. Telehealth involves electronic information and telecommunications technologies that support long-distance clinical healthcare, patient and professional health-related education, public health, and health administration (Puskin, 2001) whereas telemedicine involves the exchange of medical information from one site to another via electronic communications to improve the health status of a patient (American Telemedicine Association, n.d.). According to Field (2002), "telemedicine is the use of electronic information and communications technology to provide and support healthcare when distance separates the participants" (p.16). Jack Winters (2002) provided a conceptual view of emerging models of telehealth within which telemedicine was considered a subset of telehealth (see Figure 1). Within Winters' framework, telerehabilitation was included under telemedicine (i.e. delivery of clinical services) and telehealthcare (i.e. management of disability and health) (Winters, 2002). When Winters 'emerging model of telehealth' was initially published, telerehabilitation was still an emerging field. Since then there has been a continual shift and change in the use of telerehabilitation in rehabilitative practice, particularly in the fields of physical therapy, occupational therapy, audiology, speech-language pathology, and neuropsychology.

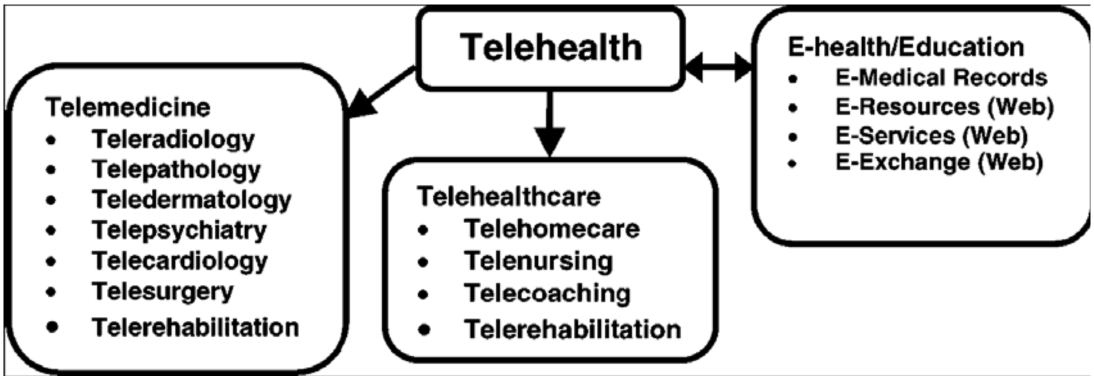


Figure 1: Conceptual View of Emerging Model of Telehealth (Winters, 2002)

Although the peer-reviewed literature on the use of technology for remote assessment and intervention in medicine (Bashshur, 2002) and rehabilitation (Lemaire, Boudrias, & Greene, 2001; Torsney, 2003; Winters, 2002) has increased most rehabilitation providers remain unaware of telerehabilitation options available to them.

In order for telerehabilitation to best benefit the end-user (the individual with a disability), all parties involved need access to all available technology options in order to choose what will work best for the consumer and the environment in which he or she functions. Secondly, as telerehabilitation services continue to expand as a supplement but as a complement to the traditional face-to-face clinical services, there is an increasing need to address (a) appropriate clinical uses (b) reimbursement, and (c) general healthcare policy regarding telerehabilitation services.

In contrast to Winters (2002), Rosen (1999) summarized telerehabilitation activity models based solely on the identity and physical location of the participant. The models included the following:

- "Home Telerehab" (HTR) – The recipient of rehabilitation services was at home during electronically-mediated interactions. During these encounters, no professional is physically present with the individual or a technician was present to provide assistance with the technology.
- "Home rehab Teleguided" (HRTG) – Care was provided at home by a community practitioner, for instance a therapist or visiting nurse with the simultaneous electronic involvement of a remote specialist. This amounted to real-time audio and video transfer for consultation regarding a specific assessment.
- "Community Telerehabilitation" (CTR) – The electronically mediated involvement of remote practitioners with the patient situated in a community health care setting. Technical support was provided by setting up the patient for an audio and video communication session with a remote rehabilitation practitioner.
- "Community rehabilitation teleguided (CRTG) – The remote practitioner provides expert guidance to a local physician, nurse, or therapist joining them in the treatment room electronically. This mode in conjunction with CTR, provided a standard model that involved a formal network which tied centralized sources of expertise, typically major urban comprehensive rehabilitation facilities.
- "Community practitioner teleconsultation" (CPTC) – The distinction offered by this model was that the telecommunication took place between health

professionals away from the presence of the patient. Software made it possible to combine on the monitor screens the images of the consulting professional along with the geographic and photographic data discussed.

1.1 METHODS

Research studies were identified through electronic database searches, beginning with Ovid Medline (1950-2008), the premier medical database, which uses controlled vocabulary Medical Subject Headings. The Cumulative Index to Nursing & Allied Health Literature, covering the years 1982 through 2008, and PsychINFO, which spanned 1967-2008 were also searched. Keywords and phrases entered included: telerehabilitation, telehealth, and telemedicine combined with the terms such as assistive technology, occupational therapy, physical therapy, speech language pathology, and rehabilitation counseling. Finally, the Telemedicine Information Exchange (TIE), produced by the Association of Telehealth Service Providers was also searched. While the TIE was current only up to 2006, it provided a cross-check on telerehabilitation articles that had previously been gathered.

The articles included for review had in their titles or abstract the keywords or phrases previously identified. Additional inclusion criteria were: a) published in referenced scientific journals or from conference proceedings and b) written in the English language. The reference lists of relevant publications were also reviewed to identify further studies that met the inclusion criteria. Articles were excluded if the study was unrelated to an assistive technology application and rehabilitation. Articles were reviewed by a single individual.

1.2 REVIEW OF LITERATURE

The 70 articles identified from the literature on telerehabilitation were reviewed and organized into the following sub-headings.

1.2.1 Delivery of Remote Healthcare Services

Remote locations experience shortages of professionals and technical resources crucial to the delivery of services related to specialized medical fields (Callas, Ricci, & Caputo, 2000). This impacts both the healthcare providers and the patients alike. Rural providers are often isolated from the advancements and technologies readily available in the larger metropolitan centers. As a result, individuals in rural areas who require an assessment, specific treatment, or both, needed to travel long distances for the specialized healthcare necessary to address their needs. Studies reported that 50% of veterans travel more than 25 miles for healthcare services (Randall et al., 1987; Wollinksky et al., 1985). In a study by Hatzakis (2001) conducted within the Veterans Health Administration, veterans with multiple sclerosis were faced with significant barriers to care as a result of their disability. Twenty percent of the veterans surveyed reported that difficulties in parking, distance, or transportation significantly interfered with receiving the treatment they needed. Furthermore, prolonged sitting during travel can carry the potential risk of worsening a pressure ulcer for individuals with sensation issues (Sabharwal, Mezaros, & Duafenbach, 2001). Moreover, mobility restrictions and problems with accessibility to healthcare services significantly interfered with the ability to receive healthcare services in urban locations (Hatzakis et al., 2003).

Technologists and clinicians have investigated the use of advanced telecommunications and information technologies since the late 1950's as a way of bridging the geographic distance between individuals with specialized medical needs living in remote areas and the source of specialty care (Benschoter, Wittson, & Ingham, 1965; Heinzelmann, Lugn, & Kvedar, 2005; Kinsella, 1998). As previously described by Field (2002), telemedicine is "the use of electronic information and communications technology to provide and support healthcare when distance separates the participants" (p.16). The terms "healthcare" and "distance" were key to the implementation of this technology. Telemedicine was used initially in small-scale feasibility projects, and later in larger-scale clinical deployments that included cardiology (Cheung et al., 1998), dermatology (Lowitt et al., 1998), neurosurgery (Pareras & Martin-Rogrigues, 1996), pathology (Ballis, 1997), radiology (Boland, 1998), oncology (Allen, 1997), and space exploration (Doarn, Nicogossian, & Merrell, 1998).

More recently in the field of rehabilitation has been gradually integrating telecommunication into clinical practice. The benefits of using telerehabilitation included: 1) decreased travel between rural communities and specialized urban health centers; 2) better clinical support in local communities; 3) improved access to specialized services; 4) delivery of local healthcare in rural communities; 5) indirect educational benefits for remote clinicians who participate in teleconsultations; 6) reduced feelings of isolation for rural clinicians; 7) improved service stability in regions with high staff turnover; and 8) multimedia communication (Lemaire, Boudrias, & Greene, 2001).

The growth of telehealth, telemedicine, and telerehabilitation worldwide has doubled from a $6.8 million industry in 1997 to a $13.8 million industry in 1998 (Savard et al., 2003).

Experts forecast by 2010, at least 15% of all healthcare services worldwide will be provided via telehealth (Sinha, 2000).

1.2.2 Summary of Telerehabilitation Literature

1.2.2.1 Assistive Technology Applications

Telerehabilitation is the application of telecommunication technology that provides distant support, assessment and intervention to individuals with disabilities (Ricker et al., 2002). Telerehabilitation offered a host of new opportunities to provide alternative rehabilitation services in distant clinical settings (Cooper et al., 2001; Lemaire, Boudrias, & Greene, 2001). Telerehabilitation offered a diversity of clinical applications such as 1) consultation by clinical rehabilitation engineers or specialized clinicians for seating and positioning, 2) provision of assistive technology using simple Plain-old Telephone Service (POTS) videophones, 3) performance by physicians and nurses of pressure sore management using either high-quality camera images or lower-quality images from interactive systems, 4) remote therapy using tools such as EMG-controlled games for stroke rehabilitation or remote interactive story retelling for brain injury rehabilitation, 5) remote rehabilitation management or teleconsultation by physiatrists and 6) specialized clinicians for clinics using group video-conferencing systems over established telemedicine networks (Winters, 2002).

Moreover, Cooper et al. (2001) discussed the potential of rapid advancements in telecommunications technology to improve access to assistive technology (AT) services for people with disabilities. According to the definition proposed in the Assistive Technology Act of 1998, assistive technology commonly refers to “any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities. AT service is directly assisting an individual with a disability in the selection, acquisition, or use of an assistive technology device." (Section 3, p.5)

Burns et al. (1998) described the experiences of a specialty hospital serving people with disabilities which explored telerehabilitation to support AT in the home. The article described four specific case studies to illustrate the use of telerehabilitation in relation to seating evaluation, home accessibility, computer access systems setup, and augmentative communication device training. Each of these case studies described the use of low-cost video telephones such as including AT&T's Picasso Still Image Video Phone, American Telecare Inc.'s Aviva 1010, and PTS-2 systems. All of the devices transmitted simultaneous audio and video over standard telephone lines. Choices were limited to systems that used the standard telephone lines because nearly all participants in the study had access to a phone line. The clinical objective in the respective case studies were: (1) a seating clinic consult for the physical therapist to observe and assess the sitting posture and effectiveness of the patient's weight shift while seated in a recliner; (2) evaluate the individual's strengths and limitations within the context of existing bathroom structure; (3) provide recommendations for a switch mount system for a 23 year-old man with quadriplegia's computer set-up; and (4) provide follow-up training for a 57 year-old man with cerebral palsy on his augmentative communication device. Although each scenario had its limitations, these case studies demonstrated the promise of telerehabilitation to expand availability, accessibility, and affordability of these important services for people with disabilities. However, several adverse conditions were reported: lack of bandwidth from the POTS line as well as the dim lighting and reduced video photography diminished both the audio and video components of the evaluation. In addition, the clinical staff who provided the consults required additional time to familiarize themselves with the technology prior to mailing the technology to the clients.

1.2.2.2 Prevention of Pressure Ulcers

Several studies have examined the feasibility of monitoring pressure relieving activities and preventing pressure ulcers (Beach, Goodall, & Miller, 2000; Mathewson, Adkins, & Jones, 2000; Mathewson et al., 1999; Roth et al., 1999; Soopramanien et al., 2005; Vesmarovish et al., 1999). Phillips et al. (1998) studied the use of a telerehabilitation intervention to promote skin care and other self-care activities for those with spinal cord injuries. In a non-controlled clinical series, researchers used a video phone that would transmit video and still images over a standard telephone line. Although the overall impression of the 11 clients was positive, there were problems with equipment, skin care, and safety. Specifically, a verbal description alone was not as reliable as a face-to-face consult with the patient for diagnosing a skin condition.

In another study, Phillips et al. (1999) examined newly injured spinal cord injured patients following hospital discharge. The research design was a non-randomized prospective trial with 37 patients. Three different approaches for the follow-up were selected: by telephone, video, and routine standard care. The goal of the study was to determine which group of participants had the lowest incidence of pressure ulcers and fewest hospitalizations. The results from this pilot study showed that the video group reported the highest number of ulcers and the standard care approach reported the lowest. A larger sample was required for more comprehensive analysis and additional training of patients was required for use of the equipment prior to discharge, eliminating additional costs for the clinicians and technicians to travel to the patient's home to set up the necessary equipment. Overall, the study showed that when interacting with a small population, video alone is not as effective as the standard care, face-to-face consultation.

1.2.2.3 Virtual Reality Applications

Virtual Reality (VR) is a practical and affordable technology for the practice of clinical medicine and modern high fidelity virtual reality systems offer a number of practical applications in areas ranging from psychiatry to intervention and rehabilitation (Bergeron, 2003). The capacity of VR allowed for creation and control of three-dimensional environments for clinical assessment and rehabilitation options that were not available with traditional methods (Schultheis & Rizzo, 2002). Virtualized reality and three-dimensional reconstruction technology provided individuals who use a wheeled mobility device an effective means of investigating the architectural features of their environment without an expert being on-site (Kim & Brienza, 2006; Kim et al., 2008). Harrison et al. (2002) applied two virtual environments to the assessment and training of inexperienced powered-wheelchair users and demonstrated that the two virtual environments represented a potentially useful means of assessing and training novice-powered-wheelchair users.

A second virtual reality application is ReCon, a remote console telerehabilitation system designed by The University of Medicine and Dentistry of New Jersey to provide therapists, at a remote location, the tools necessary to oversee a patient's rehabilitation session in real-time (Lewis et al., 2005). While the patient was exercising, the system provided the therapist with three-dimensional representations of the patient's movements, VR-based exercise progress, and performance updates. During the session, the therapist evaluated the patient's performance and either modified the current exercise or set up the next one. Additionally, the remote therapist was provided with tools for audio and video communication with the local site and chat communication with the local therapist. Researchers conducted both usability and evaluation studies to refine the system (Lewis et al., 2005; Lewis, Deutsch, & Burdea, 2006).

In a research article by Trepagnier (1999), she described the value of VR systems for the investigation and rehabilitation of cognitive and perceptual impairments and discussed current and political applications of VR technology. Relevant neurorehabilitation problems which could be addressed through VR were identified as: 1) attention and the reduction of distraction, 2) assessment and remediation of executive function deficits, 3) investigation of impairments of coordinated movement, 4) study and rehabilitation of aphasia and other severe disorders of language, 5) task presentation for functional imaging studies of the brain, and 6) a measurement of mental load in the operation of assistive technology.

1.2.2.4 Speech-Language Pathology Applications

Speech language pathology (SLP) and audiology are clinical services related to the identification, assessment and management of speech and hearing disorders and may also include assessment of and/or prescription of AT devices. The Mayo Clinic in Minnesota was one of the earliest to incorporate teleconsultations into SLP, which provided and continues to provide viable alternative to the traditional face-to-face assessment (Duffy, Werven, & Aronson, 1997). Researchers at the National Rehabilitation Hospital in Washington, D.C. developed a custom software package called RESPECT (REmote SPEech language and Cognitive Treatment) which investigated the role of interactive data sharing during teleSLP cognitive communicative treatment. RESPECT augmented and extended therapeutic interaction with the following capabilities; virtual desktop, real time shared interaction, work processing documents, scanned workbook pages, computer applications, digital drawing whiteboards, and combined audio/video conferencing in which the clinician can control the client's computer system. With a sample of

40 subjects with brain injury, researchers subsequently measured advances by establishing the validity of the system in story retelling between face-to-face in-person assessment, and remote telerehabilitation sessions (Brennan et al., 2004; Georgeadis et al., 2004). In addition to equivalent performance between settings, a high level of acceptance of telerehabilitation technology was found regardless of a subject's age, educational level, or technology background.

The Telerehabilitation Research Unit at the University of Queensland in Australia (http://www.uq.edu.au/telerehabilitation/) was another pioneer in research involving assessment and treatment for individuals with acquired neurological speech and language disorders. One of the Unit's many research projects included noting significant improvements in speech for individuals diagnosed with Parkinson's disease as measured by the Lee Silverman Voice Treatment via the Internet (Theodoros, Constantinescu, & Russell, 2006). Other examples include voice therapy at Tripler Army Base in Hawaii (Mashima et al., 2003), remote dysphagia evaluations (Georges, Potter, & Belz, 2006; Perlman & Witthawaskul, 2002), and augmentative and alternative communication evaluations (McKinlay et al., 1995).

1.2.2.5 Seating and Wheeled Mobility Applications

Several studies analyzed the use of telerehabilitation in the field of wheeled mobility and seating. For seating and positioning, telerehabilitation has the potential to provide evaluation, treatment intervention, and follow-up as needed in the home of the client or at a local clinic (V. L. Phillips et al., 1998). Assessment in the home was important considering that the use of assistive technologies (e.g., wheelchairs) is only as effective as an individual's ability to use the device in the natural environment. Research demonstrated that the use of telerehabilitation promoted re-entry in the community and improved quality of life (V. L. Phillips et al., 1998). Researchers from the Glenrose Rehabilitation Hospital in Alberta, Canada designed a study to evaluate both the effectiveness and efficiency of using telehealth to provide seating assessment and intervention. The researchers compared groups of clients under three study conditions: clients residing in Capital Health assessed in-person, clients from out-of-region assessed in-person, and clients from out-of-region assessed by telehealth (Liu & Barlow, 2005).

Malagodi et al. (1998) compared video-conferencing using ordinary POTS lines with video-conferencing using Integrated Services Digital Network (ISDN) lines. Over a 6-month period, an occupational therapist completed eight seating and wheelchair mobility evaluations. Four clients were evaluated by video-conferencing using the POTS line and four clients using an ISDN line. Despite challenges presented by the technology available at the time (i.e. lower quality video afforded by POTS lines, lower data communications rate leading to longer still picture transfer times and "jerkier" video images than those achieved with the ISDN connections), the primary condition and major problem were correctly identified in all cases. This work showed that with advancements in telecommunication technology, telerehabilitation systems had the potential to affect the manner in which services were delivered to determine the best and most appropriate AT device for the client.

Furthermore, Cooper et al. (2002) compared the reliability of the what type of wheelchair a participant currently used by two types of assessment, telerehabilitation and in-person. Clinicians who applied telerehabilitation demonstrated a high level of agreement in recommending the same basic type of wheelchair that the individual already owned, demonstrating a high level of agreement in the consistency of wheelchair recommendation. Cooper concluded that telerehabilitation was a potentially useful tool for wheelchair recommendation.

Finally, a qualitative case study at the University of Calgary was conducted among rehabilitation professionals for the implementation and planning of a telehealth seating clinic (Khoja, Casebeer, & Young, 2005). The study showed the involvement of a multidisciplinary team and proper visualization and communication between participants was essential thus the implementation of telehealth should be stepwise process.

1.2.2.6 Cost-Effectiveness

Telerehabilitation has provided not only cost-effective treatment options to patients but also permitted convenient training of healthcare professionals (Callas, Ricci, & Caputo, 2000; Delaney et al., 2002; Grigsby et al., 1995; Jennett et al., 2000; Lemaire, Boudrias, & Greene, 2001; Taylor, 1998; Zollo et al., 1999). During 1995 through 2001, cost-effectiveness of "tele" projects was being studied readily, despite the controversy over how to measure the cost of these efforts (Kitt & Clayton, 2002; Mair et al., 2000; Mair & Whitten, 2000; Ohinamaa & Hailey, 2002; Whitten & Mair, 2000). Critical reviews of telemedicine cost-effectiveness and cost-benefit literature have been published (Gamble, Savage, & Icenogle, 2004; Hakansson & Gavelin, 2000; Mair et al., 2000; Whitten, Kingsley, & Grigsby, 2000), and they provided evidence that telemedicine was a cost-effective option for society and particularly so for patients. However, cost of care for a facility increased as a result of additional costs for equipment, transmission lines, additional personnel, and administration. In contrast, Holle & Zahlmann (1999) claimed that the question of cost-effectiveness has continued to remain unanswered for most telemedicine services developed globally, since it was difficult to measure foreign costs because of the differences in standards and cost-effectiveness.

1.2.3 Professional Organizations: Stance on Telerehabilitation

Documents of professional organizations such as the American Speech-Language and Hearing Association (ASHA), American Occupational Therapy Association (AOTA), American Physical Therapy Association (APTA), and three rehabilitation counseling associations, American Rehabilitation Counseling Association (ARCA), Commission on Rehabilitation Counselor Certification (CRCC), and American Counseling Association (ACA) were viewed to determine their stance, if any in the area of telerehabilitation. The degree to which each of these organizations had acknowledged and supported telerehabilitation varied, as did their level of activity and involvement in "tele" activities.

ASHA uses the term "telepractice" to refer to "the application of telecommunications technology to deliver professional services at a distance" (American Speech-Language-Hearing Association, 2005). Since 1998, ASHA has been studying the potential impact of telepractice on speech-language pathologists (SLPs) and audiologists and the individuals they serve (American Speech-Language-Hearing Association, 1998). The first documented use of distance programs in SLP was through a grant program in the mid-1970s at the Birmingham Veterans Administration Hospital to explore "tele-communicology" as a potential solution to serving patients in remote locations (Vaughn, 1976). The National Rehabilitation Hospital in Washington D.C. and the University of Queensland in Australia have emerged as two of the leaders in studying telerehabilitation activity related to speech pathology and audiology. In 2005, ASHA published a formal position statement, technical reports (American Speech-Language-Hearing Association, 2005) and issue briefs (American Speech-Language-Hearing Association, 1998) that summarized evidence to date detailing the use of telepractice in SLP and audiology including discussions on future directions and scholarly research.

In 2008, APTA released a Board of Directors Position stating that telehealth was an appropriate model of service delivery for the profession of physical therapy when provided in a manner consistent with Association positions, standards, guidelines, and policies. (American Physical Therapy Association Government Affairs, n.d.). The Board of Directors further stated that telehealth may be used to overcome barriers of access to services caused by distance, unavailability of specialists and/or subspecialists, and impaired mobility. Telehealth offers the potential to extend physical therapy services to remote, rural, underserved, and culturally and linguistically diverse populations. Additional articles explained how physical therapists were using telehealth to overcome barriers of distance and time. Kathy Lewis, Past-President of the APTA Section on Health Policy and Administration's Technology Special Interest Group, stated "there is a need and an opportunity for us to be better with knowledge management. The amount of information that is available to us and how to use new technology effectively and efficiently to access this information will help us manage it. The more benefits I see from telehealth, the more excited I get about it. We're so busy doing what we do as PTs, but we need to take time out to prepare ourselves for the future of physical therapy. Technology is not going to replace physical therapy, but will make it better (American Physical Therapy Association, n.d.)."

AOTA published a position paper on telerehabilitation which outlined the organizations' stance and the literature supporting methods of service delivery for evaluation (Shaw et al., 2001), intervention (Vesmarovish et al., 1999), consultation (Wakeford, 2002), education, and supervision of students and other personnel (Hubbard, 2000). Telerehabilitation as defined by the AOTA position paper supported the clinical application of consultative, preventative, diagnostic, and therapeutic services via two-way interactive telecommunication technology (Wakeford et al., 2005). Likewise, the Canadian Association of Occupational Therapists (CAOT) in their position statement advocated for telehealth and tele-occupational therapy in support of The National Initiative for Telehealth Framework. CAOT recognized the ongoing development of tele-occupational therapy and promoted opportunities for effective, efficient, and accessible occupational therapy services, education and resources to all Canadians (The National Initiative for Telehealth Guidelines, 2003).

In checking both the American Rehabilitation Counseling Association and American Counseling Association websites no pertinent information regarding telerehabilitation could be found. Nevertheless, the Commission on Rehabilitation Counselor Certification Code of Ethics identified videoconferencing as an alternative form of communication. Bracy (1999) introduced the first web-based rich internet application for the telerehabilitation presentation of cognitive rehabilitation therapy followed by the design of a new system for cognitive skills enhancement programs for school children. Trepagnier (1999) of the National Rehabilitation Hospital investigated virtual environments for the rehabilitation of cognitive and perceptual impairments in individuals..

1.3 SUMMARY

The rapid advancements in telecommunications technology have the potential to improve the delivery of services to people with disabilities. Transmission of voice, image, and data provide a means for experts in wheeled mobility and other rehabilitation activities to provide consultation to other healthcare professionals and consumers alike (Cooper et al., 2001).

Telerehabilitation has been a viable alternative for individuals who would otherwise have no option for the services they need but to travel long distances to receive them. Researchers confirmed that telerehabilitation improved quality of life for many and led to an efficient use of healthcare resources (Burns et al., 1998; Krupinksi et al., 2002). Bashshur (2001) investigated the cost/ benefit ratio of using a technology similar to telemedicine. Ironically, technology was one of the key factors in the rising cost of medical care. This study further explained that the cost of care at local facilities was less than that at highly specialized care centers (Bashshur, 2001).

Despite the feasibility and encouraging results of telerehabilitation, its application has been restricted by limited reimbursement for services. Medicare has generally not been receptive to increasing reimbursement costs for telerehabilitation based on the fact that "there was little published peer-reviewed scientific data available on when telemedicine use was medically appropriate" and on the effectiveness of telerehabilitation (Hatzakis et al., 2003).

In response to these valid concerns, University of Pittsburgh researchers and clinicians have collaborated to investigate the effectiveness of telerehabilitation interventions exploring its potential as a clinical tool to address the geographic distance of services while continually to improve quality of care. One of the research tasks within the Rehabilitation Engineering Research Center on Telerehabilitation (RERC-TR) was the evaluation of remote wheelchair prescription. The need for wheeled mobility devices continues to increase as the population ages and survives trauma and disease. The availability of practitioners with specific expertise in this area is limited, especially in rural or remote areas. People are isolated from rehabilitation services due to geography or physical limitations whereby large distances and long travel times are required to receive appropriate and necessary services thus increasing monetary and health costs and other burdens.

The purpose of this project was to determine the effectiveness of using a telerehabilitation consultation model for procuring an appropriate wheeled mobility and seating device via the Internet.

Chapter 2 describes the telerehabilitation service delivery model for remote wheelchair prescription of wheelchairs. The service delivery model utilized components that have been successfully been implemented within the Center for Assistive Technology at the University of Pittsburgh Medical Center. Described are the protocols, procedures, and methodologies used for the remote wheelchair prescription study as well as the measures used for the study outcomes: Functioning Everyday with a Wheelchair (FEW), Functioning Everyday with a Wheelchair-Capacity (FEW-C).

Chapter 3 includes a study investigating using telerehabilitation to establish the inter-rater reliability and internal consistency of the FEW-C. The FEW-C had undergone validity testing with a sample of wheelchair users during in-person assessments but had not been tested under telerehabilitation conditions.

Chapter 4 includes a study measuring change in function with the FEW self-report and the FEW-C performance-based tools following the provision of a wheeled mobility and seating intervention via telerehabilitation. The study also examined the clinical effectiveness of the telerehabilitation intervention, using effect sizes of the test scores, which indicated the magnitude and effectiveness of the difference between the Pre and Post test scores of individual items of the FEW items.

Chapter 5 describes the results from the patient satisfaction and comfort level during questionnaires administered during telerehabilitation sessions, and Chapter 6 describes the concept of non-inferiority of telerehabilitation and in-person seating and wheeled mobility evaluations.

Finally, Chapter 7 includes a summary of findings new to the body of knowledge and limitations of the studies, and recommendations for future research.

2.0 TELEREHABILITATION SERVICE DELIVERY PROTOCOL FOR REMOTE WHEELCHAIR PRESCRIPTION

2.1 INTRODUCTION

Innovation in telecommunications technology and assistive technology (AT) has been a hallmark of the 21st century. This was brought about by partnerships among rehabilitation specialists, manufacturers, engineers, and most importantly consumers. The number of new AT devices were estimated to have doubled over the past 20 years (Scherer & Lane, 1997). One of the most productive areas of AT development was in wheelchair mobility, where choices for style, features, and controls have evolved (Dudgeon, 2000). Wheelchairs are used to enhance function, improve independence, and enable a disabled individual to productively live at home and within the community (Scherer & Cushman, 2001).

The wheelchair industry has expanded into a competitive half-billion dollar industry serving a growing market of nearly 2 million wheelchair users in the United States alone (Russell et al., 1997). Demographic studies of those with disabilities have shown that 12.5 million Americans in need of rehabilitation services live in non-metropolitan/rural areas (Office of Management and Budget, 2004). The Department of Veterans Affairs (2002) predicted that this number is expected to increase by 22% over the next few years. Worldwide, an estimated 100-130 million people with disabilities are in need of a wheelchair but less than 10 percent own or have access to one (New Freedom Initiative Act, 2001). Along with expanded wheelchair development, comprehensive assessment of user needs and matching the user with appropriate wheeled mobility and seating and ensuring proper fitting and training were deemed essential for successful outcomes (Cooper et al., 2001).

Moreover, the selection of an appropriate wheelchair had been commonly viewed as a complex, by-product of differing theories. Decision-making was a difficult task because of the required adjustment to change, the unknown or inexperienced reality of new impairments, and an array of personal and social issues. Selection was inevitably constrained by costs and access to resources. Few training opportunities to educate clinicians who prescribe wheelchairs were available. Prescription strategies were related to priorities, physical needs, functional environment, funding, goals, and other related issues of the individual (Axelson, Minkel, & Chesney, 1994; Schmeler, 2003).

Because of isolation from medical advances, long distance travel to specialized healthcare, and a shortage of professionals and technical resources central to the delivery of AT (Callas, Ricci, & Caputo, 2000), an increasing amount of literature has emerged on the of technology for remote assessment and intervention in medicine (Bashshur, 2002) and rehabilitation (Lemaire, Boudrias, & Greene, 2001; Torsney, 2003; Winters, 2002). However, most of the descriptions and projects reported were limited to one or two types of technologies and a single population.

Over the past 30 years, technologists and clinicians have investigated the use of advanced telecommunications and information technologies to bridge the geographic distance between healthcare professionals and individuals with specialized medical needs living in remote areas and a distance from the source of specialty care (Kinsella, 1998). Telerehabilitation (TR), a subcomponent of the broader area of telemedicine, is the application of telecommunication technology that can provide long-distant support, assessment and intervention to individuals with disabilities (Ricker et al., 2002). For those with disabilities and in need of AT specialty services, access was problematic.

In the United States, the Centers for Medicare and Medicaid Services implemented new coverage policies in 2005 for wheeled mobility and seating devices. The challenge became finding feasible and effective methods to deliver the same level of service and intervention to remote populations as to those with access to experts in metropolitan areas. One way to conceptualize TR was by point-to-point Internet-based video-conferencing for transmission of data, video, and voice. In this manner, an Expert Practitioner (EP) in a large urban clinical setting was made accessible to locations where such care was unavailable. This concept led to the development of remote clinical locations modeled after the Center for Assistive Technology at the University of Pittsburgh Medical Center (CAT-UPMC). The remainder of this Chapter describes the protocol, procedures, and methodologies for developing the remote service delivery model.

2.2 METHODS AND MATERIALS

2.2.1 Protocol

A TR clinical service delivery system was used to measure the effectiveness of wheeled mobility and seating interventions provided in a remote location by a generalist practitioner with consultation from an EP via interactive video-conferencing (Schein et al., 2008). The EP was an occupational therapist with an Assistive Technology Practitioner certification and 10 or more years of experience in the field of wheeled mobility and seating (WMS). A total of 96 (50 in-person and 46 TR) participants with mobility impairments who use a mobility device (i.e. manual wheelchair, power wheelchair, or scooter) as their primary means of mobility were recruited and assessed. The TR or experimental group was seen face-to-face by a Generalist Practitioner (GP) with consultation from the EP via TR in the remote clinic. The IP or control group was seen face-to-face by the EP at the CAT-UPMC. The Protocol is explained in 3 distinct phases and tabulated in Table 1.

Phase 1:

The first visit for each group took up to 2 hours (typical of an initial assessment). This involved a comprehensive interview regarding participant needs, preferences, and goals. The session included a physical examination of muscle strength, joint range of motion, posture, and mobility as well as observation of ability to perform mobility related activities of daily living. All study participants in both TR and in-person (IP) control groups received a face-to-face physician assessment. Study participants at both sites were given an identical Demographic Data Form-Pre and asked to reply to questions regarding satisfaction with the evaluation and prescription for their current mobility device. This session further involved trials of various WMS interventions. A baseline administration of the Functioning Everyday with a Wheelchair (FEW) was administered to both groups; however, the Functioning Everyday with a Wheelchair-Capacity (FEW-C) was administered only to the TR group. Although the same procedures were applied to both the TR and IP groups, the GP received consultation from the EP observing via telerehabilitation. The EP observed the participant’s demonstration of the various activities of daily living as identified in the FEW-C. During IP assessment participants were provided an opportunity to try various WMS interventions typically available in a specialty wheelchair clinic. Figure 2 shows a conceptual schematic of the project

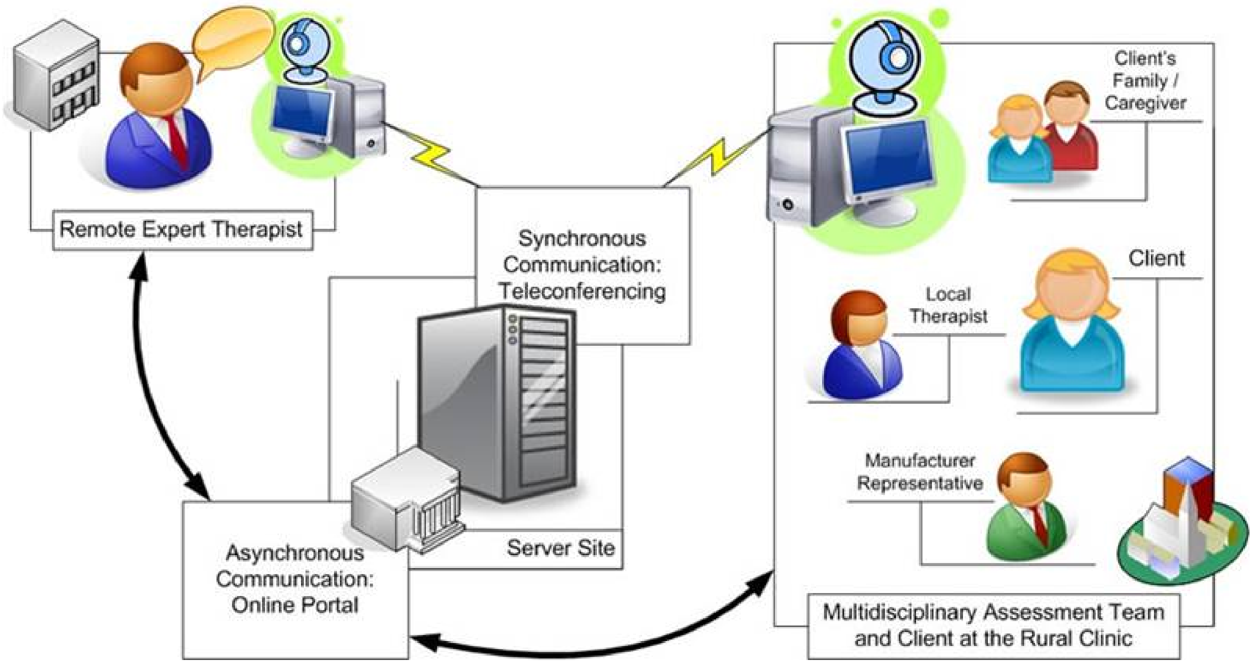


Figure 2: Conceptual Schematic of the Telerehabilitation Project

<u>Phase II:</u>

Following the initial assessment for both the TR and IP groups, a Rehabilitation Technology Supplier (RTS) visited the homes of all participants to determine the accessibility of the specified WMS intervention identified during the initial visit. The home assessments were an integral part of the service delivery protocol to determine whether the WMS intervention was compatible within the participant's natural environment. Figure 3 shows the complete service delivery protocol.

Following the home visit, the RTS reported on the home accessibility and specifications of the WMS device to practitioners via e-mail after their home assessment. For the TR group, the EP reviewed and discussed the findings from the home assessment as well as the appropriateness of the WMS specifications with the GP for preparation of a final report and Letter of Medical Necessity (LMN). The LMN template that was used at the CAT-UPMC was shared with all the remote clinics. The completed LMN was then sent to the attending physician or primary care physician for review and signature for both groups of participants. Upon the physician's signature, the LMN was forwarded to the RTS who submitted it to the participant's medical insurance or other third- party paying source.

Upon approval of the WMS intervention, an appointment was scheduled for the participant to be examined in the clinic setting for fitting and delivery of the equipment. For the experimental group, the EP participated via telerehabilitation to observe the fit and appropriateness of the intervention and to provide any further assistance as needed. After delivery of the participant's new WMS device, the Demographic Data Form-Post and TR Questionnaire were administered.

Figure 3: Clinical Service Delivery Protocol

Phase III:

The third phase was a follow-up to administer the FEW for both groups via telephone and conducted no less than 2 weeks after delivery of the WMS device and if possible via telerehabilitation for the TR group. The 2 week time interval at home is important to the study because it allowed participants to familiarize themselves with their new WMS intervention.

Table 1: Phases of the Clinical Service Delivery Protocol

	In-Person at CAT-UPMC	Telerehabilitation
Phase I	Initial evaluation by EP	Initial evaluation by a GP with consultation from EP via TR
	Fill in Demographic Data Form-Pre	Fill in Demographic Data Form-Pre with consultation from EP via TR
	Administration of FEW	Administration of FEW and FEW-C with consultation from EP via TR
	Trial of various WMS devices with RTS	Trial of various WMS devices with RTS with consultation from EP via TR
	LMN generated	LMN generated via online portal
Phase II	Home assessment by RTS	Home assessment by RTS
	RTS sends report of home assessment via secure email along with specifications of the WMS device to EP	RTS sends report of home assessment via secure email along with specifications of the WMS device to GP
	LMN sent to attending physician or primary care physician for review and signature	LMN sent to attending physician or primary care physician for review and signature
	LMN sent to RTS who then submits it to funding agency	LMN sent to RTS who then submits it to funding agency
	Once approved, fitting and delivery of the WMS device is scheduled with EP	Once approved, fitting and delivery of the WMS device is scheduled with the GP and with consultation from the EP via TR
	Fill in Demographic Data Form-Post	Fill in Demographic Data Form-Post and TR Questionnaire

Table 1 (continued)

Phase III	Administer FEW via telephone no less than two weeks following delivery	Administer FEW via telephone no less than two weeks following delivery

Key: EP = Expert Practitioner; GP = Generalist Practitioner; TR = Telerehabilitation; FEW = Functioning Everyday with a Wheelchair; FEW-C = Functioning Everyday with a Wheelchair-Capacity; WMS = wheeled mobility and seating; RTS = Rehabilitation Technology Supplier; and LMN = Letter of Medical Necessity

2.2.2 Study Participants

Participants for the studies were recruited from 4 remote wheelchair clinics: DuBois Regional Medical Center in DuBois, PA, Charles Cole Memorial Hospital in Coudersport, PA, Meadville Medical Center Health System in Meadville, PA, and Elk Regional Health Center in St. Mary's, PA. Inclusion criteria for participation consisted of the following: adult patients, age 18 or older, who used a manual/power wheelchair or scooter and were seeking a new WMS device. All individuals who were approached for participation were able to read and comprehend English to the extent that they could understand and answer questions on the FEW. The study involved 46 participants: 25 manual wheelchair users, 3 scooter users, and 18 power wheelchair users. The average participant was a 55 year old (range 22–89) Caucasian (89%) female (61%) in a manual wheelchair (54%) who reported using a WMS device for 70.5 months (range 2-180 months). Since the participants had various primary diagnoses, diagnostic categories were collapsed and placed within 5 main categories: Progressive (29%), Spinal Cord Injury (11%), Orthopedic (17%), Cardiovascular (28%), and Central Nervous System (15%). The most common diagnoses were multiple sclerosis (24%), obesity (17%), spinal cord injury (9%), cerebrovascular accident (7%), osteoarthrtits, (7%) and above knee amputation (7%) (see Table 2). The typical wheelchair used at the initial assessment was a 49.3 month-old manual wheelchair with no seating functions. At post-test the majority of participants were prescribed power wheelchairs (81%) with varied power seat functions such as power tilt-in-space, recline, seat elevator, elevating legrests or a combination of these functions (33%).

Table 2: Telerehabilitation Study Participants (n=46)

Descriptors	Parameters
Age (mean, SD)	54.63 ± 15.51 (range from 22 – 89)
Gender	
Female (%)	61
Male (%)	39
Race	
Caucasian (%)	89
Other (%)	11
Months using a wheelchair (mean, SD)	70.5 (range from 2 – 180)
Age of wheelchair at pre-test (mean, SD)	56.87 (range from 2 – 180)
Primary Medical Condition	
Progressive (%)	29
Spinal Cord Injury (%)	11
Orthopedic (%)	17
Cardiovascular (%)	28
Central Nervous System (%)	15

Of the 46 TR participants, only 36 received a new WMS device. Two of the participants were still waiting for their new WMS device prior to analysis of the study data and eight individuals were withdrawn for the following reasons:

- passed away before receiving new WMS device; however, the death was unrelated to the study

- had Veterans Insurance and needed to be evaluated at a Veterans Affairs clinic
- two participants stopped returning phone calls
- judged not safe while driving a power wheelchair and scooter - based on the suppliers home assessment
- received brochures and catalogs of various WMS devices and reported that he did not want to puruse anything new at that time
- current power wheelchair was repaired
- could not afford the 20% co-pay insurance

The reasons identified above did not appear to be related to the use of telerehabilitation but were instead real-life situations that can and do occur in clinical service delivery.

2.2.3 Outcome Measures

Outcome measurement tools must be valid, reliable, and practical for implementation within the context of clinical or natural environments and also capable of being administered within a reasonable amount of time with reasonable resources (Polgar & Barlow, 2002).

The FEW was designed as a self-report questionnaire to be administered over time to consumers of WMS technology, as a dynamic indicator or profile of perceived user function related to wheelchair/scooter use (see Appendix A and Figure 4). The FEW consists of 10 consumer-generated self-report items, which are scored using a 6 point scale: 6 = completely agree to 1 = completely disagree with a score of 0 = does not apply. The 10 items are: stability, durability, and dependability; comfort; health needs; operate wheelchair/scooter; reach and carry out tasks at different surface heights; transfers; personal care tasks; indoor mobility; outdoor mobility; and personal/public transportation (Mills, Holm, & Schmeler, 2007). The tool was systematically developed by a team of clinical researchers at the University of Pittsburgh due to the lack of available outcome measures related to functioning with the use a wheelchair. The self-report task items were developed and validated based on structured interviews with wheelchair users. Analysis of goals and items were documented by consumers and clinicians through other sources, including additional research studies related to wheeled mobility and seating. The FEW demonstrated good test-retest reliability and takes about 20 minutes to complete (Mills, Holm, & Schmeler, 2007; Mills, Holm, Schmeler et al., 2002; Mills, Holm, Trefler et al., 2002). The FEW can be self-administered, administered as an interview or by phone. There is no specific setting required to administer the FEW and no specialized examiner training is required. However, it is recommended that the examiner have some background experience and/or knowledge of seating-mobility technology and evaluation. Figure 5 shows an example of the reaching task that the investigator addressed during the assessment.

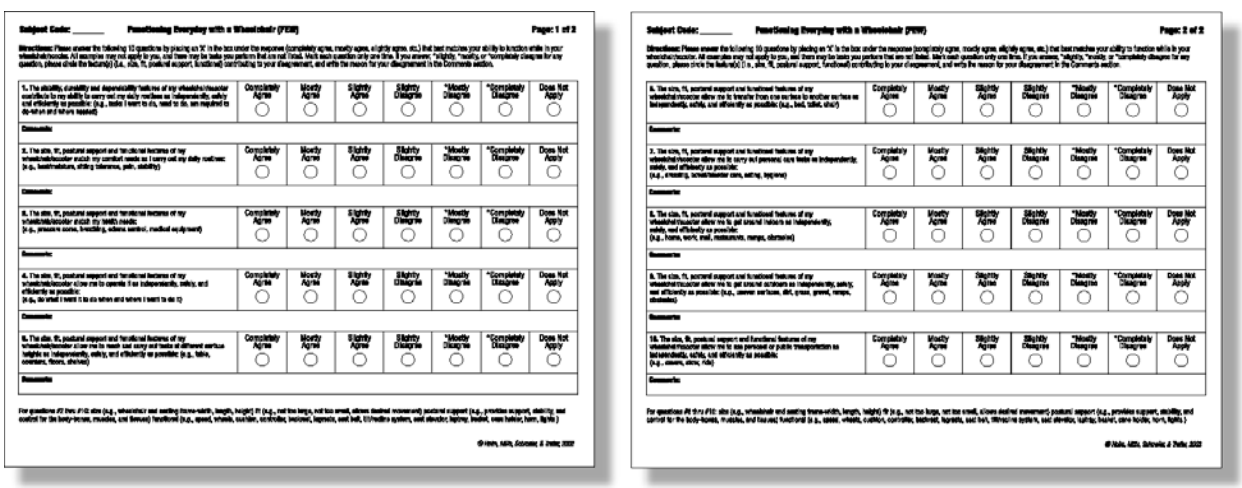
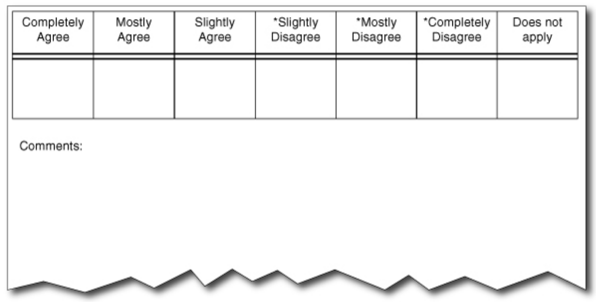


Figure 4: Functioning Everyday with a Wheelchair (FEW)

"The size, fit, postural support and functional features of my wheelchair/scooter allow me to reach and carry out tasks at different surface heights as independently, safely, and efficiently as possible: (e.g., table, counters, floors, shelves)"



Completely Agree	Mostly Agree	Slightly Agree	*Slightly Disagree	*Mostly Disagree	*Completely Disagree	Does not apply

Comments:

Figure 5: Example of Reaching Task Item and Scoring Structure

The FEW-C is a criterion-referenced, performance-based observation tool used by practitioners and researchers to measure functional outcomes of seating-mobility technology interventions. The FEW–C focuses on the consumers' capacity to perform tasks or activities (e.g., mobility, reach, and transfer) in a controlled clinical or laboratory environment and takes around 35 minutes to one hour to administer (Schmeler, 2005). The FEW–C consists of 10 criterion-referenced, performance-based tasks identical to the 10 FEW items (See Appendix B). Of the ten tasks, several are strictly performance based: operate, reach and carry out tasks at different surface heights, transfers, personal care tasks, indoor mobility, and outdoor mobility. Three tasks, comfort needs, health needs, and personal/public transportation have both performance-based and self-report components because of the complexity (i.e., subjectivity, feasibility) associated with task measurement. Stability, durability, and dependability is a self-report item which is subsequently measured during performance of all other tasks. Figure 6 shows the Task #4, Operate, along with the subtasks that the participant performs.

Task # 4: FEW-C: Operate Wheelchair/Scooter

Based on the size, fit, postural support, and functional features of the wheelchair/scooter:

Mobility Device used during task:

☐ Manual ☐ Power ☐ Scooter

Assistive Technology Devices (ATDs) used during task:
1.
2.

Total # of ATDs used: ______

Subtasks	FEW-C Subtasks	INDEPENDENCE DATA: Verbal Assist (VA)	Visual Assist (V^2A)	Physical Assist (PA)	SAFETY DATA: SP	MR	PH	SR	QUALITY DATA: SM	IP	PM	NM	SUMMARY SCORES: INDEPENDENCE	SAFETY	QUALITY	FEATURES: STABILITY	DURABILITY	DEPENDABILITY
1. Forward/ Reverse	Moves wheelchair/scooter into position and in forward and reverse directions as indicated on course diagram adequately (does not bump into or scrape body parts on surrounding surfaces, maintains balance, maintains appropriate speed/propulsion for terrain) and efficiently (does not need to stop, back up, etc., straight trajectory, controlled manner)	VA VA VA	V^2A V^2A V^2A	PA PA PA	SP	MR	PH	SR	SM	IP	PM	NM	3 2 1 0					
2. Turns	Moves wheelchair/scooter into position and demonstrates a right or left turn and a 180° turn adequately (does not bump into or scrape body parts on surrounding surfaces, maintains balance, maintains appropriate speed/ propulsion for terrain) and efficiently (does not need to stop, back up, etc., controlled manner)	VA VA VA	V^2A V^2A V^2A	PA PA PA	SP	MR	PH	SR	SM	IP	PM	NM	3 2 1 0					
3. Stops	Brings wheelchair/scooter to stop position after traveling in forward/reverse directions as indicated by therapist adequately (does not travel beyond indicated stopping point, maintains balance) and efficiently (within 1 try, does not struggle, controlled manner)	VA VA VA	V^2A V^2A V^2A	PA PA PA	SP	MR	RI	SR	SM	IP	PM	NM	3 2 1 0					
4. On/Off and Brakes	Turns wheelchair/scooter on and off or locks and unlocks brakes on wheelchair adequately (does not bump into or scrape body parts on surrounding surfaces, maintains balance, no unplanned movements) and efficiently (within 1 try, does not struggle, controlled manner)	VA VA VA	V^2A V^2A V^2A	PA PA PA	SP	MR	RI	SR	SM	IP	PM	NM	3 2 1 0					

Adapted from the Performance Assessment of Self-Care Skills (PASS), Home, Version 3.1 (Rogers & Holm, © 1989, 1994); (Holm, 2001)

Figure 6: Functioning Everyday with a Wheelchair-Capacity Operate Task

The scoring method for the items with self-report components included indicating consumers' responses with a mark or circle, and written responses in the spaces provided. The performance-based items yielded three distinct category scores, independence, safety, and quality which then equate to a summary score based on a pre-defined 4-point ordinal scale. Administered in-person to a sample of adult manual and power wheelchair users, the FEW-C demonstrated good to excellent internal consistency, moderate to strong convergent and discriminant validity and excellent inter-rater reliability (Schmeler, 2005).

For telerehabilitation to be accepted as an alternate means of providing assistive technology services, clients need to feel comfortable with this method of assessment. A questionnaire was designed to determine the user's comfort level with the technology and perceptions regarding satisfaction with the evaluation process. The questionnaire was modeled after the same or similar items from Malagodi et al. (1998) and then expanded to meet the researchers needs for the study. A 6-point scale, 6 = strongly agree to 1 = strongly agree to answer seven questions was used to score the assessment questionnaire (see Appendix C).

The Demographic Data Form-Pre (see Appendix D) was completed in order to gather information regarding current WMS device status and usage. Routine demographics such as age, gender, race, and primary diagnosis were also recorded. The Demographic Data Form-Post (see Appendix E) allowed investigators to track the type of new WMS device the study participant received. Assessed also was a pre-post measure of participant satisfaction with the previous evaluation and prescription process and comparison between the previous WMS device and the newly prescribed one. A 5-point scale, 1= very dissatisfied to 5 = very satisfied was completed as a measure of participant satisfaction.

2.2.4 Apparatus

A custom video-conferencing infrastructure was developed and deployed at each of the four remote collaborating sites. The video-conferencing system was ConferenceXP, an initiative of Microsoft Research, which is a shared source video-conferencing platform designed to address the needs of academic distance learning/multi-institutional and advanced collaboration scenarios. ConferenceXP is an open source platform wherein researchers at the Rehabilitation Engineering Research Center on Telerehabilitation were able to build a server that houses our custom infrastructure stored within the University of Pittsburgh's School of Health and Rehabilitation Sciences. The video-conferencing system was installed at each of the four remote sites along with a Logitech QuickCam Orbit MP USB web camera with built in microphone (camera on the left in Figure 7), a high speed digital subscriber line (512 kbps to over 1 Mbps), T1 wireless connection shared (5.4 Mbps) internet connection rate, and an Internet Protocol Panasonic BB-HCM381A Network Camera (camera on the right in Figure 7).

Figure 7: Camera Technology

The Panasonic BB-HCM381A Network Camera was viewed from a standard Internet browser and controlled by the EP. The camera equipped with a 42x zoom function (optical and digital) allowed the research team to remotely pan, tilt, and zoom in and out in a total of 12 steps (10-step optical zoom and 2-step digital zoom) to view the wheelchair clinic and its surrounding areas. Specific system requirements to support our video-conference infrastructure are found in Table 3.

Table 3: System Requirements to Run ConferenceXP 4.0

Requirement	Description
Processor and Memory	
For two-way conferencing	2.4 GHz Intel Pentium 4 with 500 MB RAM, or better
For three or more conferencing	3.0 GHz Intel Pentium 4 with 512 MB RAM, or better
Software	▪ Microsoft® Windows® XP Professional with Service Pack 2 (SP2) and Microsoft Journal Viewer -or- Microsoft Windows XP Tablet PC Edition with Service Pack 2 (SP2) ▪ Microsoft .NET Framework 2.0 ▪ Microsoft DirectX 9.0 or later ▪ Microsoft Windows Media Player 11 ▪ The latest drivers for your audio and video devices
Network	High-speed connection that supports multicast, such as a local area network or Internet2
Hard Disk Space	10 MB of available hard disk space for installation
Video Camera	A USB video camera, such as the Logitech QuickCam PTZ web camera
Audio	USB speakerphone, or similar unit with audio speakers with an echo-canceling microphone

The ConferenceXP research platform enabled researchers to take advantage of existing applications such as desktop sharing, browser sharing, online presentation, text-chat, media streaming, and archiving. ConferenceXP is being used in large research organizations (Anderson et al., 2003) and in a number of universities including Brown, Cornell, and the University of California at Berkeley. Built within the server were Internet Protocol (IP) addresses that offered various applications such as Venue Service, Archiving Service, and Reflector Service. The Venue Service allowed researchers to create and manage venues, virtual spaces where users participated in synchronous collaborative and learning activities. A unique feature within the Venue Service was a secure venue or "chat room" for each of the remote sites. To retain privacy and confidentiality, each remote site when logging in only saw their respective venue. The archive service enabled a recording of each of the teleconsultations and a play back option for future learning opportunities. Other capabilities of the video-conferencing infrastructure included streaming video and audio, and the sharing of PowerPoint presentations and internet browsing.

2.3 RESULTS

Outcome studies in the field of telerehabilitation originated in the laboratory and in university settings and were subsequently extended to actual clinical settings and patients who could benefit most (i.e. rural or underserved communities). The protocol for and outcome study was developed at the Rehabilitation Engineering Research on Telerehabilitation (RERC-TR) at the University of Pittsburgh where a secure Internet Protocol-based video-conferencing system was developed and installed within four rural hospitals located at least 100 miles away from originating Pittsburgh, PA site. In order to test both the video and audio components of the system, several web cameras were evaluated: Creative Labs Webcam Live!, Logitech Quickcam for Notebook, and Logitech QuickCam Orbit MP. Several microphones were also evaluated either USB-based or built in from web cameras. All of the cameras had a price range below $200, in line with the goal for incurring minimal costs without trading quality. The Logitech QuickCam Orbit MP USB 2.0 web-camera with up to 8 megapixels, autofocus lens system, microphone with Rightsound technology, up to 30 frames per second video with built in microphone met our needs. An Internet Protocol Panasonic BB-HCM381A Network Camera was used to access remote pan, tilt, and 42 times optical zoom with automatic focus adjustment to assist with the teleconsultation. A comparative approach against a referenced procedure or predefined standard such as the one implemented by the CAT-UPMC was conducted. The CAT-UPMC is referred in this study to as the "Gold Standard" for wheelchair assessment. Many so-called evaluation studies ignore this basic requirement and often end up with inconclusive results.

Four remote clinics and one urban clinic participated in the study. The four remote clinics were DuBois Regional Medical Center, DuBois, PA; Charles Cole Memorial Hospital, Coudersport, PA; Meadville Medical Health Center, Meadville, PA; and Elk Regional Health Center, Saint Mary's, PA. all of which contacted research investigators to assist them in developing a wheelchair clinic. The urban clinic was the Center for Assistive Technology at the University of Pittsburgh Medical Center (CAT-UPMC). Participants enrolled in the Pittsburgh center were considered the control group with IP assessments, and the remote clinics were considered the experimental group, using TR. All four remote clinics were compared to. All four remote clinics were located at least 100 miles away from CAT-UPMC (see Figure 8).

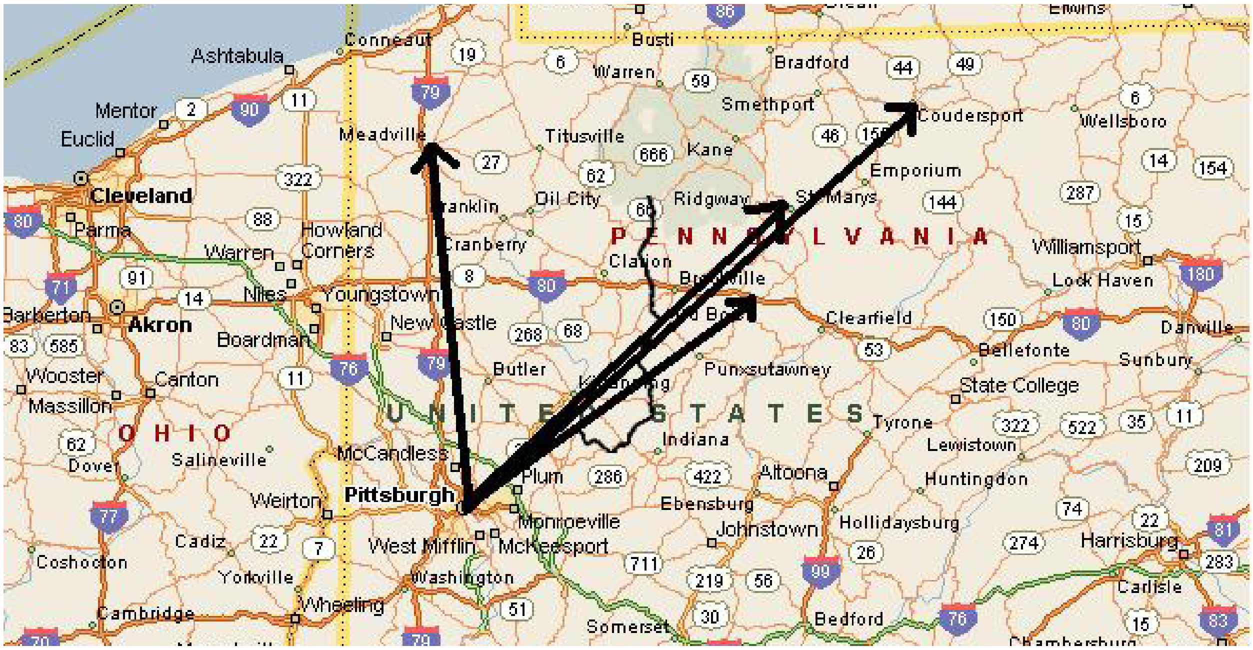


Figure 8: Map of Collaborating Remote Hospitals from Pittsburgh

2.4 DISCUSSION

As with any technological advancement, there were barriers and/or limitations to developing the TR protocol and service delivery model. Proponents of telemedicine argued that integration into mainstream healthcare delivery must be supported by scientific evidence demonstrating the technology's efficacy, effectiveness, and acceptability (Grigsby et al., 1995; Mair & Whitten, 2000; Perednia, 1995; Whitten & Mair, 2000). The TR service delivery protocol incorporated health information technology and was based on the CAT-UPMC model evaluating an individual IP (Schein et al., 2008).

One of the main problems encountered in developing a TR service delivery protocol for wheelchair prescription was the lack of scientific evidence pertaining to standards and guidelines in telerehabilitation and seating and mobility. The remote hospital clinicians were in need of assistance as training opportunities for rehabilitation professionals in seating and mobility at the professional level was less than ideal (Batavia, Batavia, & Friedman, 2001; Cooper, Trefler, & Hobson, 1996). Despite this limitation, the telerehabilitation protocol actively provided a useful way to share knowledge while at the same time also providing the general practitioners with skills, training, and mentoring. The important elements offered by the telerehabilitation consultation were access to expertise in rehabilitation technology for the participants in rural areas, benefit of services, cost savings, and no additional distance needed to travel for specialist care.

Researchers encountered no difficulty in guiding the generalist practitioners at the remote sites. This was attributed to the amount of pre-planning and time spent with each of the sites before the study started. Members of the research team including the clinical expert practitioner and two doctoral candidates within the RERC-TR met with the generalist practitioners, information technology support, and rehabilitation management at each of the collaborating clinics. A detailed presentation of the then-current state of WMS and telerehabilitation was presented at this meeting. By the time the meeting was scheduled, preliminary talks had started and training videos and materials on specific outcome measurement tools were made available to the generalist practitioners. A detailed explanation of computer requirements and specifications to install and run the video-conferencing system were sent to the information technology support before the scheduled visit. The meeting was an information session scheduled to answer any additional inquiries from management, and to meet face-to-face with the information technology support and practitioners. A rapport with each of the practitioners was initiated before the study and a meeting occurred as each attended a continuing education seminar on WMS at the

University of Pittsburgh where telerehabilitation was discussed. Discussions and follow-up were conducted, resulting in agreement and participation in the research study.

2.5 CONCLUSIONS

The telerehabilitation service delivery protocol provided a quality system that utilized current standards of practice. The protocol assisted service providers in meeting the challenges of wheelchair prescription and demonstrated a capacity to effect change and influenced outcomes. The protocol further addressed factors thought to contribute to poor assessment and generated important new outcome data that had not been reported in telerehabilitation applications. The protocol assisted in improving prescription practices by reduced variations in clinical practice and provided additional opportunities for professional development and education.

3.0 TELEREHABILITATION ASSESSMENT: THE FUNCTIONING EVERYDAY WITH A WHEELCHAIR-CAPACITY (FEW-C) OUTCOME TOOL

3.1 INTRODUCTION

Telerehabilitation (TR) did not create new clinical services; it simply provided an alternative method for delivering existing services. In response to this need, a growing number of pilot studies within the area of telemedicine extended the physical rehabilitation encounter from the clinic to distant sites, including the home (Rosen, 2004).

Initial TR studies explored video-conference consultations from clinician to clinician (Lemaire, Boudrias, & Greene, 2001), seating and wheeled mobility evaluations (Malagodi et al., 1998), and orthotic assessments (Lemaire et al., 1997). Several studies analyzed the use of TR for seating and mobility assessment and intervention. Cooper et al. (2002) compared the type of wheelchair used to the type of wheelchair recommended via TR and In-Person (IP) assessments. Clinicians who utilized telerehabilitation demonstrated a high level of agreement (Kappa = 0.760) compared to IP assessment (Kappa = 0.749), indicating a high level of agreement with their IP counterparts and the wheelchair the subjects already owned. Allegretti et al. (2004) reported the inter-rater reliability for seven trunk alignment variables was marginally better (Kappa values >0.75 for 2/7 items; average Kappa value = 0.577) when measured by two therapists through an in-person assessment, compared to measures by a therapy assistant completing the in-person assessment with a therapist observing the assessment over video-conferencing (Kappa values >0.75 for 1/7 items; average Kappa value = 0.515).

Studies have confirmed the reliability of TR assessment if impairments and function. Shafqat et al. (1999) used a telemedicine link to examine 20 patients 2 to 73 days after stroke using the National Institutes of Health Stroke Scale. The weighted Kappa coefficients ranged from -0.07 to 0.83 for the different items of the NIHSS, demonstrating mainly fair to good inter-rater agreement. Palsbo et al. (2007) explored the equivalence of physical function assessment by physical therapists during both face-to-face and remote administration of the European Stroke Scale (ESS) and the Functional Reach Test (FRT). Their conclusions indicated that when the remote physical therapist directed the patient, equivalent values were reported by the therapist for 83% for all ESS components and more than 90% of the patients with the FRT. In a pilot study by Dreyer et al, (2001) IP and remote site therapist were reported to have reached 94.12% agreement of the Kohlman Evaluation in Living Skills and 100% agreement of the Canadian Occupational Performance Measure during administration. However, for TR to mature as an effective tool in rehabilitation service delivery, outcome tools that use performance-based observation, a hallmark of rehabilitation, requires validation and reliability testing .

Reliability is a measure of precision and refers to the production of same or similar results by repeated measurement of the same individual on different occasions, or by different observers. The two types of reliability used in this study were inter-rater reliability and internal consistency. A growing literature has accumulated on categories of health outcomes and tools for measuring those outcomes (Fowler, 1995; Lohr, 1992). Tools to assess clinical performance and health outcomes have progressed considerably in recent years as methodologists and researchers tested and improved the validity and reliability of measures ensuring that the data they yielded measured what it was supposed to measure, and did so consistently (Portney & Watkins, 2000). Additionally, for TR evaluations, a measure that was sensitive to change was also critical. Therefore, the specific aims of this study were to: a) establish inter-rater reliability between an Expert Practitioner and Remote Generalist Practitioners via TR using the Functioning Everyday with a Wheelchair-Capacity (FEW-C) tool and b) determine the internal consistency of the FEW-C constructs (Independence, Safety, and Quality) of data collected via TR.

3.2 METHODS

3.2.1 Instrumentation

Since there were no published criteria available for selecting a TR measure, a similar methodology by Palsbo et al., (2007) was chosen for selecting the outcome measurement tool. The selection criteria included: 1) appropriate and relevant for people with mobility impairments who use a mobility device such as a manual/power wheelchair or scooter; 2) known psychometric properties (i.e. validity and reliability); 3) used in clinical practice; 4) visually based so that that the therapist can observe and rate performance without touching the patient; 5) could be completed within 30 minutes; and 6) a tool familiar to the seating/mobility community.

Based on the above inclusion criteria, the following outcome measures were investigated: Wheelchair Physical Function Performance test (WC-PFP) (Cress et al., 2002), Wheelchair Skills Test (WST) (Kilkens et al., 2003), Wheelchair Users Functional Assessment (WUFA) (Stanley et al., 2003), and the Functioning Everyday with a Wheelchair-Capacity (FEW-C)

(Schmeler, 2005). Based on the inclusion criteria, the WC-PFP, WST, and WUFA were not applicable as those tools measured participant function specifically in manual wheelchairs. Researchers required a tool that measured a participant's ability to function in a manual wheelchair, power wheelchair or a scooter. Thus, the FEW-C was selected, because it meat all f the criteria set forth by the research team.

The FEW-C is a criterion-referenced, performance-based observation tool used by practitioners and researchers alike to measure functional outcomes of WMS technology interventions. For the purpose of the study, the following tasks were recorded and scored: operate; reach; transfer; personal care; indoor mobility; comfort; and health. Since the video-conferencing system could not be relocated to the outside environment to evaluate performance for outdoor mobility, and personal/public transportation, these particular items were not assessed.

3.2.2 FEW-C Reliability Study

To be considered a measure of quality, evidence of reliability and validity should be provided. The measurement of reliability as a tool addresses the ability to yield consistent responses under the same given conditions (Portney & Watkins, 2008). Without agreement between independent observers able to replicate research procedures, or the ability to use research tools and procedures that yield consistent measurements, researchers cannot satisfactorily draw conclusions, formulate theories, or make claims regarding the generalizability of their research (Howell et al., 2005). Four general classes of reliability estimates can be tested, each of which estimate reliability in a different way. They include measurement of inter-rater reliability, test-retest reliability, parallel-forms, and internal consistency. In the current study, the more clinically relevant inter-rater reliability and internal consistency were selected for examination. Inter-rater reliability was used to assess the degree to which the FEW-C ratings were consistent between the generalist practitioner (GP) conducting the in-person (IP) FEW-C assessment at the remote site, and the expert practitioner (EP) observing the FEW-C assessment via TR. Internal consistency was calculated to assess the consistency of FEW-C across the individual items within the test (Trochim, 2006). Test-retest reliability was not chosen due to the dependence on transportation and family member availability (taking off from work) as well as study participant burden.

The reliability study focused on four objectives:

a) Create training videos and conduct in-person training sessions for administering and scoring the FEW-C;
b) Implement FEW-C inter-rater reliability testing;
c) Establish ≥ 0.80 inter-rater reliability using the intraclass correlation coefficient (ICC, 2*k*); and
d) Establish internal consistency of the FEW-C constructs of independence, safety, and quality with a target Cronbach's alpha between 0.70 and 0.95.

3.2.2.1 Study Raters

Five raters, which included one EP and four GPs were identified for this study. The EP was an occupational therapist with an assistive technology practitioner certification and 10 or more years of experience in wheeled mobility and seating. The four GPs were clinicians who approached investigators from their respective hospitals for assistance in opening a wheelchair clinic. The level of clinical experience varied among GPs: one practitioner with 4 years of experience with CVA and hand/ortho patients; one practitioner with 6 years of experience; one practitioner with 8 years of experience with pediatrics, neurorehabilitation, and work hardening, and one practitioner with over 20 years of experience.

3.2.2.2 Study Raters Training

The Institutional Review Boards at each of the four remote locations, DuBois Regional Medical Center (DRMC), Charles Cole Memorial Hospital (CCMH), Meadville Medical Center Health System (MMCHS), Elk Regional Health Center (ERHC), and the University of Pittsburgh reviewed and approved the study protocols. Training videos were created on how to administer, score, and interpret the FEW-C outcome tool with a past client of the expert practitioner. The training videos and test manual were mailed to each of the GPs. The raters reviewed the training videos and test manual prior to a formal training session with research team members at each of the remote clinics. A member of the research team simulated symptoms of an individual with multiple sclerosis and performed each of the FEW-C tasks. After each task was completed, both the EP and GP scored the task and individual scoring was discussed. Training was considered complete when there were not further questions or discrepancies and consensus scoring was achieved. The training sessions varied from 2 to 3 hours per site.

3.2.2.3 Study Participants

Study participants were recruited from DRMC in DuBois, PA, CCMH in Coudersport, PA, ERHC in St. Mary’s, PA, and MMCHS in Meadville, PA. The TR reliability study included 46 participants: 25 manual wheelchair users, 3 scooter users, and 18 power wheelchair users. Descriptive data of TR participants can be found in Table 4.

Table 4: Telerehabilitation Reliability Participant and Wheelchair Characteristics

Participant	Gender	Age	Race	Diagnosis	Wheelchair Type
1	Male	72	C	Orthopedic	Power
2	Female	58	C	Progressive	Power
3	Female	74	C	Cardiovascular	Manual
4	Female	47	C	Progressive	Manual
5	Male	57	C	Central Nervous System	Scooter
6	Female	74	C	Cardiovascular	Manual
7	Male	41	C	Cardiovascular	Manual
8	Male	55	C	Progressive	Scooter
9	Female	48	C	Cardiovascular	Manual
10	Female	65	C	Cardiovascular	Manual
11	Female	70	C	Orthopedic	Manual
12	Female	82	C	Cardiovascular	Manual
13	Female	84	C	Orthopedic	Manual
14	Male	57	C	Central Nervous System	Power
15	Female	40	C	Spinal Cord Injury	Manual
16	Female	25	A	Central Nervous System	Power
17	Female	89	C	Orthopedic	Manual
18	Female	63	C	Orthopedic	Power
19	Male	61	C	Central Nervous System	Manual
20	Female	37	C	Cardiovascular	Manual
21	Female	33	C	Progressive	Manual
22	Male	59	C	Orthopedic	Manual
23	Female	55	C	Progressive	Power
24	Female	50	C	Progressive	Power
25	Male	46	C	Cardiovascular	Power
26	Female	60	C	Cardiovascular	Power
27	Female	72	C	Cardiovascular	Manual
28	Female	60	C	Progressive	Power

Table 4 (continued)

29	Male	55	C	Progressive	Power
30	Female	52	C	Spinal Cord Injury	Power
31	Female	47	C	Orthopedic	Scooter
32	Female	45	C	Spinal Cord Injury	Power
33	Female	57	C	Cardiovascular	Manual
34	Male	27	C	Central Nervous System	Power
35	Male	55	A	Cardiovascular	Manual
36	Male	52	C	Progressive	Manual
37	Female	87	C	Progressive	Manual
38	Male	47	A	Central Nervous System	Manual
39	Male	22	C	Central Nervous System	Power
40	Male	63	C	Orthopedic	Manual
41	Female	45	C	Central Nervous System	Manual
42	Male	43	C	Spinal Cord Injury	Manual
43	Female	43	C	Central Nervous System	Power
44	Female	39	C	Spinal Cord Injury	Power
45	Male	45	A	Orthopedic	Manual
46	Male	55	A	Progressive	Power

Key: C = Caucasian; and A = African American

3.2.2.4 Apparatus

A custom video-conferencing infrastructure was installed at each of the remote collaborating sites and detailed in Chapter 2.

3.2.2.5 Reliability Study Procedures

The reliability study was conducted over a period of 26 months. During that time the remote clinics were held once every few months. The GPs, with guidance from the research team incorporated the FEW-C into their clinical service delivery model. The FEW-C was administered to participants during the initial intake (pre-intervention) using their current WMS device after the initial intake. The IP GPs administered the FEW-C using standardized directions, asking the participant to perform each of the required FEW-C tasks. If there were questions or concerns about a certain task, the EP was available via TR to respond. The raters observed the participant and simultaneously rated each of the tasks identified by the FEW-C. Each of the hospitals' wheelchair clinics were arranged in a manner similar to an Activities of Daily Living Laboratory where there was a sink to allow the participants to perform personal care tasks, linoleum flooring with a transition to carpet for indoor mobility and operation of the device and a mat table to transfer to and from their mobility device. The In-person GP and EP rated the FEW-C separately as each observed the participant perform the tasks.

3.2.3 Data Analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS) Version 14.0. Descriptive statistics were analyzed to determine the frequencies for all the variables recorded in the data collection, including age, sex, primary diagnosis, race, and current wheeled mobility and seating (WMS) intervention.

According to Portney and Watkins (2008), "inter-rater reliability is best assessed when all raters are able to measure a response during a single trial, where they can observe a subject simultaneously and independently..." (p. 69). Test-retest reliability was not done due to the dependence on transportation and family member availability (taking off from work) as well as study participant burden. Inter-rater reliability was established using the intra-class correlation coefficient (ICC, 2*k*). The goal was to have an ICC ≥ 0.80. The ICC formula chosen uses the average scores assigned by raters for each FEW-C item. The use of the ICC had several advantages: ICC reflects the degree of correlation and agreement, assesses reliability among two or more ratings, and is applicable for ordinal or ranked data where intervals between measurements are assumed to be equal (Huck & Cormier, 1996; Lahey, Downey, & Saal, 1983; Portney & Watkins, 2008).

The internal consistency of the total FEW-C tool was examined using Cronbach's coefficient alpha. Cronbach's alpha reflects the extent to which item responses correlate with each other and with a total test score. The individual item scores and total scores vary as a function of common or shared variance and unique or error variance. An alpha greater than 0.70 but less than 0.95 was set as the statistically acceptable coefficient because this indicated good to excellent homogeneity of the total FEW-C, without unnecessary redundancy of items (Portney & Watkins, 2008).

3.3 RESULTS

3.3.1 Inter-rater Reliability

The EP and the GPs demonstrated excellent inter-rater reliability when scoring the FEW-C IP and via TR with an ICC = 0.97 [95% CI = 0.95– 0.98, $p < 0.001$]. This measure was also consistent for each of the items, while the combined ICCs for independence, safety, and quality data and summary scores were > 0.80 [range, 95% CI = 0.68 – 0.99] (see Table 5). Both of these primary findings were above the acceptable value > 0.80, and all reliability coefficients had small to moderate confidence intervals, indicating that the EP using the TR video-conferencing system and GPs showed minimal variability in their FEW-C ratings. With all ICCs > 0.80, the ratings also affirmed the quality and precision of the video-conferencing images.

3.3.2 Internal Consistency

Internal consistency of the total FEW-C tool for independence, safety and quality ratings achieved a standardized Cronbach's alpha of 0.94. Internal consistency for each scale was also good, with standardized alphas of 0.91 for independence, 0.83 for safety, and 0.82 for quality (see Tables 6, 7, and 8).

Table 5: Inter-rater Reliability of the FEW-C via Telerehabilitation

FEW-C Item	ISQ ** ICC_2 [CI]	Independence ** ICC_2 [CI]	Safety ** ICC_2 [CI]	Quality ** ICC_2 [CI]
Comfort Needs	0.91 [0.83 – 0.95]	0.99 [0.98 – 0.99]	0.88 [0.78 – 0.93]	0.86 [0.74 – 0.92]
Health Needs	0.89 [0.79 – 0.94]	0.96 [0.92 – 0.98]	0.85 [0.72 – 0.92]	0.85 [0.72 – 0.92]
Operate	0.91 [0.85 – 0.95]	0.93 [0.88 – 0.96]	0.91 [0.84 – 0.95]	0.90 [0.82 – 0.95]
Reach	0.88 [0.79 – 0.94]	0.93 [0.87 – 0.96]	0.85 [0.73 – 0.92]	0.87 [0.76 – 0.93]
Transfer	0.91 [0.82 – 0.95]	0.98 [0.96 – 0.99]	0.83 [0.68 – 0.90]	0.91 [0.83 – 0.95]
Personal Care Tasks	0.95 [0.91 – 0.97]	0.96 [0.93 – 0.98]	0.93 [0.87 – 0.96]	0.96 [0.93 – 0.98]
Indoor Mobility	0.92 [0.87 – 0.96	0.98 [0.97 – 0.99]	0.89 [0.80 – 0.94]	0.90 [0.83 – 0.95]
Total	**0.91 [0.84 – 0.95]**	**0.96 [0.93 – 0.98]**	**0.88 [0.77 – 0.93]**	**0.90 [0.82 – 0.94]**

Key: ISQ = Independence, Safety, and Quality; FEW-C = Functioning Everyday with a Wheelchair-Capacity; ICC = intraclass correlation coefficient; CI = Confidence Intervals; and $^{**}p<0.001$, unless ICC_2 = intraclass correlation coefficient Model (2, k)

Table 6: Internal Consistency of FEW-C Independence Construct via Telerehabilitation

FEW-C Task	COM	HN	OP	RCH	TRN	PC	IM
Comfort	1.000	0.78	0.66	0.61	0.50	0.44	0.56
Health Needs		1.000	0.55	0.69	0.65	0.59	0.45
Operate			1.000	0.59	0.46	0.57	0.87
Reach				1.000	0.64	0.61	0.47
Transfers					1.000	0.67	0.41
Personal Care Tasks						1.000	0.56
Indoor Mobility							1.000
Overall Internal Consistency							**0.91**

Key: COM = Comfort; HN = Health Needs; OP = Operate; RCH = Reach; TRN = Transfer; PC = Personal Care; IM = Indoor Mobility; and FEW-C = Functioning Everyday with a Wheelchair-Capacity

Table 7: Internal Consistency of FEW-C Safety Construct via Telerehabilitation

FEW-C Task	COM	HN	OP	RCH	TRN	PC	IM
Comfort	1.000	0.70	0.22	0.35	0.26	0.29	0.35
Health Needs		1.000	0.31	0.33	0.50	0.40	0.31
Operate			1.000	0.47	0.32	0.39	0.67
Reach				1.000	0.51	0.58	0.52
Transfers					1.000	0.47	0.34
Personal Care Tasks						1.000	0.47
Indoor Mobility							1.000
Overall Internal Consistency							**0.83**

Key: COM = Comfort; HN = Health Needs; OP = Operate; RCH = Reach; TRN = Transfer; PC = Personal Care; IM = Indoor Mobility; and FEW-C = Functioning Everyday with a Wheelchair-Capacity

Table 8: Internal Consistency of FEW-C Quality Construct via Telerehabilitation

FEW-C Task	COM	HN	OP	RCH	TRN	PC	IM
Comfort	1.000	0.72	0.30	0.34	0.37	0.22	0.44
Health Needs		1.000	0.24	0.35	0.28	0.35	0.25
Operate			1.000	0.44	0.40	0.22	0.62
Reach				1.000	0.55	0.58	0.46
Transfers					1.000	0.41	0.33
Personal Care						1.000	0.42
Indoor Mobility							1.000
Overall Internal Consistency							**0.82**

Key: COM = Comfort; HN = Health Needs; OP = Operate; RCH = Reach; TRN = Transfer; PC = Personal Care; IM = Indoor Mobility; and FEW-C = Functioning Everyday with a Wheelchair-Capacity

3.4 DISCUSSION

Generalist practitioners at a remote site and an EP observing The FEW-C assessments via TR established high levels of inter-rater reliability and internal consistency. This was evident from the ICCs and the Cronbach's alphas for the overall tool and for individual items and constructs. Recent publications of TR pilot studies focused on physical measurement (Allegretti et al., 2004), impairment measures (Palsbo et al., 2007; Shafqat et al., 1999), and paper/pencil tests of function (Dreyer et al., 2001). The current reliability study using a TR consultation model and a performance-based observational tool adds new information to the body of knowledge.

The TR consultation model enabled an EP from a distance of over 100 miles away to evaluate a participant's functional status and task performance while seated in a mobility device. The lack of "hands on" exposure has been a barrier associated with telerehabilitation. Nonetheless, with this study, the inter-rater reliability data has shown that a practitioner can assess an individual's functional status as accurately via TR as another practitioner can assess the same individual face-to-face.

These results were comparable to those found during the validation of the FEW-C by Schmeler (2005), in which he and other raters observed 15 FEW-C administrations in-person. Schmeler reported that the FEW-C demonstrated excellent inter-rater reliability with an ICC = 0.99 [95% CI = 0.98 – 0.99, $p < 0.001$] whereas this study resulted in an ICC = 0.97 [95% CI = 0.95– 0.98, $p < 0.001$]. Similarly, the constructs of independence, safety, and quality, reached the acceptable value ≥ 0.80. Likewise, similar internal consistency standardized alphas were achieved overall (> 0.90) and for each construct (> 0.70).

Several factors contributed to the reliability of the FEW-C via telerehabilitation. The simultaneous scoring of the participant by the expert practitioner from a distance and the generalist practitioner face-to-face eliminated the problems of patient fatigue from repeat testing. A second factor was the systematic training procedure that all the generalist practitioners received. The provision of video training materials and manuals in advance of training ensured that the GPs were ready to build on what they had already learned. A third factor was related to the raters and information technologists who were assigned to each of the remote sites. The raters were all licensed occupational therapists with varying levels of clinical experience and limited exposure to the WMS field. All raters were eager to implement outcome measures while the systematic training procedure supported them in administering and scoring the tool. Further studies with a more diverse mix of rehabilitation professionals would strengthen our findings, and further confirm the consultative model. Without the assistance of the information technologists at each remote site, this study would not have been as successful. Research team members worked with information technologists to verify and test the video and audio quality of the video-conferencing system before each scheduled clinic session. The testing was part of the planning stage of the study and was put in place to eliminate possible issues that might arise before beginning participant assessment and data collection.

One primary limitation of the study was the small number of raters involved. Only two raters were present during administration of the FEW-C. Future TR investigations using the FEW-C or other observational tools should take advantage of the asynchronous or store-and-forward interaction. The ability to archive each of the FEW-C administrations allows for future studies to be conducted for education and research. The videos can be used to establish protocols and for training. After training is completed, the videos can be posted to a Web Site where practitioners can log in and view the training sessions while scoring how the individual performed on the tasks, thus enabling a larger set of raters to participate in such studies. The archived videos then can be viewed and used as an educational piece to demonstrate discrepancies in results among many raters.

Similar to several other reliability studies (Palsbo et al., 2007; Schmeler, 2005), test-retest was not performed because of the burden it would cause participants to return to the clinic for a third visit. Future studies could consider trading practitioner roles whereby generalist practitioners could observe the expert practitioner administering the FEW-C and then measure the performance in the participant's home environment instead of in the controlled clinic setting. This would require testing of the video-conferencing system by using a slower Internet connection than the high speed connection provided by the remote site or to incorporate the video-conferencing system on a "smart" video cellular telephone with 3G network capability.

3.5 CONCLUSIONS

The TR consultation model was affirmed with excellent inter-rater reliability between an in-person GP administering the FEW-C and an EP observing via TR. Because of the up front training in the administration of the FEW-C, and cueing from the EP via TR, the development of quality additional wheelchair clinics in remote locations was achieved. Using telerehabilitation increased awareness, confidence, and trust among its practitioners who initially doubted that TR applications could provide reliable results. With the TR consultation model, an EP had the ability to assess wheeled mobility function from a distance simultaneously with an on-site GP. These findings indicated that the FEW-C was a reliable tool for assessment of wheeled mobility function and warrants continued use in TR assessments, as well as studies to validate performance-based tools via TR. Additional studies using performance-based outcome tools such as the Wheelchair Skills Test (Kirby et al., 2004; Kirby et al., 2002) and Wheelchair Circuit (Kilkens et al., 2004; Kilkens et al., 2002) should also be investigated to test the effectiveness of TR.

4.0 CHANGE IN FUNCTIONING FOLLOWING THE PROVISION OF A WHEELED MOBILITY AND SEATING INTERVENTION VIA TELEREHABILITATION

4.1 INTRODUCTION

Prior to 1996, Galvin & Scherer (1996) reported that one-third of all assistive technology (AT) devices were abandoned by users. A review of the literature by Scherer and Cushman (2001) indicated that although a person may no longer need an AT device, the most significant factor associated with technology abandonment was the failure to take under consideration user opinions and preferences. When choosing a new wheeled mobility and seating (WMS) device, the following components are considered essential for consumer input: wheelchair design, size, weight, maneuverability, and portability (Kittel, DiMarco, & Stewart, 2002).

However, the shortage of rehabilitation experts in the area of WMS has perhaps contributed to AT abandonment because of limited wheeled mobility and device assessment and intervention services (Scherer & Lane, 1997). Limited accessibility to wheeled mobility services was one of the main factors driving the demand and development of telerehabilitation (TR) DeRuyter (1997), who had published extensively on AT outcomes research offered considerations when considering TR services and research: (a) identify the most effective and efficient interventions and services, (b) evaluate the performance of programs and practitioners,

(c) identify areas of needed improvement, (d) examine quality and cost-effectiveness, and (e) increase the knowledge base and accountability of major stakeholders (e.g., consumers, practitioners, payers, and policy makers).

Clinicians and researchers considering the use of TR for wheeled mobility assessment must first identify the functional assessment tools they will use. Although self-report function measures are often used in clinical settings, the optimal approach for assessing functional status has been an ongoing debate (Guralnik et al., 1989; Keith, 1994). Among clinicians and researchers there are differences in opinions about self-reported measures versus performance-based measures. Performance-based measures were considered more objective, free of reporting bias, sensitive to change, reproducible, and clinically relevant for determining treatment effectiveness (Keith, 1994; McDowell & Newell, 1996). However, self-report measures are inexpensive, easy to administer and can provide information about the general performance of basic tasks in the clinic or home environment (Owens et al., 2002).

Studies have measured agreement between the more clinically relevant self-reported and performance-based measures of function and indentified sources of disagreement, including Cress et al. (1995), and Owens et al. (2002). Cress et al. (1995) compared self-perceived and performance based physical function tools to individuals with a broad range of abilities. Their conclusions indicated that self-perceived and performance-based measures were moderately correlated, with a range from $r = -.194$ to $r = -.625$ ($p < 0.05$). Owens et al. (2002) reported that disagreement between the self-reported and performance-based measure of function was common among post-menopausal women who experienced a stroke (slight disagreement, 55.0%; substantial disagreement, 19.3%). Most women (95.4%) over-reported their level of function. Although, good to excellent correlation was reported (r=.95) between self-reported skills of manual wheelchair users and scores on the Wheelchair Skills Test, however, authors reported that with self-report, users tended to overestimate their own abilities (Newton et al., 2002).

4.1.1 Aims of the Study

The first aim of this study was to investigate differences in user's perceived function from the baseline assessment to post-provision of a new WMS device via TR using the self-reported Functioning Everyday with a Wheelchair (FEW) tool. The second of the study was to compare baseline assessment data from the self-reported FEW with data from the performance-based observational data, the Functioning Everyday with a Wheelchair-Capacity (FEW-C).

The hypotheses were:

1) There will be no significant difference between average baseline and average post-TR WMS intervention ratings on the FEW
2) There will be no significant difference between baseline and post-TR WMS intervention ratings of specific FEW items.
3) There will be no significant relationship between the self-report FEW and the performance-based FEW-C ratings administered at baseline via TR with the participants' current WMS device.

4.2 METHODS

4.2.1 Study Sample

Participants from the 4 remote wheelchair clinics, DuBois Regional Medical Center in DuBois, PA, Charles Cole Memorial Hospital in Coudersport, PA, Meadville Medical Center Health System in Meadville, PA, and Elk Regional Health Center in St. Mary's, PA were recruited. This study involved a sample of 46 participants: 25 manual wheelchair users, 3 scooter users, and 18 power wheelchair users. The typical wheelchair used at the initial assessment was a 49.3 month-old manual wheelchair with no seating functions. At post-test the majority of participants were prescribed power wheelchairs (81%) with varied power seat functions such as power tilt-in-space, recline, seat elevator, elevating legrests or a combination of these functions (33%) (see Table 9). Raters for the FEW-C consisted of one expert practitioner (EP) and four generalist practitioners (GP). The EP was an occupational therapist with an assistive technology practitioner certification and 10+ years of experience in WMS. The four GPs were clinicians with various level of clinical experience: one practitioner with 4 years of experience with CVA and hand/orthopedic patients; one practitioner with 6 years of experience; one practitioner with 8 years of experience with pediatrics, neurorehabilitation, and work hardening, and one practitioner with over 20 years of experience.

Table 9: Telerehabilitation Study Characteristics at Pre-Post

Characteristics	Pre (n=46)	Post (n=36)
Type of Mobility Assistive Equipment		
Manual wheelchair (%)	54.3	11.1
Scooter (%)	8.7	8.3
Power wheelchair (%)	37.0	80.6
Wheelchair Classification		
Standard manual wheelchair (%)	21.7	0.0
Highstrength lightweight manual wheelchair (%)	26.1	0.0
Ultralightweight manual wheelchair (%)	8.7	11.1
Scooter (%)	6.5	8.3
Power wheelchair (%)	37.0	80.6
Seat Functions		
Manual elevating legrests (%)	0.0	0.0
Power tilt-in-space (%)	4.3	5.6
Power recline (%)	0.0	0.0
Power elevating legrests (%)	0.0	0.0
Power seat elevator (%)	4.3	2.8
At least two seat functions (%)	0.0	33.3
No seat functions (%)	91.3	58.3

4.2.2 Instruments

The FEW was designed as a self-report questionnaire to be administered over time to consumers of WMS technology as a dynamic indicator or profile of perceived user function related to wheelchair/scooter use. The FEW consists of 10 consumer-generated, self-report items which were scored using a 6 point scale of 6 = completely agree to 1 = completely disagree, and a score of 0 = does not apply. The 10 items are: stability, durability, and dependability (SDD), comfort, health needs; operate wheelchair/scooter, reach and carry out tasks at different surface heights, transfers, personal care tasks, indoor mobility, outdoor mobility, and personal/public transportation (Mills, Holm, & Schmeler, 2007).

The FEW-C is a criterion-referenced, performance-based observation tool used by practitioners and researchers to measure functional outcomes of WMS technology interventions (Schmeler, 2005). The FEW–C consists of 10 criterion-referenced, performance-based tasks, which were identical to the 10 FEW items. For purposes of this study, the following tasks were recorded and scored: operate; reach; transfer; personal care; indoor mobility; comfort; and health. The video-conferencing system could not be relocated to the outside environment to score outdoor mobility and personal/public transportation, therefore these specific items were not assessed.

4.2.3 Procedure

Prior to beginning data collection, Institutional Review Board approval was obtained at each of the four remote clinics and the University of Pittsburgh. In-service training was conducted at each of the hospitals to explain the service delivery protocol to the occupational and/or physical therapists assisting with the research project as described in Chapter 2. The opportunity to participate in the study was presented to wheelchair users at the clinic. Those who agreed to participate and fulfilled the set of criteria described above were invited to join the study. Informed consent of all participants was obtained by the therapist at each of the respective remote sites.

The initial assessment occurred during a regularly scheduled clinic visit for seating evaluation. Following the collection of demographic data, the FEW was administered followed by a baseline administration of the FEW-C. A second visit included delivery of the participant's new WMS device. A follow-up FEW interview was conducted in no less than 2 weeks after delivery via the telephone. The 2 week interval following delivery of the new WMS device allowed participants to familiarize themselves with their new WMS intervention.

4.2.4 Data Analysis

For hypotheses 1 and 2, data were aggregated and analyzed using the paired t-test to examine the differences between pre and post average FEW scores and FEW items. Because the use of repeated t-tests increased the chance for a Type I error (finding significant differences by chance alone), a Bonferroni correction was used in the data analysis [desired alpha/number of comparisons = alpha needed for desired alpha, or .05/11 = p = 0.005] (Huck & Cormier, 1996; Portney & Watkins, 2000). Cohen's *d* [*d* = 2*t* / sqrt (df)] was calculated to identify the clinical or practical significance of the WMS intervention for the total tool and individualized item grand means of the FEW. Cohen's *d* was chosen because it can be appropriately used for pre-post studies and does not require experimental and control groups. An effect size of 0.2 to 0.3 was a "small" effect, 0.5 a "medium" effect, and 0.8 to 1.0 a "large" effect for Cohen's *d.* When examining hypothesis 3, reliability testing was conducted for internal consistency of the FEW and FEW-C. Cronbach's alpha was set at ≥ 0.6 to indicate acceptable agreement at baseline for the FEW and FEW-C tools. In addition, spearman rho correlations were used to test the relationship between the FEW and FEW-C at baseline. For the correlation analysis, the ratings of the FEW were collapsed and recorded to match the FEW-C ratings for comparison (6 = 3, 5/4

= 2, 3/2 = 1, and 1 = 0) as the FEW ratings are completed on a 6-point ordinal scale, and FEW-C ratings on a 4-point ordinal scale.

4.3 RESULTS

Forty-six participants were recruited during the 26 month duration of the study and data collection, but only 36 participants received a new WMS device. As shown in Table 10, the WMS intervention with the TR consultation resulted in changes in the FEW self-report scores on several items. The SDD, comfort, health needs, operate, reach, and outdoor mobility all improved whereas transfer, personal care, indoor mobility, and transportation decreased in ranked score. The outdoor mobility task changed the most (+7) while transportation decreased the most (-6) in terms of rank scoring. All FEW items showed a change in scores from pre to post administration.

Table 10: Rank of FEW Items at Pre-Post

FEW Item	Pre mean(SD) N = 46*	Pre rank	Post(SD) N = 36	Post rank
SDD	3.04(1.43)	6	5.61(0.49)	3
Comfort	2.93(1.48)	7	5.61(0.49)	3
Health Needs	2.93(1.42)	7	5.64(0.49)	2
Operate	3.11(1.60)	5	5.71(0.46)	1
Reach	2.80(1.50)	8	5.31(0.62)	6
Transfer	3.28(1.50)	4	5.31(0.58)	6
Personal Care	3.46(1.43)	2	5.39(0.55)	5
Indoor Mobility	3.43(1.50)	3	5.53(0.51)	4
Outdoor Mobility	2.76(1.68)	9	5.64(0.54)	2
Transportation	3.68(1.46)	1	4.63(1.03)	7

Key: SDD = Stability, Durability, and Dependability; SD = Standard Deviation; and of the 46 participants at baseline, 10 participants did not receive WMS devices leaving 36 participants who responded to the post-FEW outcome tool

At the initial assessment, the average self-reported pre-FEW score was 3.20(±1.06). Following the telerehabilitation consultation evaluation and intervention, the average self-reported post-FEW score was 5.49(±0.32), a significant difference ($p< 0.001$). Therefore, null hypotheses 1 was rejected because there was a significant difference in average FEW scores. Furthermore, null hypothesis 2 was also rejected as participants reflected significant pre-post improvement on each of the 10 FEW items ($p< 0.001$) (see Table 11 and Figures 9 and 10). The FEW items which had the largest of change were outdoor mobility (206.16%), comfort

(165.46%), and health needs (151.11%), transportation (62.67%), and personal care (97.59) while indoor mobility (96.02%) had the smallest change. The majority of the participants were in low quality manual and/or power wheelchairs before receiving the face-to-face assessment with the generalist practitioner and the consultation via TR. However, the majority (80%) of study participants were prescribed high end powered wheelchairs with various powered seat functions such as power tilt-in-space, recline, seat elevator, and elevating legrests.

Table 11: Mean Differences and Relative Change % on FEW Items (n=36)

Item	Mean Difference (SD)	T	df	*P*	Relative Change %
SDD	2.42(1.23)	11.81	35	< 0.001	110.05
Comfort	2.75(1.46)	11.29	35	< 0.001	165.46
Health Needs	2.69(1.37)	11.81	35	< 0.001	151.11
Operate	2.40(1.44)	9.87	35	< 0.001	121.14
Reach	2.53(1.52)	9.97	35	< 0.001	160.83
Transfer	2.03(1.40)	8.67	35	< 0.001	113.10
Personal Care	1.83(1.46)	7.51	35	< 0.001	97.59
Indoor Mobility	1.97(1.40)	8.43	35	< 0.001	96.02
Outdoor Mobility	2.86(1.71)	10.04	35	< 0.001	206.16
Transportation	1.06(1.44)	3.81	29	< 0.001	62.67
Average FEW	2.29(0.87)	15.83	35	< 0.001	88.53

Key: SDD = Stability, Durability, and Dependability; SD = Standard Deviation; FEW = Functioning Everyday with a Wheelchair

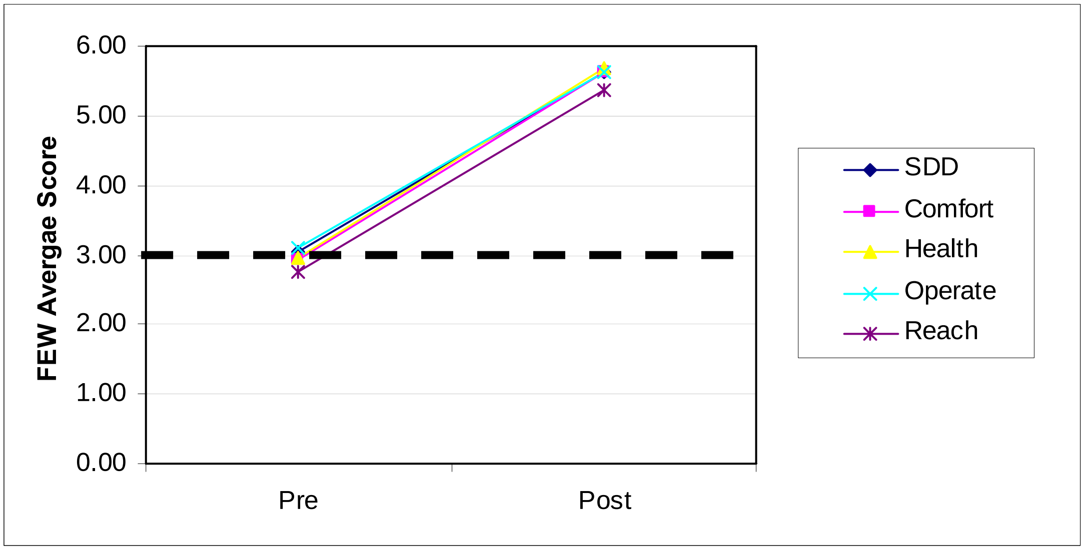


Figure 9: FEW Scores at Pre-Post for SDD, Comfort, Health, Operate & Reach

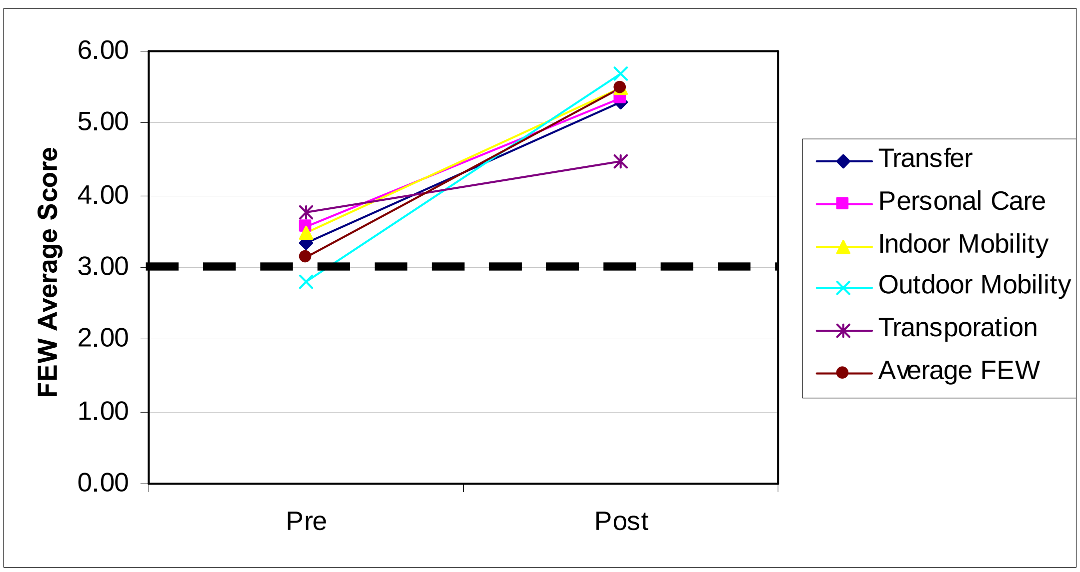


Figure 10: FEW Scores at Pre-Post for Transfer, Personal Care, Indoor Mobility, Outdoor Mobility, Transportation, and Average FEW

Cohen's *d* effect size calculations indicated that nine out of the ten items within the FEW as well as the total FEW had very large effect sizes (see Table 12). Transportation was the only item that showed a medium effect size (0.69). Because of the large t values, the effect sizes for the individualized items were larger than expected, indicating the perceived effectiveness of the TR evaluation and intervention (Huck & Cormier, 1996).

Table 12: FEW Effect Sizes of Wheeled Mobility and Seating Intervention Using Cohen's *d*

Item	(t)	2*(t)	df	Cohen's *d*
SDD	11.81	23.62	35	1.96
Comfort	11.29	22.58	35	1.88
Health	11.81	23.62	35	1.96
Operate	9.87	19.74	35	1.67
Reach	9.97	19.94	35	1.66
Transfer	8.67	17.34	35	1.45
Personal Care	7.51	15.02	35	1.25
Indoor Mobility	8.43	16.86	35	1.41
Outdoor Mobility	10.04	20.08	35	1.67
Transportation	3.81	7.62	29	0.69
Total Tool	15.83	31.66	35	2.63

Key: SDD = Stability, Durability, and Dependability

Internal consistency of the self-report FEW and performance-based FEW-C tools at baseline achieved a standardized Cronbach's alpha of 0.90 and 0.87 respectively (see Tables 13 and 14.)

Table 13: Internal Consistency of the FEW at Baseline

FEW Task	SDD	COM	HN	OP	RCH	TRN	PC	IM	OM	TRANS
SDD	1.000	0.44	0.40	0.52	0.52	0.41	0.26	0.49	0.46	0.34
Comfort		1.000	0.82	0.30	0.59	0.23	0.28	0.30	0.31	0.28
Health Needs			1.000	0.47	0.65	0.29	0.35	0.43	0.37	0.28
Operate				1.000	0.48	0.24	0.26	0.64	0.79	0.35
Reach					1.000	0.62	0.45	0.57	0.47	0.31
Transfer						1.000	0.45	0.46	0.36	0.11
Personal Care							1.000	0.56	0.27	0.33
Indoor Mobility								1.000	0.60	0.42
Outdoor Mobility									1.000	0.38
Transportation										1.000
Overall Internal Consistency										**0.90**

Key: FEW = Functioning Everyday with a Wheelchair; SDD = Stability, Durability, and Dependability; COM = Comfort; HN = Health Needs; OP = Operate; RCH = Reach; TRN = Transfer; PC = Personal Care; IM = Indoor Mobility; OM = Outdoor Mobility; and TRANS = Transportation

Table 14: Internal Consistency of the FEW-C at Baseline

FEW-C Task	COM	HN	OP	RCH	TRN	PC	IM
Comfort	1.000	0.56	0.32	0.38	0.31	0.34	0.45
Health Needs		1.000	0.41	0.45	0.52	0.36	0.43
Operate			1.000	0.17	0.19	0.14	0.64
Reach				1.000	0.45	0.43	0.26
Transfer					1.000	0.43	0.24
Personal Care						1.000	0.43
Indoor Mobility							1.000
Overall Internal Consistency							**0.87**

Key: FEW-C = Functioning Everyday with a Wheelchair-Capacity; COM = Comfort
HN = Health Needs; OP = Operate; RCH = Reach; TRN = Transfer; PC = Personal Care;
and IM = Indoor Mobility

Correlation analyses on the self-report FEW and performance-based FEW-C in collapsed form for certain tasks identified a significant correlation at baseline. The tasks of Comfort, Operate, Reach, Transfer, Indoor Mobility, and Average FEW FEW-C resulted in a significant correlation at $p<0.01$, while Health Needs resulted in a significant correlation at $p<0.05$ (see Table 15). There was no significant correlation for the task of Personal Care at baseline. On average, participants under reported on each tasks of the self-report FEW in comparison to the performance-based FEW-C. Figure11 shows the FEW and FEW-C scores at baseline and Figures 12 through 18 show the Pre FEW and FEW-C scores and only a Post FEW score. The results determined that both self-report and performance-based tools should be used in order to obtain a comprehensive picture of function with mobility impaired participants.

Table 15: Correlations Between FEW and FEW-C Scores at Baseline

Item	Mean(SD)	Spearman's rho
FEW Comfort	1.16(0.84)	0.47**
FEW-C Comfort	1.77(0.85)	
FEW Health Needs	1.16(0.86)	0.40*
FEW-C Health Needs	1.48(0.84)	
FEW Operate	1.41(0.95)	0.50**
FEW-C Operate	1.90(0.85)	
FEW Reach	1.11(0.78)	0.42**
FEW-C Reach	1.46(0.84)	
FEW Transfer	1.43(0.79)	0.54**
FEW-C Transfer	1.50(0.87)	
FEW Personal Care	1.54(0.85)	0.29
FEW-C Personal Care	1.93(0.77)	
FEW Indoor Mobility	1.55(0.78)	0.65**
FEW-C Indoor Mobility	1.74(0.91)	
FEW Average	1.33(0.59)	0.51**
FEW-C Average	1.61(0.68)	

Key: FEW = Functioning Everyday with a Wheelchair; FEW-C= Functioning Everyday with a Wheelchair-Capacity; *Correlation is significant at the 0.05 level; and **Correlation is significant at the 0.01 level

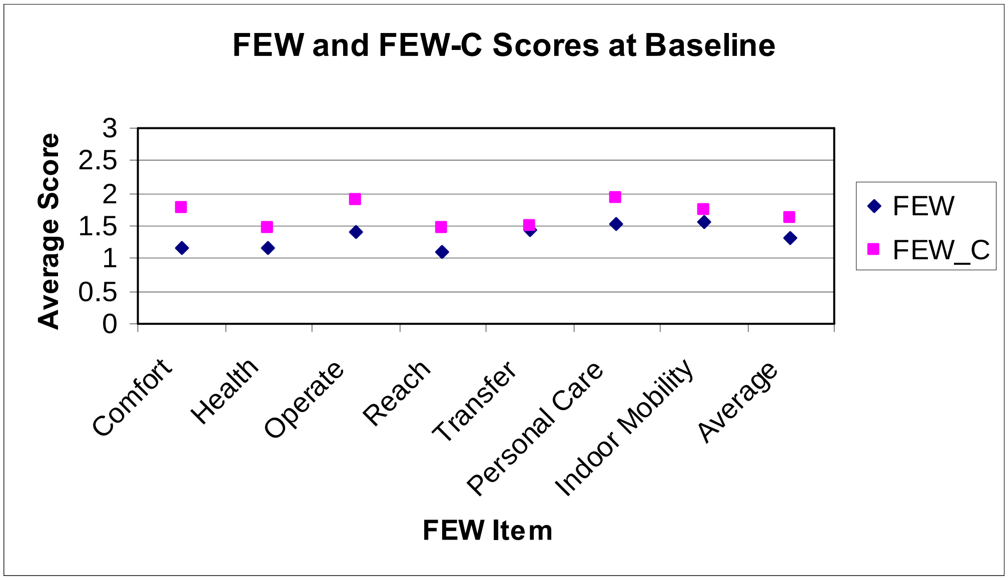


Figure 11: FEW and FEW-C Scores at Baseline (Pre-Intervention)

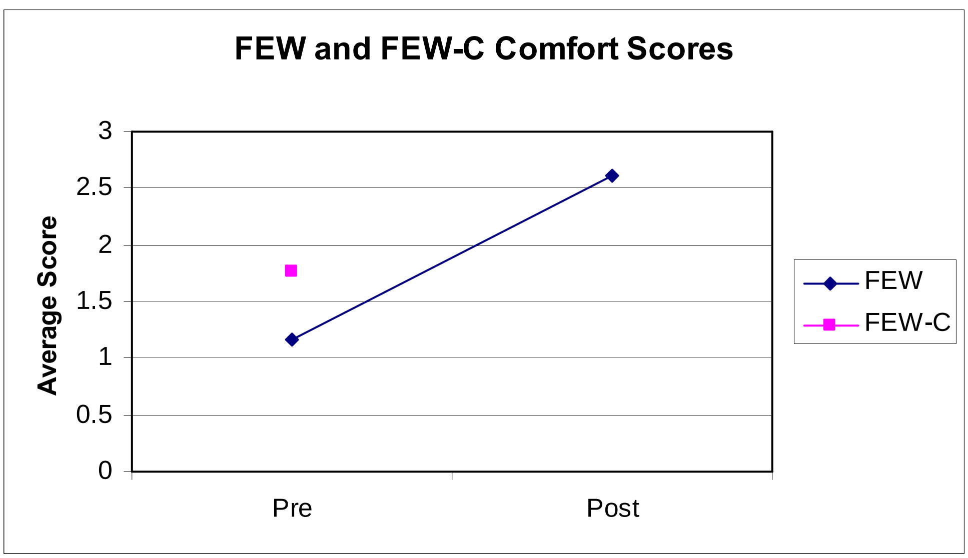


Figure 12: FEW and FEW-C Comfort Scores

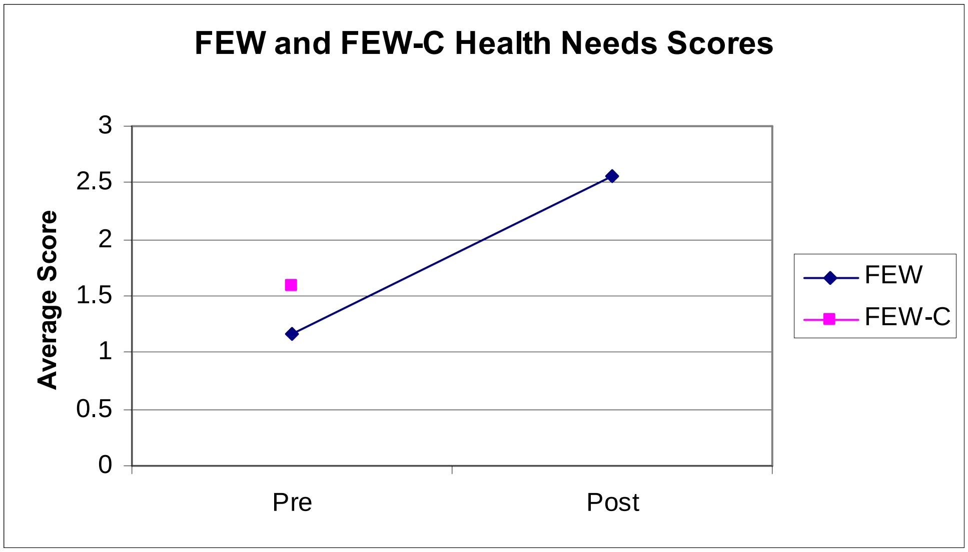


Figure 13: FEW and FEW-C Health Needs Scores

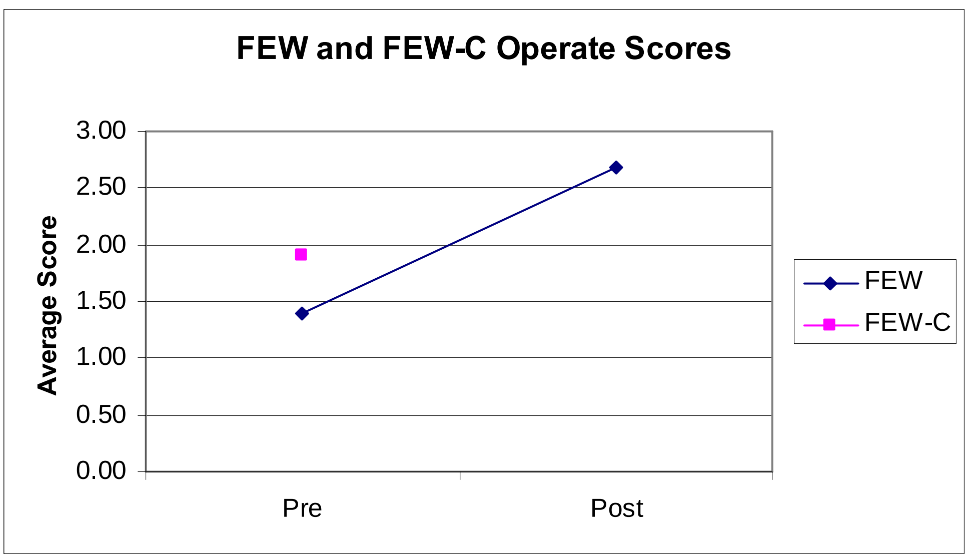


Figure 14: FEW and FEW-C Operate Scores

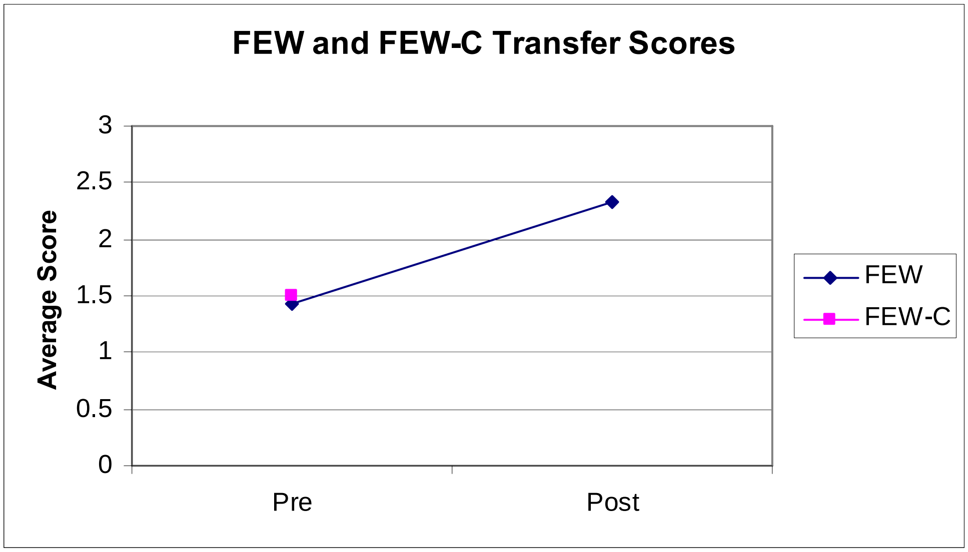


Figure 15: FEW and FEW-C Transfer Scores

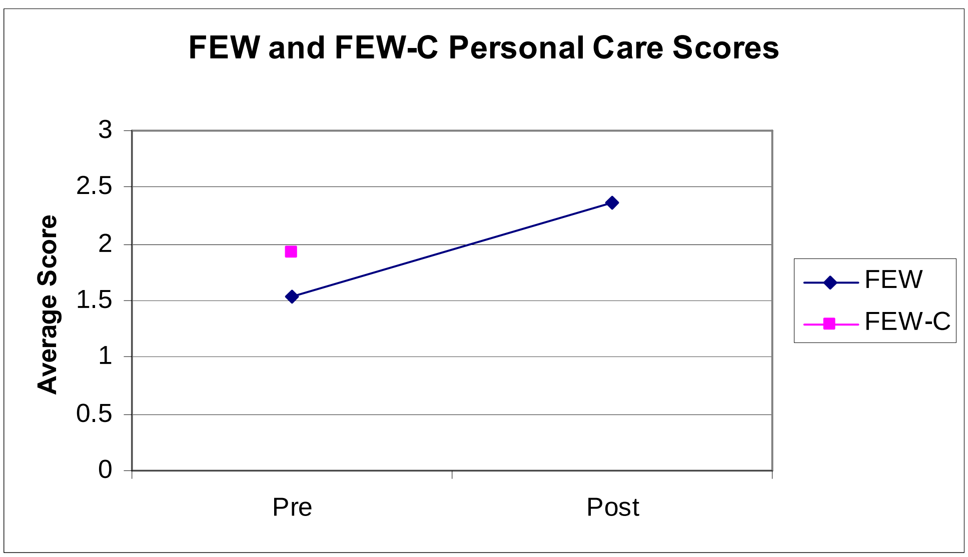


Figure 16: FEW and FEW-C Personal Care Scores

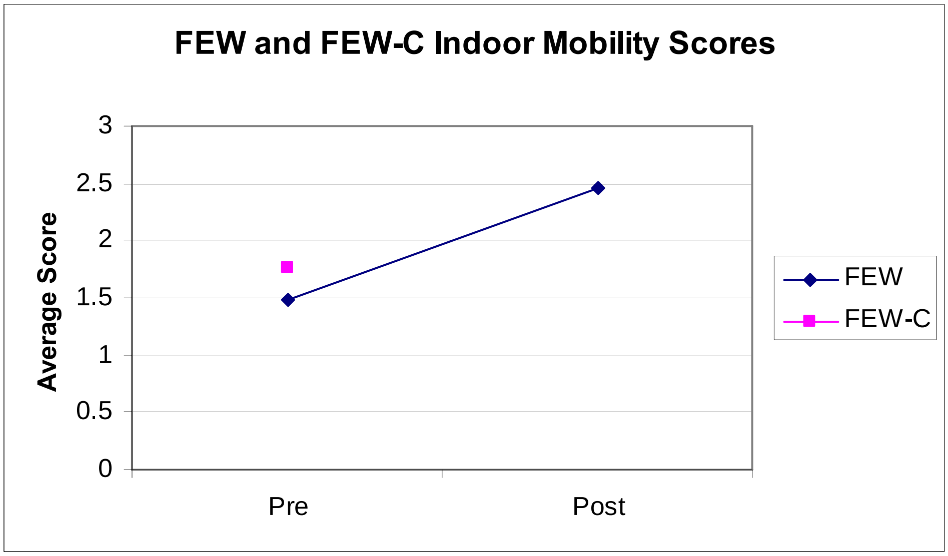


Figure 17: FEW and FEW-C Indoor Mobility Scores

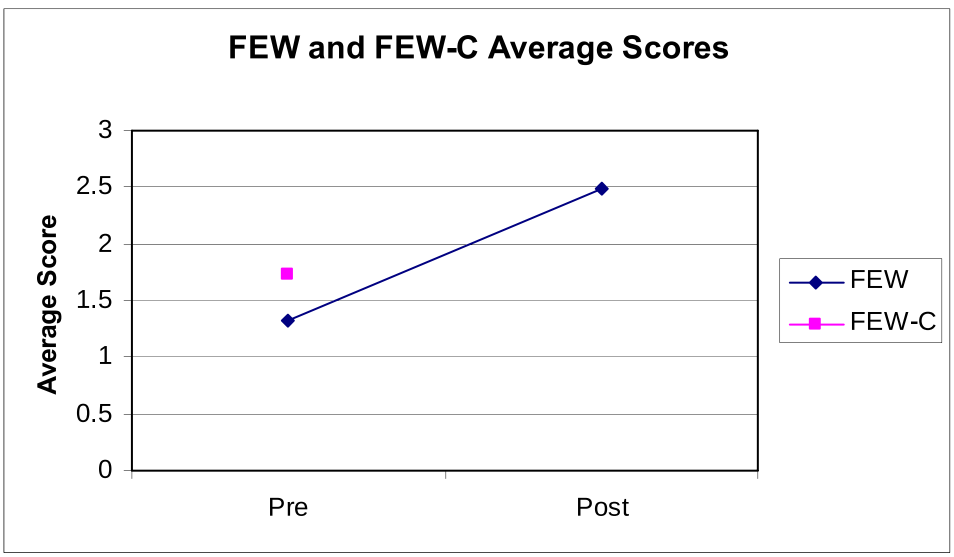


Figure 18: FEW and FEW-C Average Scores

4.4 DISCUSSION

When this non-randomized multicenter prospective clinical trial was initially undertaken, the study design was to test the perceived change in function following the provision of a new WMS intervention via telerehabilitation and to ascertain the agreement between the self-report FEW and performance-based FEW-C outcome tools. Participants' overall perceptions of the functional utility of their WMS pre-post intervention was significantly more positive, and thus null hypothesis 1 was rejected. Moreover, participants' perceptions on each item of the FEW were significantly more positive from pre to post intervention, thus rejecting null hypothesis 2. Even though, null hypothesis 3 was partially rejected, there was still a significant relationship for 7 out of the 10 items as well the average score between the self-report FEW and performance-based FEW-C tools.

The baseline data showed that the participants, on average, were using a 49.3 month-old manual wheelchair with no seating functions. The average pre-FEW score was 3.2, which indicated that the current WMS device was not meeting participants' functional needs. More than half the participants had diagnoses categorized as "progressive" or "cerebrovascular." These were populations that had complex needs that required appropriate WMS devices in order to participate in basic activities measured by the FEW. The proper selection of WMS was constrained by limited availability of clinicians with knowledge and skill in this specialty area as well as access to resources (Cooper, Trefler, & Hobson, 1996). TR reduced the geographical barriers and provided greater access to clinical expertise. The expert practitioner via telerehabilitation was able to collect information, expand on questions to assist with the generalist practitioner's assessment, and endorsed his recommendations with the generalist practitioner and rehabilitation technology supplier. A significant change in the average FEW scores as well as the FEW item score reflected participants' affirmation that their new WMS device, prescribed through a TR consultation model was appropriate for their needs.

Approximately 94% of the participants at baseline were using a low-end manual or power wheelchair with limited seat functions. The Cohen's *d* effect sizes indicated the magnitude of the pragmatic and clinical changes experienced by the participants on the FEW from pre to post. The new WMS device via a TR consultation model demonstrated the real changes in function that the participants experienced on the ten FEW items.

The internal consistency of the total tool at baseline for the self-report FEW and performance-based FEW-C were greater than the Cronbach's alpha set at ≥ 0.60. Correlation analysis between the tools indicated that there was a significant correlation for each of the items except Personal Care. On average, participants under reported on each items of the self-report FEW in comparison to the performance-based FEW-C. Similarly, Schmeler et al. (2005) found similar results in which participants under reported on the FEW items when compared to FEW-C at baseline. Newton et al. (2002) reported good to excellent correlation (r=.95) between skills reported by manual wheelchair users (self-report) and scores on the Wheelchair Skills Test; however, with self-report, users tended to overestimate their own abilities. Because all study participants were recruited from a clinical setting to which they had come to be evaluated for a new WMS device, it is not unexpected that their perceptions of their function were lower than their performance on the FEW-C indicated. It is not unusual for individuals seeking healthcare to underestimate their capabilities in order to obtain the services or products they need (Cress et al., 1995; Institute of Medicine, 2007).

The present study had several limitations. First, test-retest was not assessed on the

FEW-C due to participant burden associated with retuning to the clinic after a new WMS device was delivered. Second, participants were recruited through convenience sampling with the possibility of selection bias. Although sample size was relatively large for a telerehabilitation study, there was no formal control group, and no randomization in the selection process. Of the 46 participants recruited, only 36 received a new WMS device and reported post FEW scores. Two had not received their WMS device prior to data collection and analysis and 8 participants were withdrawn from the study. Third, the FEW only measured function for individuals who currently used a manual/power wheelchair and scooter. Individuals who use other mobility assistive equipment such as canes, crutches, prostheses, and walkers did not meet the inclusion criteria for this study based on outcomes chosen. Fourth, only one expert practitioner was identified and consulted for each participant's assessment. Fifth, no additional follow-up periods were conducted other than the 2 weeks after fitting and delivery of a new WMS device. Finally, the number of raters involved and their varying levels of clinical experience. Only 2 raters were present during administration of the performance-based FEW-C tool at baseline.

4.5 CONCLUSIONS

The present study demonstrated that participant's perceived a significantly positive change in function following a WMS evaluation and intervention via a TR consultation model. Large effect sizes reflecting the positive changes documented on the self-report FEW affirmed the magnitude of the changes the participants experienced with their new WMS devices. This outcome demonstrated that collaboration between a generalist and expert practitioner was able to fill an important educational gap in healthcare service delivery.

5.0 PATIENT SATISFACTION DURING TELEREHABILITATION ASSESSMENT FOR WHEELED MOBILITY AND SEATING

5.1 INTRODUCTION

A prologue of "tele" projects is improved access to health services for individuals living in areas where medical professional and facilities were scarce or absent. Patient-centered outcomes have become the primary means of measuring the effectiveness of healthcare delivery (Bolus & Pitts, 1999). Quality of life and satisfaction with care and services are considered just as important as clinical health outcomes (Asadi-Lari, Tamburini, & Gray, 2004). Patient satisfaction is an important outcome in healthcare services. In the United States, healthcare organizations have been operating in a competitive environment, and patient satisfaction became key to gaining and maintaining its market share (Pinette, 2003).

Remote areas experience a shortage of professionals and technical resources crucial in the delivery of services related to specialized medical fields (Callas, Ricci, & Caputo, 2000). Rural providers can be isolated from advances in technology available in metropolitan centers. As a result, when individuals residing in rural areas require assessment, specific treatment, or both, travel distance becomes an issue to receive the specialized healthcare necessary to address their needs. Studies have reported that 50% of veterans travel more than 25 miles for healthcare (Randall et al., 1987; Wollinksky et al., 1985). Hatzakis (2001) surveyed veterans diagnosed with multiple sclerosis and 20% reported barrier issues with parking, distance and transportation that interfered with them receiving treatment. Furthermore, for individuals with sensation issues, prolonged sitting during travel carried the potential risk of worsening a pressure sore (Sabharwal, Mezaros, & Duafenbach, 2001). In addition, individuals with mobility impairments, such as cerebral palsy and rheumatoid arthritis reported that healthcare barriers included access to the physical environment as well to specialists (O'Day, Dautel, & Scheer, 2002). For these reasons, individuals delayed or avoided required treatment. Mobility restrictions and problems with accessibility were found to decrease the quality of healthcare for individuals located in rural areas (Hatzakis et al., 2003).

Telerehabilitation (TR) is the clinical application of consultative, preventative, diagnostic, and therapeutic services via a two-way interactive telecommunication technology (Wakeford et al., 2005). The broader availability of telecommunications technology and the initiation of "tele" programs offer solutions to issues associated in rural or underserved areas. Patient insight remains essential across medical fields served by "tele" projects, especially as the number of projects continued to increase (Whitten & Love, 2005). In a study by Rogante et al. (2006), authors designed a system that extended into the home environment of patients diagnosed with neurological diseases while under the control, supervision, and responsibility of a hospital. It was reported that patient satisfaction reached 96% with the attention received via the TR application.

In the past, TR had been listed under the subheading of the broader terms of tele-healthcare and telemedicine. Two systematic reviews discussed the limitations of patient satisfaction in tele-healthcare (Williams, May, & Esmail, 2001) and telemedicine (Mair &

Whitten, 2000). Williams, May & Esmail (2001) concluded that current evidence concerning patient satisfaction was limited, and consisted mostly of pilot projects and feasibility studies of patients receiving telemedicine services in addition to standard treatment. The authors also reported that patient satisfaction emerged as a byproduct of the growing number of trials and pilot studies. These studies provided positive and/or negative feedback concerning particular healthcare services. Similarly, Mair & Whitten (2000) concluded that studies had small sample sizes with low response rates and used only simple survey instruments to ascertain patient satisfaction. Patients reported that the teleconsultations were acceptable, noted definite advantages of increased accessibility of specialist expertise, less travel and a reduced wait time. Altogether, these reviews served as a guide for how patients viewed “tele” projects through a number of healthcare fields.

The aim of this study was to measure participant satisfaction using a TR consultation model for a new WMS device. The specific objectives included:

1) Evaluate participants’ satisfaction with their previous wheeled mobility and seating (WMS) device evaluation process compared to their current TR WMS device evaluation process.
2) Evaluate participants’ satisfaction with their previous WMS device prescription process compared to their current TR WMS device prescription process.
3) Evaluate participants’ satisfaction with the TR assessment process and technology on the Telerehabilitation Questionnaire.

5.2 METHODS

5.2.1 Sample

The 46 study participants were recruited and consented from 4 remote wheelchair clinics: DuBois Regional Medical Center, Charles Cole Memorial Hospital, Meadville Medical Center and Elk Regional Health Center. Inclusion criteria for participation consisted of the following: adult patients age 18 or older, currently use a manual/power wheelchair or scooter, and looking for a new WMS device. All individuals participating were able to read and comprehend English. All participants resided in a rural or distant location whereby travel to the Center for Assistive Technology at the University of Pittsburgh Medical Center (CAT-UPMC) was difficult or inconvenient.

5.2.2 Instrumentation

The Demographic Data Form-Pre was completed in order to gather information regarding current WMS device status and usage. Routine demographics such as age, gender, race, and primary diagnosis were also recorded. The Demographic Data Form-Post allowed investigators to track the type of new WMS device the study participant received. Assessed also was a measure of participant satisfaction with their previous WMS device evaluation and prescription process compared to their current TR WMS device evaluation and prescription process. The evaluation process details the participant's physical examination of muscle strength, joint range of motion, seating and mobility, and posture. The prescription process is the type of WMS device and accessories prescribed. Evaluation process was rated on a 5-point scale, 1= very dissatisfied to 5

= very satisfied as was the prescription process. No psychometric properties were conducted on the Demographic Data Forms Pre and Post.

A Telerehabilitation Questionnaire was designed to determine participant satisfaction with the technology and perceptions regarding the TR assessment process, especially regarding the impact of the technology. The questionnaire was modeled after the same or similar items from Malagodi et al. (1998) and then expanded to meet the researchers needs for the study. Content validity was established using an occupational therapist and rehabilitation engineers with expertise in TR. A 6-point scale, 6 = strongly agree to 1 = strongly agree to answer seven questions was used to score the Telerehabilitation Questionnaire.

5.2.3 Procedure

Prior to initiating the study, Institutional Review Board approval was obtained at each of the sites. In-service training was conducted at each hospital to explain the service delivery protocol detailed in Chapter 2. Informed consent was obtained by the therapists at each of the remote sites.

Protocol during the initial appointment asked participants to report how satisfied they were with both their previous WMS device evaluation and prescription process, what city they resided in, and how long it took to travel to the clinical site. Participants were asked again to report how satisfied they were the TR WMS device evaluation and prescription process on the Demographic Data Form-Post during the delivery of their new WMS device via a TR consultation model. In addition, participants were also asked to fill out the Telerehabilitation Questionnaire during fitting and delivery. For participants who did not receive a new WMS device, a follow-up phone call was done to determine their satisfaction with the technology and perceptions regarding the TR assessment on the Telerehabilitation Questionnaire.

5.3 RESULTS

The satisfaction items of evaluation and prescription process were analyzed for 36 participants who received a new WMS device via a TR consultation model. The typical wheelchair at initial assessment was a 49.3 month-old manual wheelchair with no seating functions. At post-test the majority of participants received a newly prescribed power wheelchair (80.6%) with varying power seat functions such as power tilt-in-space, recline, seat elevator, elevating legrests or a combination (33.3%). The results revealed a significant difference of the participant's previous WMD evaluation process compared to their current TR WMS evaluation process ($p<0.001$). Similarly, a significant difference of the participant's previous WMD prescription process compared to their current TR WMS prescription process ($p<0.001$) was found (see Table 16, Figure 19). Thus the effect of a TR consultation model had a significant effect on participant satisfaction for both the WMS device evaluation and prescription processes.

Table 16: T-test for Evaluation and Prescription Process (Previous and Current TR)

Item	Mean (SD)	T	df	*p*
Previous Evaluation	2.89(1.01)	12.55	35	< 0.001
Current TR Evaluation	4.97(0.17)			
Previous Prescription	3.00(1.01)	11.84	35	< 0.001
Current TR Prescription	4.97(0.17)			

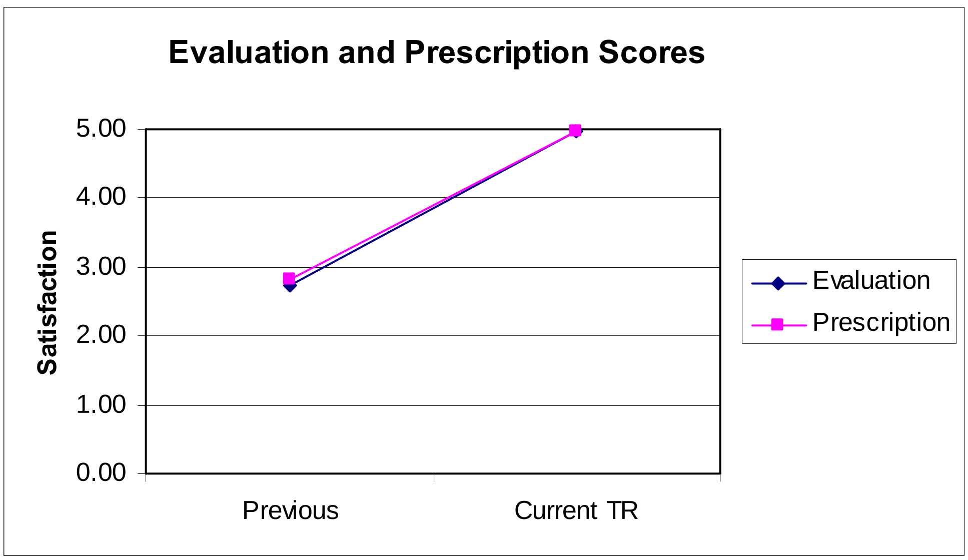


Figure 19: Evaluation and Prescription Scores (Previous and Current TR)

Of the 46 participants recruited, 42 (92%) completed the Telerehabilitation Questionnaire. Each of the items were significantly different (p<0.001) suggesting participant satisfaction with the TR assessment (see Table 17, Figure 20).

Table 17: One Sample *t*-tests for the Telerehabilitation Questionnaire

Item	Mean(SD)	t	df	*p*
Question 1	5.88(0.33)	116.28	41	< 0.001
Question 2	5.64(0.49)	75.41	41	< 0.001
Question 3	5.93(0.26)	114.40	41	< 0.001
Question 4	5.55(0.50)	71.37	41	< 0.001
Question 5	5.31(0.72)	48.11	41	< 0.001
Question 6	5.52(0.55)	64.90	41	< 0.001
Question 7	5.93(0.26)	147.40	41	< 0.001

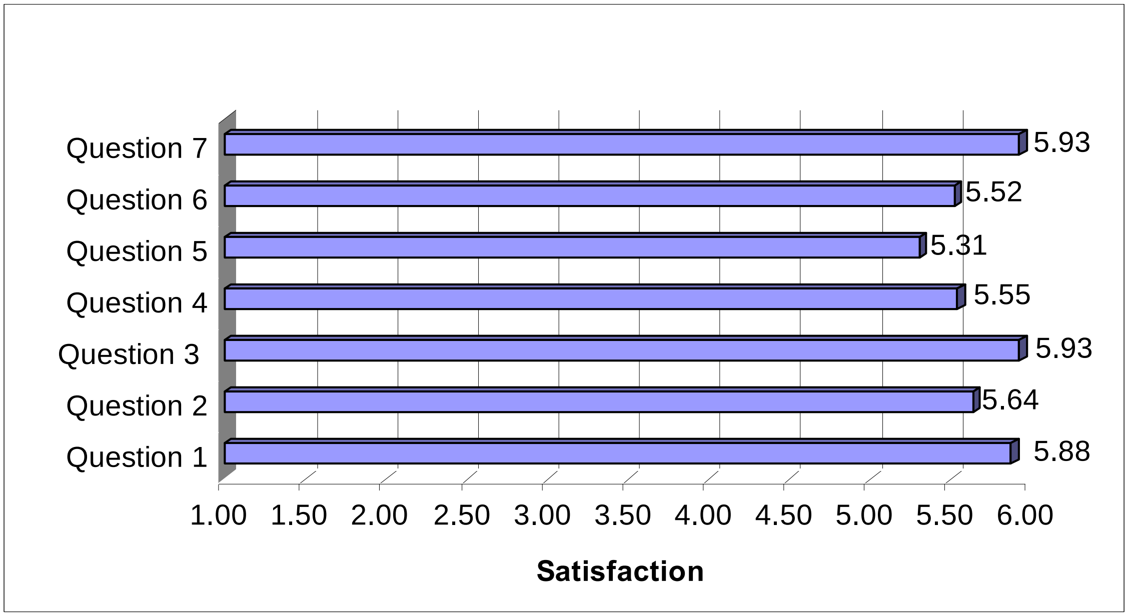


Figure 20: Participant Reported Satisfaction with Telerehabilitation

Participants completed the Telerehabilitation Questionnaire either during the delivery of the new WMS device or during follow-up, (See Figures 21 through 27). The participants rated each of the items at a very high level of satisfaction (6 = strongly agree or 5 = mostly agree) with the exception of “The quality and clarity of the video and audio was acceptable.” Responses to this item included the following: slightly disagree (2.4%), slightly agree (7.3%), mostly agree (46.3%), and strongly agree (43.9%). Furthermore, space was provided for qualitative feedback where participant comments were generally positive (see Table 18).

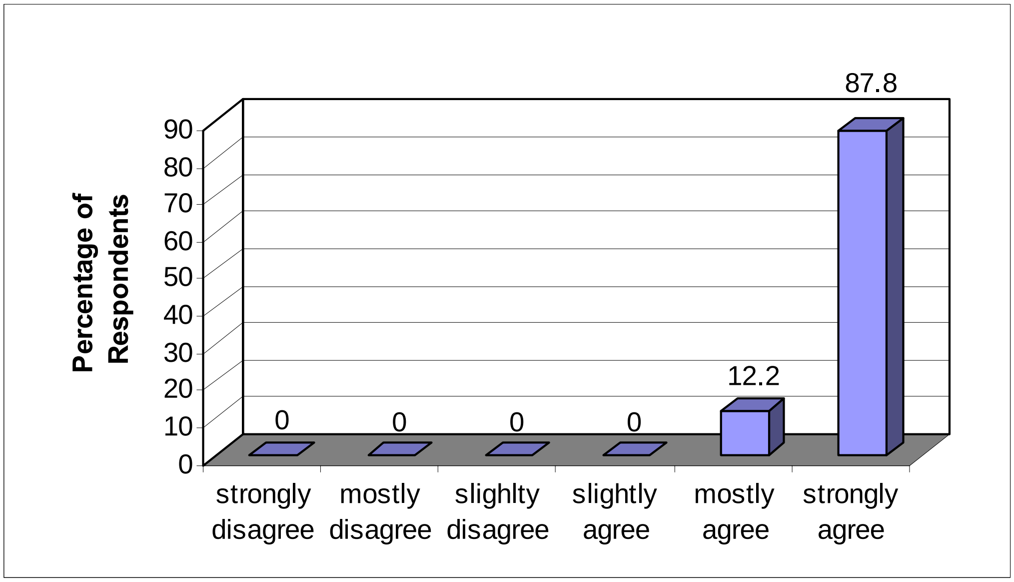


Figure 21: Question 1 "I was comfortable being evaluated by this means"

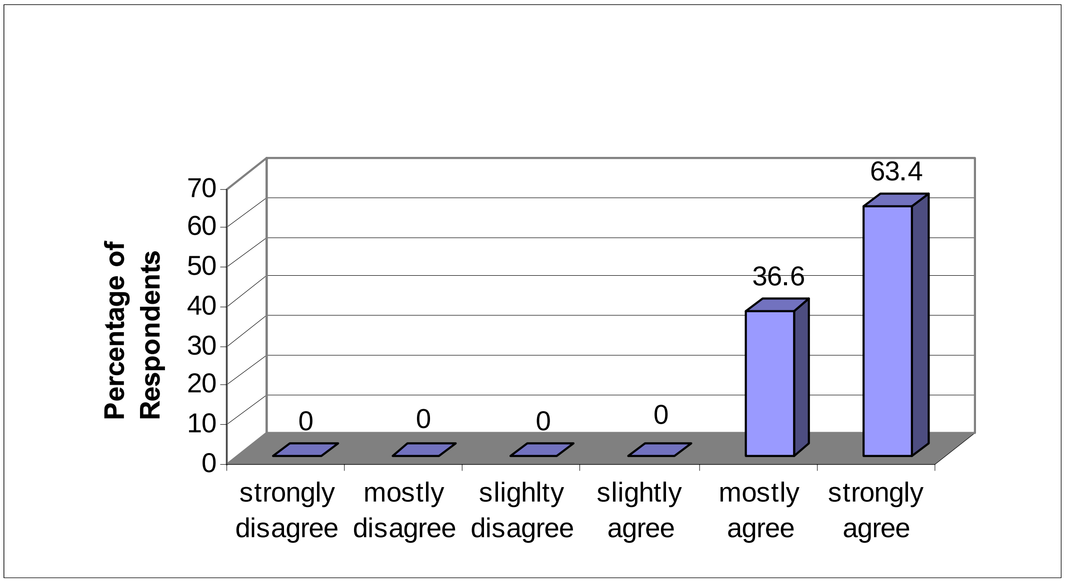


Figure 22: Question 2 "The results of the evaluation through video-conference would be as accurate as an evaluation being completed in-person by an expert practitioner"

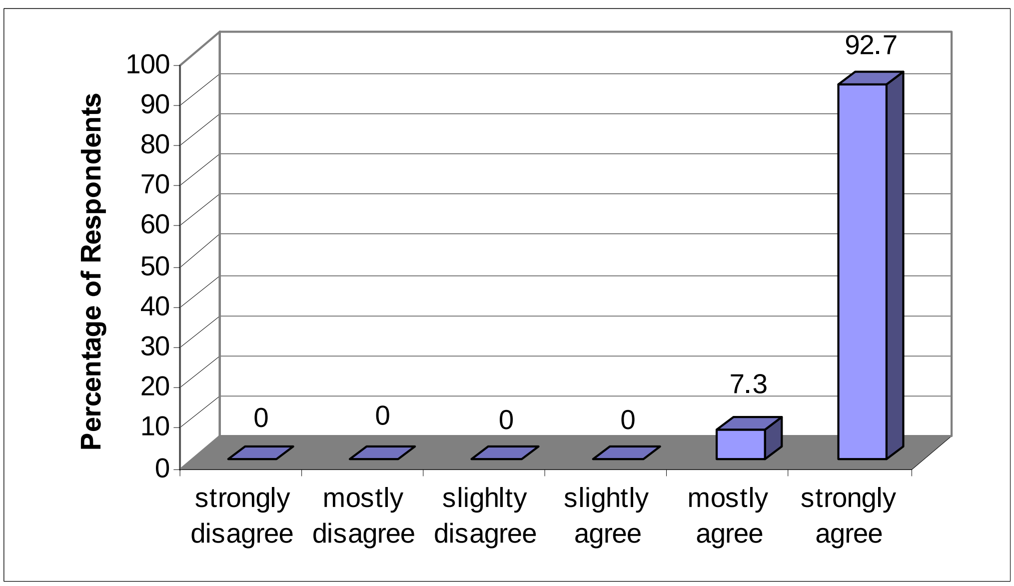


Figure 23: Question 3 "All areas of your lifestyle were considered with this process"

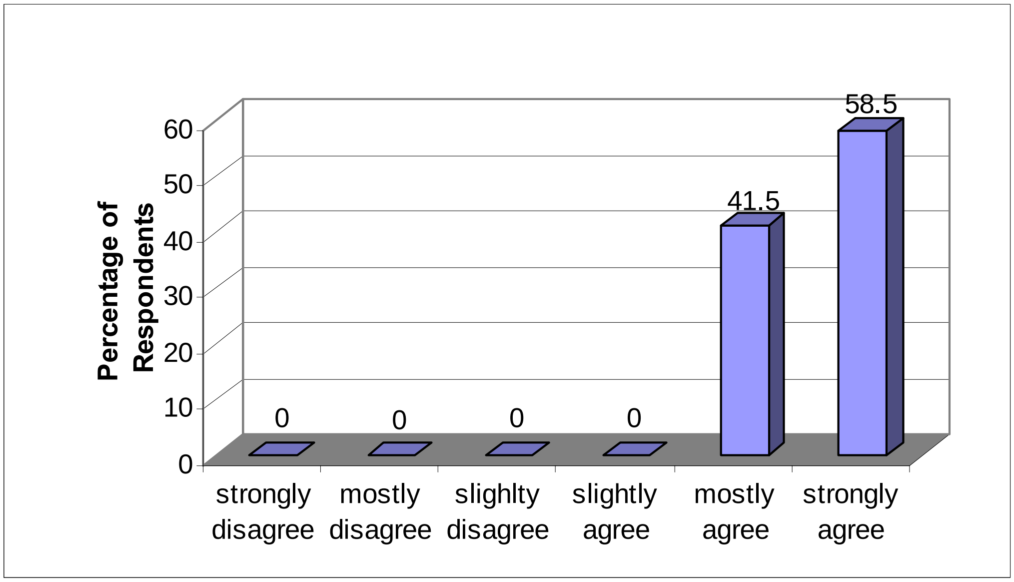


Figure 24: Question 4 "The technology did not interfere with the assessment"

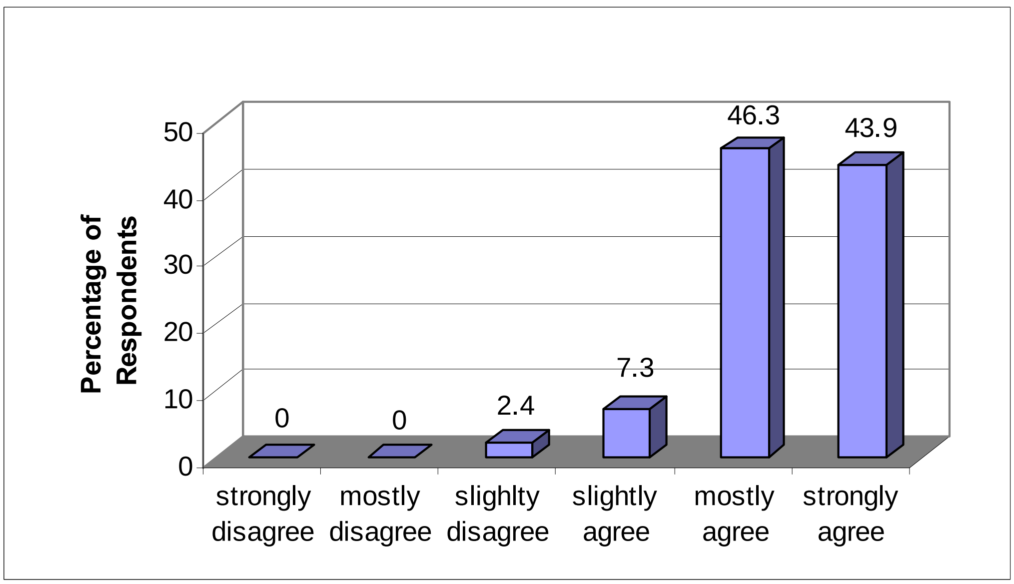


Figure 25: Question 5 "The quality and clarity of the video and audio was acceptable"

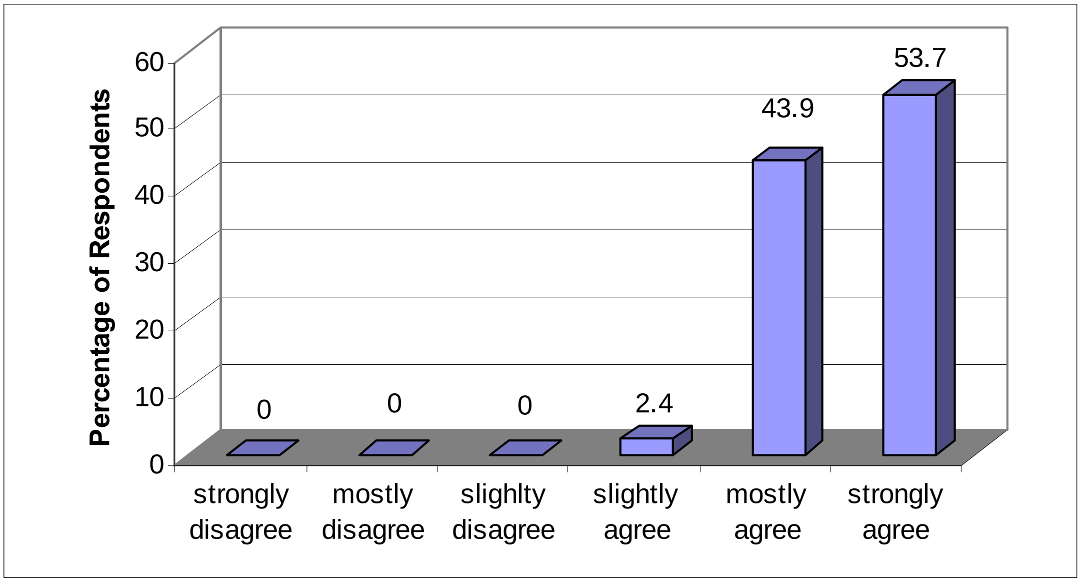


Figure 26: Question 6 "Consulting with an expert clinician through tele-video conferencing saved you monetary expenses (i.e. travel time, gas, taking off of work, family, etc..)"

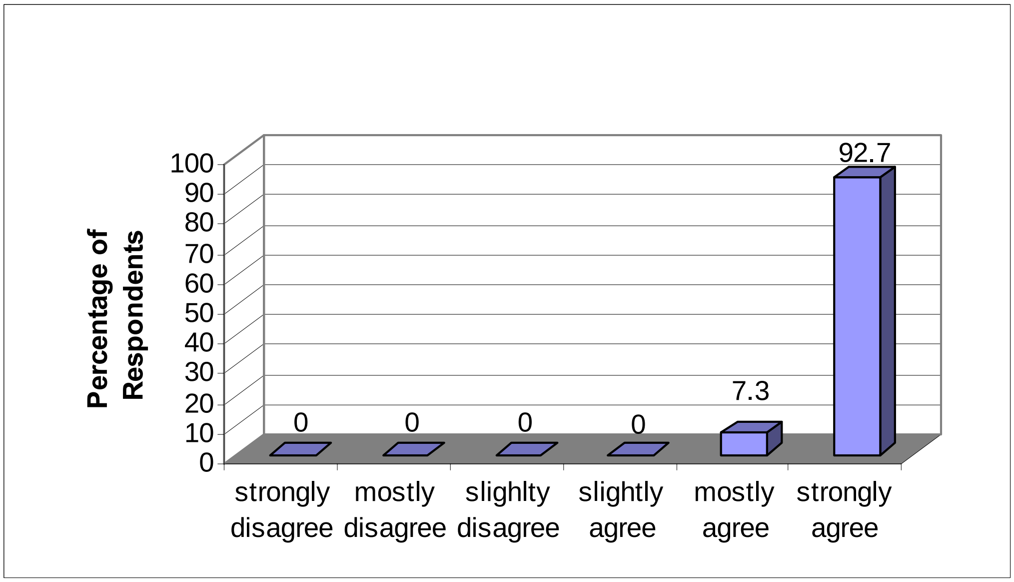


Figure 27: Question 7 "Would you be willing to use a telerehabilitation evaluation process again?"

Table 18: Feedback from Telerehabilitation Questionnaire

Feedback from Telerehabilitation Questionnaire
- "Very thorough assessment"
- "We didn't even notice the cameras."
- "I don't think my mother would have been able to be in a car for six hours to get to Pittsburgh. We were very pleased that a clinic was only a half hour way and still be able to meet with experts in the field."
- "I would love to see this technology expanded into different areas."
- "They evaluated me and not my disability."
- "We were very pleased with the assessment and how knowledgeable everyone was."
- "If it was up to me, I would do this for all of my healthcare needs instead of making arrangements to travel all over to see my doctors."
- "There was some (audio) feedback but it went away in a matter of minutes."
- "I could not understand what the gentlemen were saying during certain parts of the assessment."

Furthermore, the average duration of a TR consultation was 88 minutes (range 74 to 117 minutes), the number of days from initial assessment to the fitting and delivery was 116 days (SD 72, range 29 to 330) and the number of days until follow-up was 135 days (SD 70, range 50 to 354). Of the 46 participants, 5 were scheduled to be re-assessed before determining an appropriate WMS device as a result of outdated paperwork or for re-assessment of their seating needs. Four of the participants were denied new WMS devices and appeal letters were written on behalf of the participant or a peer-to-peer conference call was held with the participant's respective insurance company. Eventually, the new WMS device was approved and delivered to the participant.

In addition, data regarding distance (miles) and time (minutes) traveled to and from the remote site, compared with that which would have occurred if the participant had traveled to the

CAT-UPMC, is shown in Figures 28 and 29. As expected, the average travel distance to the remote site was less than the average travel distance would have been to CAT-UPMC, 22.4 (SD 16.91) miles versus 123.2 (SD 36.97) miles ($p < 0.0001$). Similarly, the average total travel time to the remote site was far less than the average total travel time would have been to CAT-UPMC, 33.7 (SD 21.83) minutes versus 147.4 (SD 45.27) minutes ($p < 0.0001$). In 2007, the average cost of regular grade gas was \$3.05 and the average mile per gallon was 20.18 (Energy Information Administration, 2007). Therefore, had the TR group traveled from their home to the CAT-UPMC for a WMS assessment, on average, the participants would have spent \$37.25 in contrast to the \$6.23 cost to be assessed at the remote site via a TR consultation model.

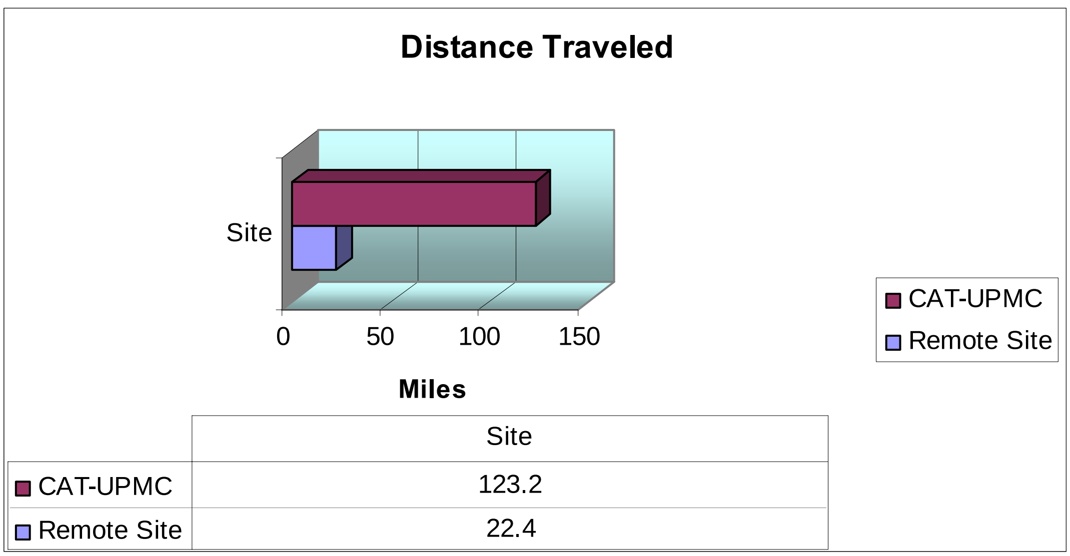


Figure 28: Distance Traveled for Participants

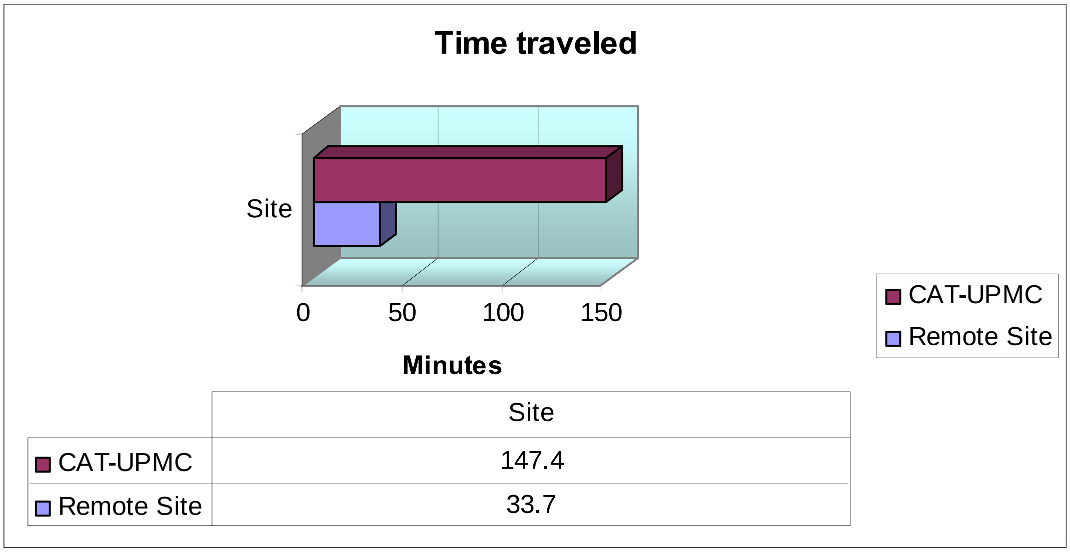


Figure 29: Time Traveled for Participants

5.4 DISCUSSION

There was a significant difference of the participant's previous WMD evaluation process compared to their current TR WMS evaluation process (p<0.001). Similarly, a significant difference of the participant's previous WMD prescription process compared to their current TR WMS prescription process (p<0.001) was found. Likewise, the data indicated a significant difference (p < 0.001) with a high degree of satisfaction regarding the impact of the technology. The results are similar to systematic reviews of patient satisfaction among "tele" activity by Williams, May, & Esmail (2001) and Mair & Whitten (2000). The service delivery protocol at the remote sites was a factor in the high participant satisfaction on the Telerehabilitation Questionnaire. The variability of responses for the Telerehabilitation Questionnaire item, "The quality and clarity of the video and audio was acceptable," was due to an unstable wireless connection being shared with other hospital personnel during the time of the assessment at

Charles Cole Memorial Hospital. Nevertheless, even with the high satisfaction results, future studies should expand a TR consultation model to other regions and/or states not only for WMS but for other types of assistive technology services.

Of the 46 participants recruited, 36 reported a high level of satisfaction with their post evaluation and prescription after receiving a new WMS device. Two of the participants had not received their WMS device prior to data analysis and eight were withdrwan from this study because clinical service delivery situations occurred. For example, four denials were received from the Pennsylvania Department of Public Welfare or Medicaid in which the reason of notice was the "requested service or item was not medically necessary." In addition, two participants did not return phone calls, one participant was determined not to be a candidate for either a scooter or powered mobility secondary to unsafe driving, and one passed away. .

The impetus behind the development of TR services provided equitable access to rehabilitation services for individuals in remote areas in need of rehabilitation specialists. The factors driving the need for TR services include: transportation cost and time savings for both participant and healthcare systems. For both participants and family members, transportation cost and time were significantly less when traveling to a remote site for their clinical assessment using a TR consultation model.

The study had limitations. Recall bias was evident when participants rated their previous evaluation and prescription process for their current WMS device. The majority of participants never received a formal assessment and evaluation and unaware of the specialized clinics and specialists who could provide care. Second, participant financial issues were not disclosed. Third was the ceiling effect on the Telerehabilitation Questionnaire. A fourth limitation was that only one expert practitioner was involved with all of the TR assessments and evaluations. Lastly, patient satisfaction occurred only once.

5.5 CONCLUSION

In conclusion, this study provided valuable feedback and added to the body of knowledge concerning patient satisfaction using a TR consultation model evaluating an individual for a new WMS device. Patient acceptance of telerehabilitation is integral to the future success of incorporating technology into clinical service delivery. The use of a TR consultation model in remote sites provides a closer, easier, and less expensive mode for assessment and evaluation for participants. Future studies should address satisfaction of various rehabilitation professionals. The input of the generalist practitioners and rehabilitation technology suppliers is important and should be measured. Satisfaction should be measured over time instead of only once. Cost-effectiveness analysis within satisfaction needs to be addressed in future projects. Although measurement of cost-effectiveness is difficult, economic factors that should be considered to develop a satisfaction study include: communication network (i.e. bandwidth), equipment, staffing, and patients. Overall, the results indicated a high level of satisfaction in post-evaluation and post-prescription procurement as well as patient satisfaction with the technology and perceptions via a TR consultation model.

6.0 SEATING AND WHEELED MOBILITY EVALUATIONS UNDER TWO CONDITIONS: TELEREHABILITATION AND IN-PERSON

6.1 INTRODUCTION

Concerns about individuals accessing their healthcare created interest in clinical applications in remote assessment and intervention in medicine (Bashshur, 2002) and rehabilitation (Lemaire, Boudrias, & Greene, 2001; Torsney, 2003; Winters, 2002). The proliferation of advanced technologies led researchers to devise technology assessments and guidelines for clinical practice considering organizational need, social needs and goals (Kinsella, 1998; Cooper et al., 2001). Equally important, researchers continued to examine the benefits, risks, and costs of alternative technologies or programs (Kinsella, 1998; Cooper et al., 2001). The purpose of medical care is to maintain or improve health, well-being, and access. From its inception, a major promise of telerehabilitation (TR) had been improved access to health services for people living in underserved or remote areas where expert healthcare professionals and facilities are scarce.

As discussed in Chapter 1, a number of studies in recent years have performed to demonstrate the clinical utility of using "tele" technology in a variety of clinical applications. TR offered new opportunities to provide rehabilitation services in alternative ways and in different clinical settings (Cooper et al., 2001; Lemaire, Boudrias, & Greene, 2001). For TR to move beyond recognition as a tool or substitute for traditional healthcare delivery impacting diagnosis and treatment options, patient outcomes need to be demonstrated with the use of experimentally rigorous techniques supported by appropriate statistics (Krupinksi et al., 2006). For example, methodological gaps in previous trials included using the same evaluator for both the “tele” and in-person consultation (Grigsby et al., 1995).

Wheelchair prescription was a multifaceted complex intervention even before adding the TR component. This complexity developed from the relationship between three variables: 1) the wheelchair user’s needs, abilities and preferences; 2) available technology; and 3) demands of the natural environment (Batavia, Batavia, & Friedman, 2001). Reasons for unsuccessful wheelchair prescription outcomes include:

- lack of active involvement in the prescription process by the user (B. Phillips & Zhao, 1993; Scherer, 1993);
- lack of trained professionals or poor prescription practices (Cooper, Trefler, & Hobson, 1996; Hoenig et al., 2005);
- disparities in disability and socioeconomic populations for provision of WMS (Hubbard et al., 2006; Hunt et al., 2004); and
- poor device performance and unsatisfactory features with poor fit (B. Phillips & Zhao, 1993; Scherer & Vitaliti, 1997)

The above factors contribute to poor outcomes in wheelchair prescription; however can be corrected when properly addressed with a TR service delivery model.

Conceptually, the definitions of a non-inferiority or equivalence trial among the areas of “tele” and the Federal Drug Administration (FDA) are different. In the area of “tele,” an equivalence clinical trial was conducted to determine concordance or reliability of measuring a performance, diagnosis, or therapeutic intervention on the same individual under two separate conditions: i.e. face-to-face and “tele” assessment (Nelson & Palsbo, 2006). Within the FDA, a non-inferiority trial was conducted to clinically demonstrate that an experimental treatment was not worse than an active control by no more than a pre-defined margin (Mallik et al., 2006). As recent advances in medical sciences have improved the treatment in diseases, attention had shifted toward developing new therapeutic modalities such as TR without being necessarily more effective than the standard treatment. Specific advantages include: 1) decreased travel from rural communities to specialized urban health centers; 2) enhanced clinical support in local communities; 3) improved access to specialized services; 4) expanded delivery of local healthcare in rural communities; 5) educational benefits for remote clinicians participating in teleconsultations; 6) reduced feelings of isolation for rural clinicians; 7) improved service stability in regions with excessive staff turnover; and 8) multimedia communication (Lemaire, Boudrias, & Greene, 2001).

Based on quasi-experimental designs at the University of Pittsburgh and research recommendations by Krupinksi et al. (2006), the use of pre-test post-test, interrupted time series, and randomized controlled designs were recommended. Krupinksi et al. (2006) stated that using meaningful control/comparison groups and participants with varying demographics (e.g. gender, age, ethnicity, and race) in the samples improve the generalizability of the finding. TR interventions that yield at least equivalent clinical outcomes to conventional care insures that TR did not deliver inferior care (Krupinski et al., 2006). The authors further stated that in any type of non-inferiority or equivalence study the use of an independent “gold standard,” referred to as an independent and known-to-be accurate source for information to verify and validate the outcome of a study is needed. Outcome studies in TR certainly began in the laboratory or university setting; however the need was to extend outward to real-world settings particularly in rural or underserved communities (Krupinksi et al., 2006).

The specific aim of this study was to evaluate the non-inferiority of wheeled mobility and seating (WMS) assessments delivered under separate conditions: Gold Standard (In-Person (IP) at Center for Assistive Technology at the University of Pittsburgh Medical Center (CAT-UPMC)) vs. Experimental (TR at remote clinics). Non-inferiority was measured in terms of the functional abilities obtained by the participant as a result of the new WMS device measured by the Functioning Everyday with a Wheelchair (FEW).

6.2 METHODS

6.2.1 Sample

Individuals were recruited from five wheelchair clinics in Western Pennsylvania. Inclusion criteria for participation consisted of the following: adult patients, age 18 or older, who currently used a manual/power wheelchair or scooter and were seeking a new WMS device. All individuals who were approached for participation were able to read and comprehend English to the extent that they could understand and answer questions on the FEW. Institutional Review Board approval and informed consent was obtained at each remote site for study recruitment. A total of 96 participants were recruited and consented; 50 IP assessments and 46 via TR (see Table 19). The larger number allowed for drop-outs or the possibility of participants not being able to meet the number of visits required by the research protocol detailed in Chapter 2.

Table 19: Baseline Characteristics

Descriptors	In-Person (n=50)	Telerehabilitation (n=46)	p
Age (mean, SD)	50.28 ± 14.04	54.63 ± 15.38	0.206
Gender			0.158
Female (%)	23 (46)	28 (61)	
Male (%)	27 (54)	18 (39)	
Race			0.181
Caucasian (%)	40 (80)	41 (89.1)	
Other (%)	10 (20)	5 (10.9)	
Months using a wheelchair (mean, range)	91.8 (12-360)	70.5 (2 – 180)	
Age of wheelchair at pre-test (mean, range)	49.44 (12-108)	56.87 (2 – 180)	
Primary Medical Condition			0.240
Progressive (%)	14 (28)	13 (28.3)	
Spinal Cord Injury (%)	14 (28)	5 (10.9)	
Orthopedic (%)	3 (6)	8 (17.4)	
Cardiovascular (%)	10 (20)	13 (28.3)	
Central Nervous System (%)	9 (18)	7 (15.2)	
Type of WMS Device at Pre			0.049*
Manual wheelchair (%)	39 (78.0)	25 (54.3)	
Scooter (%)	2 (4.0)	4 (6.5)	
Power wheelchair (%)	9 (18.0)	17 (37.0)	

Key: TR = Telerehabilitation; IP = In-Person; and * significant at $p = 0.05$

6.2.2 Study Design

This study used a multicenter prospective controlled non-randomized design. Four remote clinics located at least 100 miles away from CAT-UPMC took part in the TR group: DuBois Regional Medical Center, DuBois, PA; Charles Cole Memorial Hospital, Coudersport, PA; Meadville Medical Health Center, Meadville, PA; and Elk Regional Health Center, Saint Mary's, PA. The urban clinic was the CAT-UPMC, referred to as the "Gold Standard" or control group for IP assessments.

Participants in the TR group received care at one of the remote clinics by a generalist practitioner from an expert practitioner via a TR consultation model. The expert practitioner was an Occupational Therapist with an assistive technology practitioner (ATP) certification and 10+ years of experience in the area of WMS. The 46 participants who used TR resided in rural or distant locations where travel to the CAT-UPMC was difficult or inconvenient. Participants in the IP group received care as usual from the expert practitioners at CAT-UPMC without a TR consultation model.

6.2.3 Apparatus

A custom video-conferencing infrastructure was installed at each of the remote collaborating sites detailed in Chapter 2.

6.2.4 Measurement

The FEW was designed as a self-report questionnaire to be administered over time to consumers of WMS technology as a dynamic indicator or profile of perceived user function related to wheelchair/scooter use. The FEW consists of 10 consumer-generated, self-report items which were scored using a 6 point scale of 6 = completely agree to 1 = completely disagree, and a score of 0 = does not apply. The 10 items are: stability, durability, and dependability (SDD), comfort, health needs; operate wheelchair/scooter, reach and carry out tasks at different surface heights, transfers, personal care tasks, indoor mobility, outdoor mobility, and personal/public transportation (Mills, Holm, & Schmeler, 2007).

6.2.5 Data Analysis

SPSS version 14.0 (Chicago, IL) and SAS version 9.2 were used to analyze the data. Results are expressed as mean ± SD, or as percentages in corresponding categories. Comparisons between the TR group and IP group at baseline and follow-up were performed using the independent *t*-test. To test the comparison of the average FEW scores for the TR and IP groups, both should have similar distributions (Sheiner, 1992). A value difference of 1.85 points pre to post of the FEW total score and individual items was determined as clinically significant based on research (Schmeler, 2005) and clinical judgment. To test the non-inferiority between the Post FEW items for TR and IP groups, the following hypothesis was calculated:

$$H_o : \mu_{TR} - \mu_{IP} < \pm 1.85$$

$$H_1 : \mu_{TR} - \mu_{IP}. > \pm 1.85$$

In non-inferiority trials a margin or δ was chosen by using clinical judgment with reference to relevant guidance. This margin was chosen so that a difference in treatments of such a magnitude was considered clinically irrelevant and anything greater would be deemed unacceptably large. The confidence interval (CI) between treatments judged to be clinically relevant and considered non-inferior was ±1.85, meaning that the TR group had to score less than the +1.85 and greater than -1.85 when compared to the IP group. This CI was pre-specified during the design of the trial and determined too large for both the non-inferiority testing and clinical difference marker. However, it was unethical to change the CI during data collection. To examine the non-inferiority difference, CIs were calculated to estimate the range of values in which the treatment difference was likely to lie. This CI was used to provide the basis for drawing the study's results. Probability (p) values of 0.05 were considered the limit of significance in all other analyses.

6.3 RESULTS

At baseline, no significant differences between the TR and IP groups were observed in terms of demographics except previous WMS device (p=0.049) (see Table 18). The results revealed no significant differences for the average pre FEW score and pre FEW item scores between the TR and IP groups. This indicated the TR and IP groups had the same starting point and opportunity for change (Table 20, Figure 30).

Table 20: Average Pre FEW and Pre FEW Item Scores for Telerehabilitation and In-Person Groups

Item	Group	N	Mean(SD)	t	*P*
SDD	IP	50	3.62 (1.75)	1.76	0.06
	TR	46	3.04 (1.43)		
Comfort	IP	50	3.22 (1.52)	0.93	0.35
	TR	46	2.93 (1.38)		
Health Needs	IP	50	3.34 (1.60)	1.31	0.19
	TR	46	2.93 (1.42)		
Operate	IP	50	3.14 (1.68)	0.09	0.93
	TR	46	3.11 (1.60)		
Reach	IP	50	2.84 (1.60)	0.11	0.91
	TR	46	2.80 (1.50)		
Transfer	IP	50	3.76 (1.66)	1.47	0.14
	TR	46	3.28 (1.50)		
Personal Care	IP	50	3.56 (1.69)	0.32	0.75
	TR	46	3.46 (1.43)		
Indoor Mobility	IP	50	3.74 (1.61)	0.96	0.34
	TR	46	3.43 (1.50)		
Outdoor Mobility	IP	50	2.46 (1.46)	-0.94	0.35
	TR	46	2.76 (1.68)		
Transportation	IP	50	3.37 (1.73)	-0.90	0.37
	TR	46	3.68 (1.50)		
Average FEW	IP	50	3.29 (1.10)	0.66	0.51
	TR	46	3.15 (1.04)		

Key: SDD = Stability, Durability, and Dependability; TR = Telerehabilitation; IP = In-Person; and FEW = Functioning Everyday with a Wheelchair

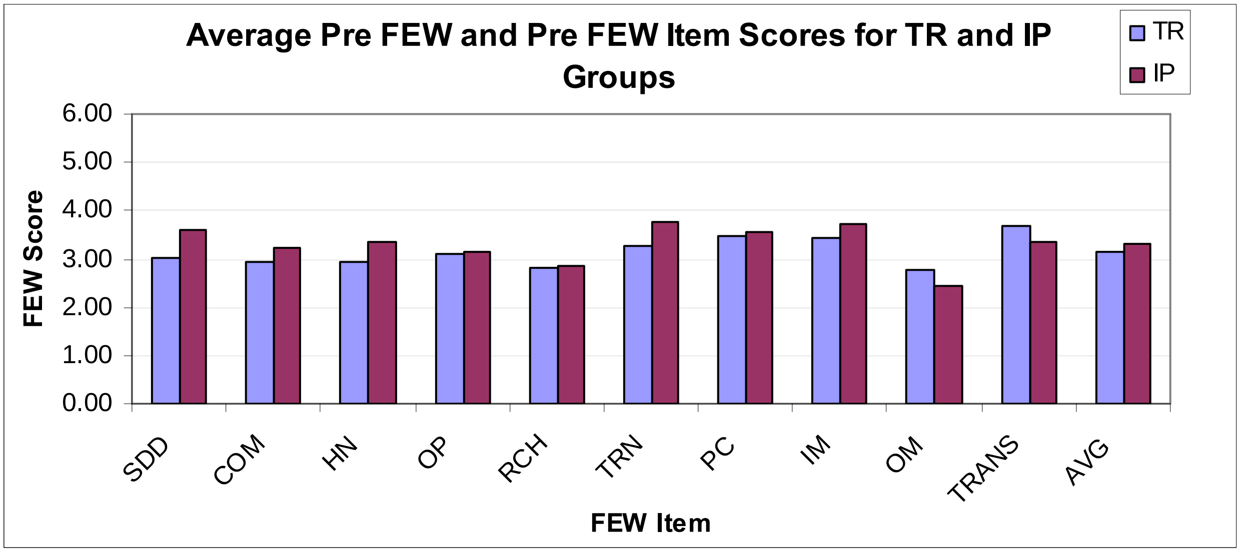


Figure 30: Average Pre FEW and Pre FEW Item Scores for Telerehabilitation and In-Person Groups

No significant differences were indicated between the TR and IP groups for the average post FEW and post FEW item scores except for the Transportation (*p*=0.02) item (See Table 21 and Figure 31). All FEW items, except Transportation (4.63), averaged at least a post score of 5, corresponding to mostly agree on the FEW. Figures 32 though 37 displayed the average pre and post FEW and pre and post FEW item scores for TR and IP groups.

Table 21: Post Few Items for Telerehabilitation and In-Person Groups

Item	Group	N	Mean(SD)	t	*P*
SDD	IP	50	5.62(0.49)	0.83	0.93
	TR	36	5.61(0.49)		
Comfort	IP	50	5.56(0.50)	-0.47	0.64
	TR	36	5.61(0.49)		
Health	IP	50	5.66(0.59)	0.18	0.86
	TR	36	5.64(0.49)		
Operate	IP	50	5.58(0.54)	-1.20	0.23
	TR	36	5.71(0.46)		
Reach	IP	50	5.36(0.90)	0.31	0.76
	TR	36	5.31(0.62)		
Transfer	IP	50	5.34(1.21)	0.16	0.87
	TR	36	5.31(0.56)		
Personal Care	IP	50	5.46(0.58)	0.57	0.57
	TR	36	5.39(0.55)		
Indoor Mobility	IP	50	5.62(0.64)	0.72	0.47
	TR	36	5.53(0.51)		
Outdoor Mobility	IP	50	5.48(0.61)	-1.24	0.22
	TR	36	5.64(0.54)		
Transportation	IP	43	5.23(1.11)	2.34	0.02*
	TR	30	4.63(1.03)		
Average FEW	IP	50	5.51(0.40)	1.16	0.25
	TR	36	5.46(0.54)		

Key: SDD = Stability, Durability, and Dependability; TR = Telerehabilitation; IP = In-Person; FEW = Functioning Everyday with a Wheelchair; and *significant at $p = 0.05$

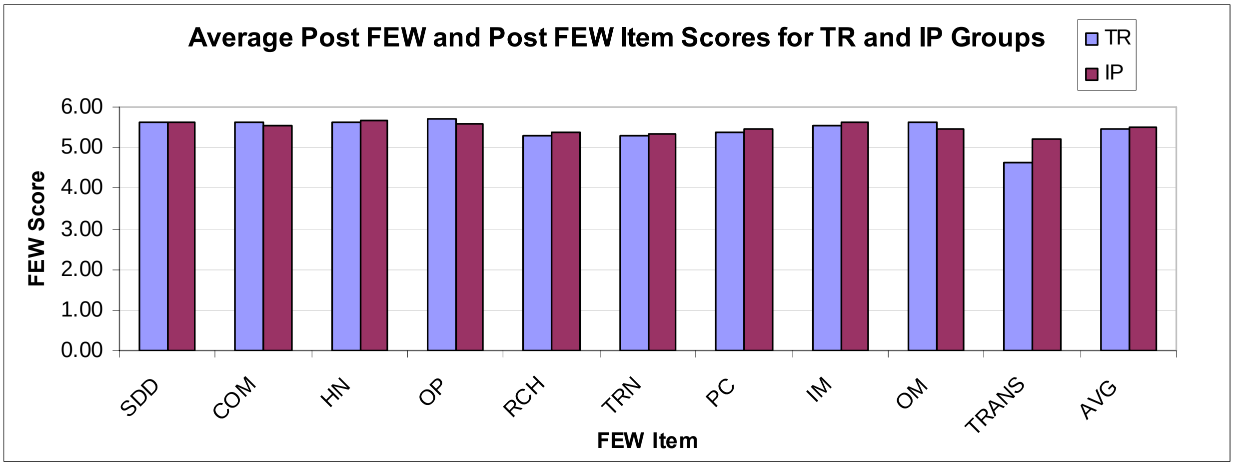


Figure 31: Average Post Few and Post FEW Item Scores for Telerehabilitation and In-Person Groups

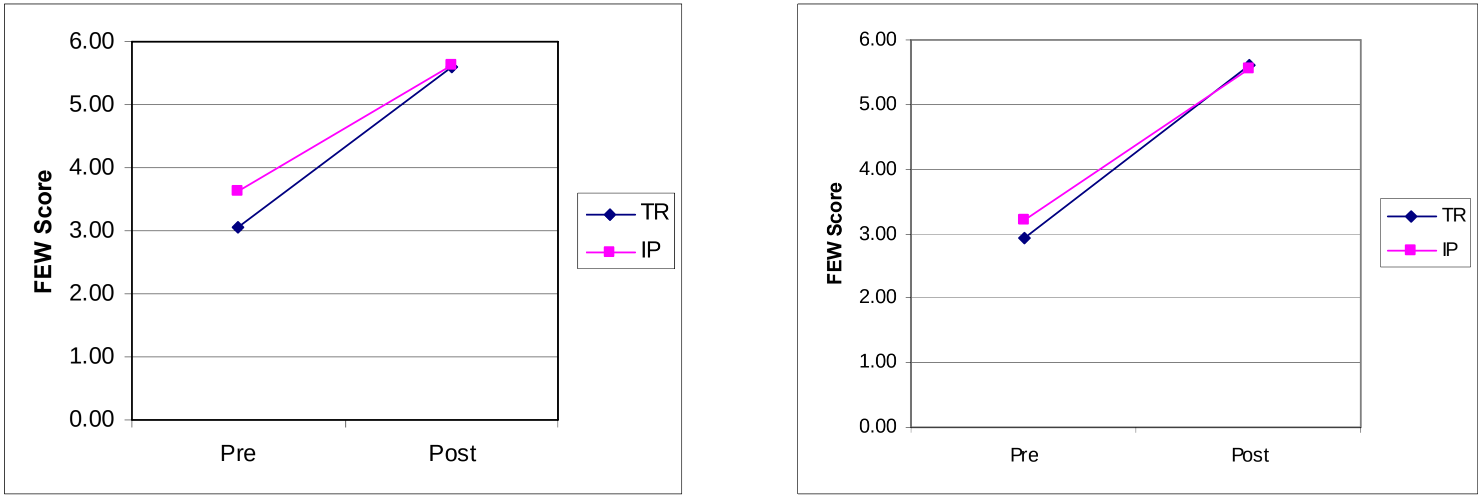


Figure 32: SDD (Left) and Comfort (Right) FEW Scores for TR and IP Groups at Pre and Post

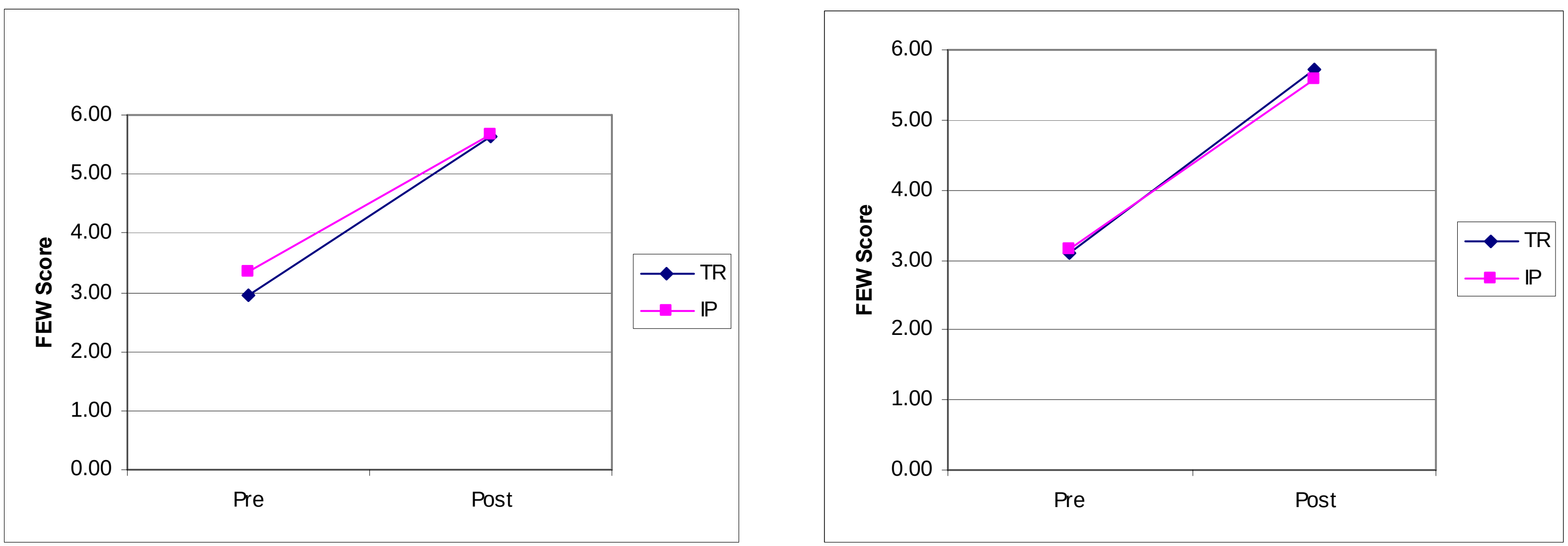


Figure 33: Health Needs (Left) and Operate (Right) FEW Scores for TR and IP Groups at Pre and Post

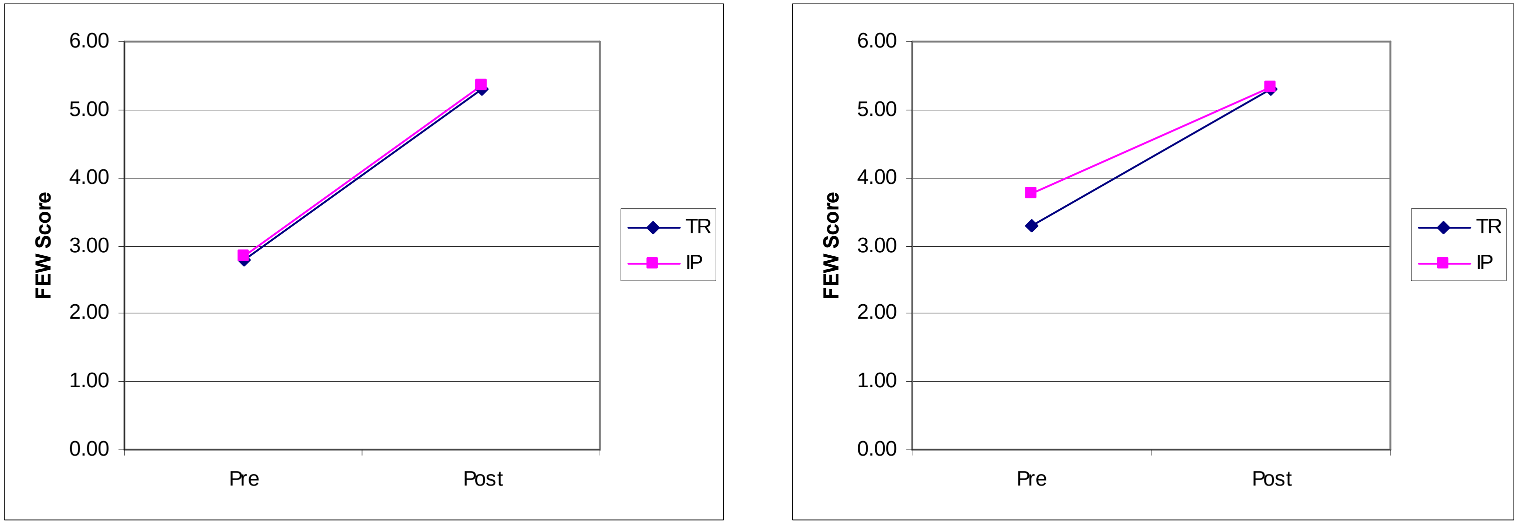


Figure 34: Reach (Left) and Transfer (Right) FEW Scores for TR and IP Groups at Pre and Post

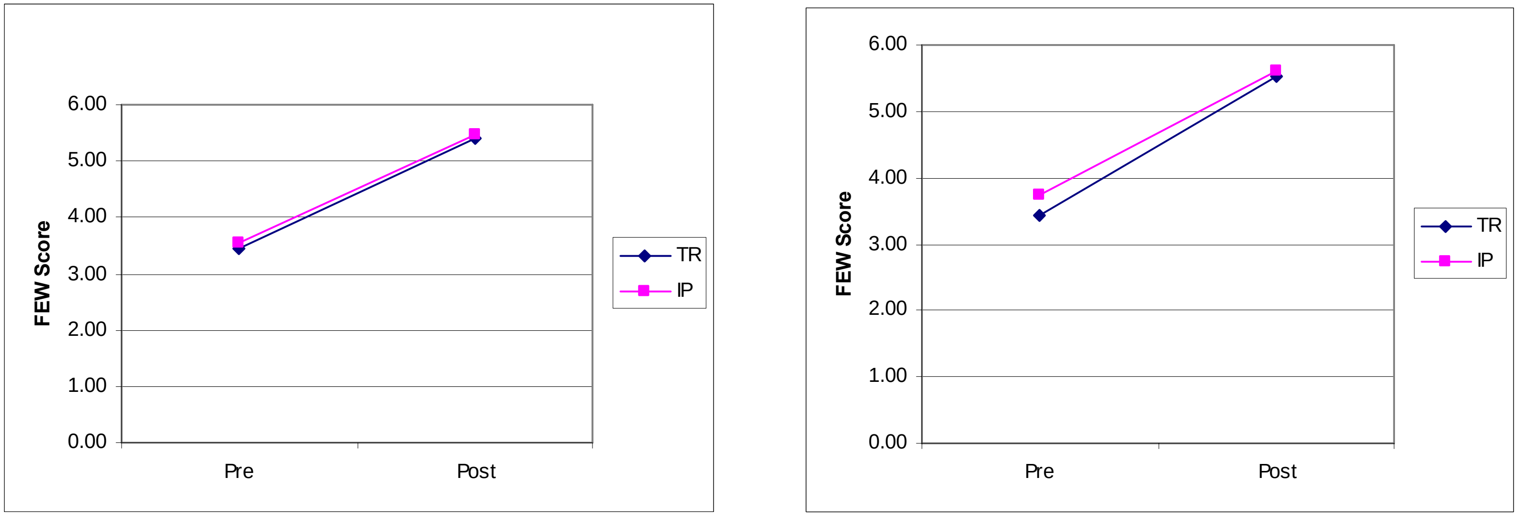
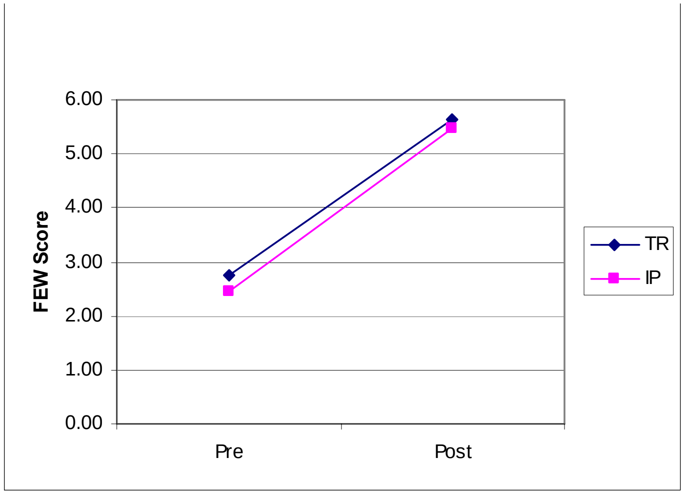


Figure 35: Personal Care (Left) and Indoor Mobility (Right) FEW Scores for TR and IP Groups at Pre and Post



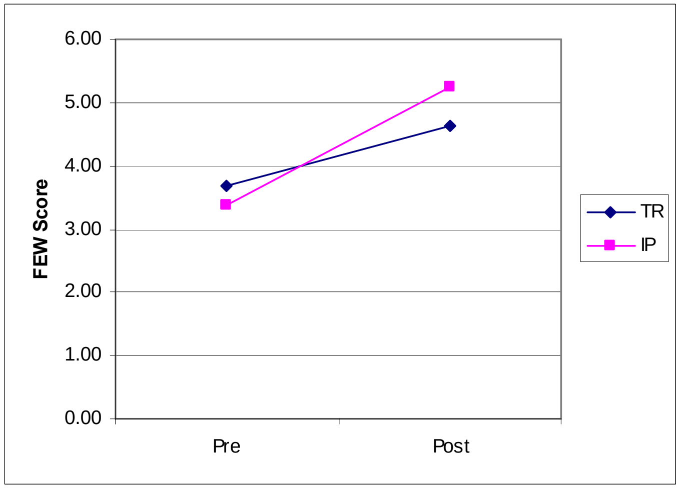
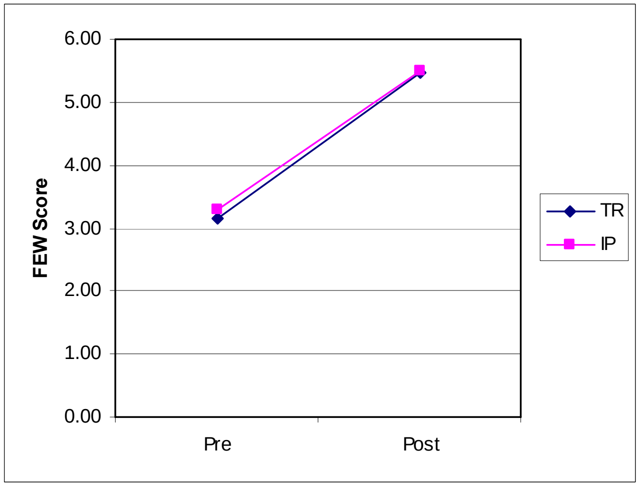


Figure 36: Outdoor Mobility (Left) and Transportation (Right) FEW Scores for TR and IP Groups at Pre and Post

Figure 37: Average FEW Scores for TR and IP Groups at Pre and Post



The average FEW and FEW item scores within the TR and IP groups reached the clinical difference value of 1.85 and were significantly different at pre, except for IP Transfer (1.56) and TR Transportation (1.06) and Personal Care (1.83) (see Table 22 and Figure 38).

Table 22: Clinical Difference of Telerehabilitation and In-Person Groups

Item	Group	N	Mean[CI]	t	*P*
SDD	IP	50	2.00 [1.54-2.46]+	8.75	<0.001*
	TR	36	2.42 [2.00-2.83]+	11.81	<0.001*
Comfort	IP	50	2.34 [1.94-2.74]+	11.75	<0.001*
	TR	36	2.75 [2.26-3.24]+	11.29	<0.001*
Health	IP	50	2.32 [1.90-2.74]+	11.21	<0.001*
	TR	36	2.69 [2.23-3.16]+	11.81	<0.001*
Operate	IP	50	2.44 [2.00-2.88]+	11.10	<0.001*
	TR	36	2.40 [1.91-2.89]+	9.87	<0.001*
Reach	IP	50	2.52 [2.09-2.95]+	11.66	<0.001*
	TR	36	2.53 [2.01-3.04]+	9.97	<0.001*
Transfer	IP	50	1.58 [1.07-2.09]	6.22	<0.001*
	TR	36	2.03 [1.55-2.50]+	8.67	<0.001*
Personal Care	IP	50	1.90 [1.41-2.39]+	7.77	<0.001*
	TR	36	1.83 [1.34-2.33]	7.51	<0.001*
Indoor Mobility	IP	50	1.90 [1.42-2.34]+	8.25	<0.001*
	TR	36	1.97 [1.50-2.45]+	8.43	<0.001*

Table 22 (continued)

Outdoor Mobility	IP	50	3.02 [2.59-3.45]+	14.19	<0.001*
	TR	36	2.86 [2.28-3.44]+	10.04	<0.001*
Transportation	IP	43	2.00 [1.38-2.47]+	7.16	<0.001*
	TR	30	1.06 [0.46-1.54]	3.81	<0.001*
Average FEW	IP	50	2.22 [1.92-2.65]+	10.87	<0.001*
	TR	36	2.29 [1.87-2.70]+	10.95	<0.001*

Key: SDD = Stability, Durability, and Dependability; TR = Telerehabilitation; IN = In-Person; FEW = Functioning Everyday with a Wheelchair; + = mean difference clinically different at 1.85; and *significant at *p*=0.05

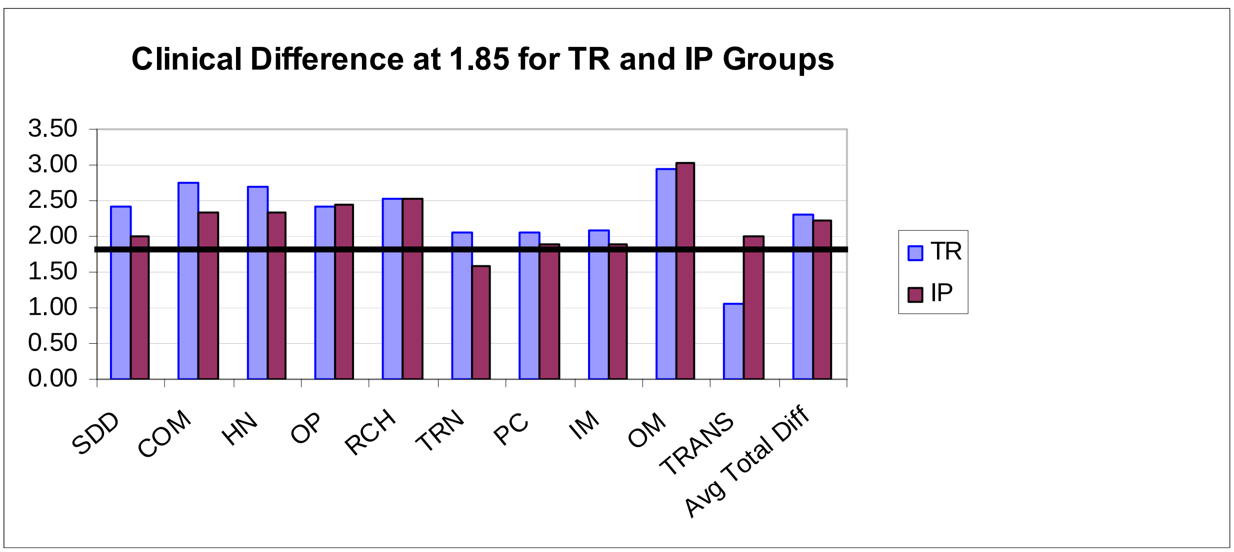


Figure 38: Clinical Difference at 1.85 for Telerehabilitation and In-Person Groups

The majority of the participants, whether in the TR or IP group, were seated in low quality manual and/or power wheelchairs before receiving an assessment. From the initial assessment until delivery, participants in the TR group were in the study for 116 days and for the IP group, participants were in the study for 111 days. Around 79% of the total participants were prescribed and delivered high end powered wheelchairs (see Table 23) with various powered seat functions such as power tilt-in-space, recline, seat elevator, and elevating legrests. Prescription classification of participants within the TR group was: 4 from manual to manual, 2 from manual to scooter, 12 from manual to power, 1 scooter to scooter, 2 scooter to power, and 15 power to power. Prescription classification of participants within the IP group was: 10 manual to manual, 1 manual to scooter, 29 manual to power, 2 scooter to power, 9 power to power. Disparities existed in the provision of WMS for diagnosis (see Tables 24 and 25). Participants in the TR and IP groups with a "Progressive" diagnosis were fitted with powered wheelchairs (86%). Similarly, participants in both groups with a "Orthopedic," "Cardiovascular," and "Central Nervous System" diagnosis were prescribed and fitted with powered wheelchairs (72%). However, 13 participants who were seated in highstrength manual wheelchairs and categorized with a "Spinal Cord Injury" diagnosis, 2 TR participants and 8 IP participants were prescribed an ultralightweight manual wheelchair (77%).

Table 23: Wheeled Mobility and Seating Devices for Telerehabilitation and In-Person Groups at Pre-Post

Characteristics	Telerehabilitation	In-Person
Pre Wheeled Mobility and Seating Device	n=46	n=50
Manual wheelchair (%)	25 (54.3)	39 (78.0)
Scooter (%)	4 (8.7)	2 (4.0)
Power wheelchair (%)	17 (37.0)	9 (18.0)
Post Wheeled Mobility and Seating Device	n=36	n=50
Manual wheelchair (%)	4 (11.1)	10 (20.0)
Scooter (%)	3 (8.3)	1 (2.0)
Power Wheelchair (%)	29 (80.6)	39 (78.0)

Table 24: Wheeled Mobility and Seating Devices Associated with Participants Primary Diagnosis at Baseline (Pre-Intervention)

Primary Diagnosis	Group	Manual	Scooter	Power
Progressive	IP	9	0	5
	TR	4	2	7
Spinal Cord Injuries	IP	13	0	1
	TR	2	0	3
Orthopedic	IP	2	0	1
	TR	5	1	2
Cardiovascular	IP	8	0	2
	TR	11	0	2

Table 24 (continued)

Central Nervous System	IP	7	2	0
	TR	3	1	3

Table 25: Wheeled Mobility and Seating Device Associated with Primary Diagnosis at Post-Intervention

Primary Diagnosis	**Group**	**Manual**	**Scooter**	**Power**
Progressive	IP	1	0	13
	TR	0	1	10
Spinal Cord Injuries	IP	8	0	6
	TR	2	0	3
Orthopedic	IP	0	0	3
	TR	0	1	5
Cardiovascular	IP	1	1	8
	TR	1	1	6
Central Nervous System	IP	0	0	9
	TR	1	0	5

Table 26 detailed participant responses of FEW items in the TR and IP groups. The table showed an even distribution in participants pre-post FEW scores. However, one TR participant reported a 2(mostly disagreed) with the post FEW item of Transportation regarding their new WMS device. Similarly, within the IP group, a small number of participants reported below a

4(slightly agree) for certain post FEW items regarding their new WMS device (Transfer (n=3), Reach (n=2), and Transportation (n=1)). Table 27 displayed the response distribution of total FEW items at pre-post for TR and IP groups. Within the table, there was an even distribution among pre FEW scores except at completely agree which was expected as the participants were seated in WMS devices that did not accommodate their needs and were never formally evaluated. Meanwhile, at post, about 95% of participants responded that they mostly or completely agree with their new WMS device.

Table 26: Response Distribution among Telerehabilitation and In-Person FEW Items at Pre-Post

	Telerehabilitation		In-Person	
SDD	**Pre**	**Post**	**Pre**	**Post**
1 = completely disagree	7		9	
2 = mostly disagree	11		7	
3 = slightly disagree	11		4	
4 = slightly agree	10		13	
5 = mostly agree	4	14	8	19
6 = completely agree	3	22	9	31
Comfort	**Pre**	**Post**	**Pre**	**Post**
1 = completely disagree	9		9	
2 = mostly disagree	12		8	
3 = slightly disagree	8		10	
4 = slightly agree	9		12	
5 = mostly agree	6	14	8	22
6 = completely agree	2	22	3	28
Health	**Pre**	**Post**	**Pre**	**Post**
1 = completely disagree	9		8	
2 = mostly disagree	8		9	
3 = slightly disagree	15		10	1
4 = slightly agree	8		9	
5 = mostly agree	3	13	9	14
6 = completely agree	3	23	5	35

Table 26 (continued)

Operate	**Pre**	**Post**	**Pre**	**Post**
1 = completely disagree	10		14	
2 = mostly disagree	7		4	
3 = slightly disagree	10		10	
4 = slightly agree	11		8	1
5 = mostly agree	3	10	11	19
6 = completely agree	5	26	3	30

Reach	**Pre**	**Post**	**Pre**	**Post**
1 = completely disagree	12		16	1
2 = mostly disagree	9		7	
3 = slightly disagree	11		7	1
4 = slightly agree	5	3	10	1
5 = mostly agree	8	19	9	22
6 = completely agree	1	14	1	25

Transfer	**Pre**	**Post**	**Pre**	**Post**
1 = completely disagree	8		6	2
2 = mostly disagree	6		8	1
3 = slightly disagree	10		7	
4 = slightly agree	12	2	8	4
5 = mostly agree	7	21	13	11
6 = completely agree	3	13	8	32

Personal Care	**Pre**	**Post**	**Pre**	**Post**
1 = completely disagree	6		8	
2 = mostly disagree	6		8	
3 = slightly disagree	9		7	
4 = slightly agree	13	1	9	2
5 = mostly agree	10	20	11	23
6 = completely agree	2	15	7	25

Indoor Mobility	**Pre**	**Post**	**Pre**	**Post**
1 = completely disagree	6		7	
2 = mostly disagree	7		4	
3 = slightly disagree	10		12	1
4 = slightly agree	11		5	1
5 = mostly agree	8	17	16	14
6 = completely agree	4	19	6	34

Outdoor Mobility	**Pre**	**Post**	**Pre**	**Post**
1 = completely disagree	16		18	
2 = mostly disagree	6		12	

Table 26 (continued)

3 = slightly disagree	10		5	
4 = slightly agree	4	1	10	3
5 = mostly agree	7	11	4	20
6 = completely agree	3	24	1	27
Transportation	**Pre**	**Post**	**Pre**	**Post**
1 = completely disagree	4		8	1
2 = mostly disagree	8	2	7	
3 = slightly disagree	4		9	
4 = slightly agree	13	11	6	2
5 = mostly agree	12	11	6	19
6 = completely agree	3	6	7	20

Table 27: Response Distribution of Total FEW Items at Pre-Post

	Total Pre FEW	% of Total Pre FEW	Total Post FEW	% of Total Post FEW
1 = completely disagree	190	20.0%	4	0.5%
2 = mostly disagree	154	16.2%	3	0.4%
3 = slightly disagree	179	18.8%	3	0.4%
4 = slightly agree	186	19.6%	32	3.8%
5 = mostly agree	163	17.1%	333	39.4%
6 = completely agree	79	8.3%	471	55.7%
Total	951		846	

The null hypothesis stated that TR was non-inferior to the standard IP treatment when compared at post-intervention. The differences between TR and IP groups at post FEW means were well within the non-inferiority margin of ±1.85, supporting the null hypothesis (see Table 28). If researchers had chosen ±0.5, another non-inferiority margin being considered, the margin would have been smaller looking at the post FEW differences between TR and IP groups. The null hypothesis would still not have been rejected for each of the post FEW items except for Transportation. Nonetheless, the majority of the 95% CI contained zero which led to interpretation that the TR and IP groups were the same for FEW items of SDD, Comfort, Health, Indoor Mobility, Personal Care, Reach, and Transfer. All of these FEW items had a small standard error resulting in a small CI containing zero. For the FEW items of Operate and Outdoor Mobility, the difference in the post means was positive for the TR group and the majority of the 95% CI. This resulted in positive scores which led to interpretation that the TR group scored higher than the IP group. Within the FEW items of Transportation, the TR group differences in post mean was higher than on any other item (-0.6), concluding that the IP group scored higher than the TR group as both the upper and lower bounds of the CI were negative.

Table 28: Post Mean Differences Between Telerehabilitation and In-Person Groups Testing Non-inferiority with Confidence Intervals

FEW Item	Group	N	Mean	Mean Differences (TR - IP)	Standard Error	Confidence Interval
SDD	IP	50	5.6	-0.0	0.05	-0.1 – 0.1
	TR	36	5.6			
Comfort	IP	50	5.6	0.1	0.05	-0.1 – 0.2
	TR	36	5.6			
Health	IP	50	5.7	-0.0	0.06	-0.2 – 0.1
	TR	36	5.6			
Operate	IP	50	5.6	0.1	0.05	0.0 – 0.3
	TR	36	5.7			
Reach	IP	50	5.4	-0.1	0.13	-0.3 – 0.2
	TR	36	5.3			
Transfer	IP	50	5.3	-0.0	0.21	-0.5 – 0.4
	TR	36	5.3			

Table 28 (continued)

Personal Care	IP	50	5.5	-0.1	0.07	-0.2 – 0.1
	TR	36	5.4			
Indoor Mobility	IP	50	5.6	-0.1	0.07	-0.2 – 0.1
	TR	36	5.5			
Outdoor Mobility	IP	50	5.5	0.2	0.07	0.0 – 0.3
	TR	36	5.6			
Transportation	IP	43	5.2	-0.6	0.27	-1.1 – (-0.1)
	TR	30	4.6			

Key: FEW = Functioning Everyday with a Wheelchair; SDD = Stability, Durability, and Dependability; TR = Telerehabilitation; and IP = In-person

6.4 DISCUSSION

For individuals with mobility impairments, access to resources and practitioners with special training in WMS was difficult and cumbersome (Cooper, Trefler, & Hobson, 1996). Attempts to establish interventions and service delivery systems targeting improved patient outcome is imperative. TR allows the use of telecommunications technology to provide rehabilitation support for people with disabilities in geographically remote regions and provide a means for training and educating generalist practitioners.

In this study, no significant differences were seen in pre FEW scores and post Few scores except for Transportation. The IP group did score higher on 8 of the 10 pre FEW items, except Outdoor Mobility and Transportation; however, this was found to be not significantly different compared to the TR group. Granted, there were more power wheelchair users in the TR group compared to the IP group. The FEW item of Transportation seemed to be the troubling item when it came to healthcare service delivery in remote areas as compared to the IP group located in a metropolitan area. On the post FEW items, the IP group scored higher on 7 of the 10 items except for Comfort, Operate, and Outdoor Mobility. No significant differences were found from the initial assessment until delivery for participants in the TR (116 days) and IP (111 days) groups. This was noteworthy when taking into consideration the coverage policy changes implemented by the Centers for Medicare and Medicaid Services in the WMS field. Meanwhile, there was a significant difference for pre-post FEW change scores within the TR and IP groups. The participants at post were prescribed a new WMS device custom fitted to their needs, preferences, abilities, and natural environment setting. A TR consultation model showed that it was a non-inferior treatment for participants in remote areas when compared to traditional IP assessments. This was partly due to the service delivery protocol established at each remote site. Ample time was spent with each participant in both groups to conduct the evaluation, answer questions, and demo equipment if available. The generalist practitioners at the remote sites directed the evaluation assessment with the expert practitioner observed and followed-up with additional questions or comments. With an extensive background in the WMS field, the expert practitioner was able to suggest numerous options for an appropriate WMS device, seating options, and accessories. The assessment of the user's needs and matching the user with an appropriate WMS device and fitting and training was essential for successful outcomes (Cooper et al., 2001).

Scientific evidence for telerehabilitation for patients with mobility impairments was relatively limited. This study was the first to look at non-inferiority testing for this specific population for whom it was difficult to draw results in previous studies. At the time of this study no practice guidelines were written in the areas of telerehabilitation and wheelchair prescription; however, are currently being written. Nevertheless, a TR consultation model was a feasible option in evaluating people with mobility impairments for WMS devices. Future studies should continue to evaluate healthcare utilization costs for TR activity and compare it to traditional systems. Furthermore, randomized controlled trials with sufficient sample size and longer follow-up periods are needed to asses both the short and longer-term effects of a TR consultation model. In addition, research is needed to evaluate how individuals perform in their natural environment. Data gathered through such quality systems can be useful in improving outcomes for wheelchair prescription.

A major limitation in the clinical trial was the clinical difference value of 1.85. This value was too large for testing differences between pre-post within the groups but also too large to use for the non-inferiority margin. The clinical difference marker was a function of one study and clinical judgment. There is potential that the non-inferiority margin be decreased, for example to 0.5 and still remain comparable between the two methods. There were also unequal sample sizes because 10 individuals within the TR group did not receive a WMS device and could not be included in the post FEW analysis. This factor might have biased the outcome. The recruitment at the remote sites for the TR group was from a convenience sample and not random selection. The remote sites held their wheelchair clinics once every few months depending on referrals. In contrary to the IP group at the CAT-UPMC, the clinic is held twice a week and sees on average 15-20 patients. Matching the participants within both groups on type of WMS device, disability, age, gender, and race would have improved the study design, but was not feasible at the time based on the remote site recruitment. As far as technical concerns, only one site used a wireless connection where a few second delay occurred between video and audio due to the bandwidth connection. Altogether, there were no other technical problems with the use of the video-conferencing system.

6.5 CONCLUSION

In conclusion, the study evaluated the non-inferiority of WMS assessments delivered by means of two separate conditions: Gold Standard (IP at CAT-UPMC) vs. Experimental (TR at remote clinics). An expert practitioner located at least 100 miles away from each of the remote sites used a TR video-conferencing system to consult during WMS evaluations. The TR video-conferencing system allowed for live video and audio transmission between all participants. This study represented the results of a multicenter prospective controlled non-randomized design for patients with mobility impairments in need of a WMS device at a remote wheelchair clinic. This was in comparison to a group of patients receiving customary care at the CAT-UPMC by expert practitioners. The TR group showed that treatment was non-inferior on most of the FEW items. Telerehabilitation can be adopted into everyday clinical practice not only for evaluation purposes but also for follow-up and education. Telerehabilitation can assist with improving access to knowledge, information and services, controlling healthcare, improving clinical quality and patient satisfaction.

7.0 SUMMARY

The purpose of this study was to determine the effectiveness of a telerehabilitation (TR) consultation model for procuring an appropriate wheeled mobility and seating (WMS) device. The availability of practitioners with specific expertise in this area was limited particularly in Westerns Pennsylvania. It is apparent that the need for WMS devices will continue to increase as life expectancy is lengthened and individuals are surviving trauma and disease due to medical advancements. Therefore, the specific aims were to:

1. Develop a telerehabilitation service delivery model and protocol.
2. Establish inter-rater reliability of the Functioning Everyday with a Wheelchair- Capacity (FEW-C) via telerehabilitation.
3. Establish internal consistency of the FEW-C via telerehabilitation.
4. Investigate the ability of the Functioning Everyday with a Wheelchair (FEW) to measure the difference and magnitude of user-perceived change in function following provision of a new wheeled mobility and seating (WMS) device via telerehabilitation.
5. Investigate the relationship between the self-report FEW and performance-based FEW-C outcome tools at baseline via telerehabilitation
6. Measure participant satisfaction during the telerehabilitation assessment
7. Evaluate the non-inferiority of WMS assessments delivered by two conditions: Gold Standard (i.e. In-Person) vs. Experimental (i.e. TR) measured by the self-report FEW tool.

The telerehabilitation protocol provided a quality system that utilized current standards of practice. The protocol assisted service providers in meeting the challenges of wheelchair prescription as it demonstrated the capacity to effect change and influence outcomes. These outcomes addressed factors that had not been reported in TR applications before. The protocol used a combination of Rosen's models of "Community rehabilitation teleguided" and "Community practitioner consultation." For example, a TR consultation model provided guidance to generalist practitioners and put into practice the opportunity to share documents, web-browsers, and PowerPoint presentations in real-time with the use of the videoconferencing system. This allowed for visual sequences during discussions between the multi-interdisciplinary team and participant. The protocol assisted in improving prescription practices which reduced variations in clinical practice and presented opportunities for professional development and education.

The FEW-C yielded excellent inter-rater reliability coefficients administered to participants. On average two trained observers simultaneously rated participant performance via telerehabilitation. For the same participants, the FEW-C demonstrated good to excellent internal consistency via telerehabilitation. Using the telerehabilitation model, a practitioner had the ability to assess the type of function seen at a remote clinic. These findings indicated that the FEW-C is a valid tool for assessment and warrants continued development not only in-person but with alternative methods of delivery such as TR.

A clinical trial investigated the ability of the FEW to measure the differences of the user's perceived function following provision of a new WMS device via a TR consultation model. The FEW demonstrated that change in function did occur and showed large effect sizes for change in a participants' WMS device verifying the significant change scores. There was a significant relationship with specific items on the self-report FEW and performance-based FEW-C at baseline.

Within the same study, participant satisfaction was also measured. The use of a TR consultation model in remote sites provided a closer, easier, and less expensive mode for assessment and evaluation for participants. The results indicated a high level of satisfaction for their current TR WMS device evaluation and prescription process as well as patient satisfaction regarding the impact of the technology via a TR consultation model.

In the final study, a multicenter prospective controlled non-randomized clinical trial was undertaken to test the non-inferiority of WMS evaluation under two conditions, Telerehabilitation and In-Person. The results revealed no significant differences for the average pre FEW, and pre FEW item scores comparing the TR and IP groups which indicated that there was no ceiling effect as all participants started out at the same point. No significant changes in post average FEW and post FEW item scores comparing the TR and IP groups except for the FEW item of Transportation. When examining the clinical difference, each of the FEW items within the groups reached that test value of 1.85 and were significantly different, except for IP Transfer and TR Transportation and Personal Care. The difference of each of the FEW means at post for the TR and IP groups were within the non-inferiority margin of ±1.85 failing to reject the null hypothesis. Altogether, almost 80% percent of participant's within the TR and IP groups were prescribed power wheelchairs secondary to their diagnoses and functional level.

To summarize, this research project had strengths and limitations. The strengths were: (a) development of wheelchair clinics structured within a remote hospital centered around patients needs, (b) created a new model of care and delivery for WMS assessments via a TR consultation model which decreased geographical barriers and travel for patients, (c) implemented evidence-based care with outcome management tools providing a gap in the TR literature, (d) applied innovative clinical information technology for service delivery within rural hospitals, and (e) provided continued education to prepare the workforce in WMS via a TR consultation model.

Limitations of the studies were: (a) the focused literature review was limited to clinical applications of TR specifically to assistive technology service delivery, (b) identified only one expert practitioner to consult on all telerehabilitation assessments, (c) the self-report FEW outcome tool does not include canes, crutches, walkers, prostheses, and no mobility device as it only measures participants function with their current manual and/or power wheelchair and scooter, (d) lack of validated participant satisfaction questionnaires, (e) lack of knowledge implementing a non-inferiority clinical trial, (e) limited follow-up periods with the self-report FEW and satisfaction questionnaire, (f) recruitment at remote sites was from a convenience sample, (g) and the number of raters who implemented the performance-based FEW-C reliability testing.

With advanced telecommunications and information technology, future telerehabilitation studies need to research the cost-effectiveness of the technology and its clinical application. The use of this telerehabilitation consultation model should be expanded and implemented with other assistive technology service systems such as computer access and augmentative alternative communication devices. Additional follow-up periods are needed to assess the short and longer-term effects of a TR consultation model, specifically within the WMS field and other clinical applications. Tele-homecare can be viewed as a form of a TR application allowing a practitioner the ability to observe how a participant is performing within their natural environment, consult on accessibility issues, and provide follow-up care. Most of the TR studies were small in sample size. Therefore, creating an on-line outcome database would allow information to be pooled into larger sample sizes increasing the power of clinically based studies. Future studies should investigate alternative approaches to provide distance learning continuing education for rehabilitation professionals. Telerehabilitation suggests new opportunities to provide rehabilitation services in clinical settings, especially in rural or underserved locations and in alternative ways.

APPENDIX A: Functioning Everyday with a Wheelchair (FEW)

Subject Code: _______

Functioning Everyday with a Wheelchair (FEW)

DIRECTIONS: Please answer the following 10 questions by placing an 'X' in the box under the response (completely agree, mostly agree, slightly agree, etc.) that best matches your ability to function while in your wheelchair/scooter. All examples may not apply to you, and there may be tasks you perform that are not listed. Mark each question only one time. If you answer, *slightly, *mostly, or *completely disagree for any question, please circle the feature(s) (i.e., size, fit, postural support, functional) contributing to your disagreement, and write the reason for your disagreement in the Comments section.

	Completely Agree	Mostly Agree	Slightly Agree	*Slightly Disagree	*Mostly Disagree	*Completely Disagree	Does not apply
1. The stability, durability and dependability features of my wheelchair/scooter contribute to my ability to carry out my daily routines as independently, safely and efficiently as possible: (e.g., tasks I want to do, need to do, am required to do- when and where needed)							
Comments:							
2. The size, fit, postural support and functional features of my wheelchair/scooter match my comfort needs as I carry out my daily routines: (e.g., heat/moisture, sitting tolerance, pain, stability)							
Comments:							
3. The size, fit, postural support and functional features of my wheelchair/scooter match my health needs: (e.g., pressure sores, breathing, edema control, medical equipment)							
Comments:							
4. The size, fit, postural support and functional features of my wheelchair/scooter allow me to operate it as independently, safely, and efficiently as possible: (e.g., do what I want it to do when and where I want to do it)							
Comments:							
5. The size, fit, postural support and functional features of my wheelchair/scooter allow me to reach and carry out tasks at different surface heights as independently, safely, and efficiently as possible: (e.g., table, counters, floors, shelves)							
Comments:							

For questions #2 thru #10:
size (e.g., wheelchair and seating frame- width, length, height)
fit (e.g., not too large, not too small, allows desired movement)
postural support (e.g., provides support, stability, and control for the body- bones, muscles, and tissues)
functional (e.g., speed, wheels, cushion, controller, backrest, legrests, seat belt, tilt/recline system, seat elevator, laptray, basket, cane holder, horn, lights)

Subject Code: _______

6. The size, fit, postural support and functional features of my wheelchair/scooter allow me to transfer from one surface to another surface as independently, safely, and efficiently as possible: (e.g., bed, toilet, chair)	Completely Agree	Mostly Agree	Slightly Agree	*Slightly Disagree	*Mostly Disagree	*Completely Disagree	Does not apply
Comments:							

7. The size, fit, postural support and functional features of my wheelchair/scooter allow me to carry out personal care tasks as independently, safely, and efficiently as possible: (e.g., dressing, bowel/bladder care, eating, hygiene)	Completely Agree	Mostly Agree	Slightly Agree	*Slightly Disagree	*Mostly Disagree	*Completely Disagree	Does not apply
Comments:							

8. The size, fit, postural support and functional features of my wheelchair/scooter allow me to get around indoors as independently, safely, and efficiently as possible: (e.g., home, work, mall, restaurants, ramps, obstacles)	Completely Agree	Mostly Agree	Slightly Agree	*Slightly Disagree	*Mostly Disagree	*Completely Disagree	Does not apply
Comments:							

9. The size, fit, postural support and functional features of my wheelchair/scooter allow me to get around outdoors as independently, safely, and efficiently as possible: (e.g., uneven surfaces, dirt, grass, gravel, ramps, obstacles)	Completely Agree	Mostly Agree	Slightly Agree	*Slightly Disagree	*Mostly Disagree	*Completely Disagree	Does not apply
Comments:							

10. The size, fit, postural support and functional features of my wheelchair/scooter allow me to use personal or public transportation as independently, safely, and efficiently as possible: (e.g., secure, stow, ride)	Completely Agree	Mostly Agree	Slightly Agree	*Slightly Disagree	*Mostly Disagree	*Completely Disagree	Does not apply
Comments:							

For questions #2 thru #10:
size (e.g., wheelchair and seating frame- width, length, height)
fit (e.g., not too large, not too small, allows desired movement)
postural support (e.g., provides support, stability, and control for the body- bones, muscles, and tissues)
functional (e.g., speed, wheels, cushion, controller, backrest, legrests, seat belt, tilt/recline system, seat elevator, laptray, basket, cane holder, horn, lights)

APPENDIX B: **Functioning Everyday with a Wheelchair-Capacity (FEW-C)**

Task # 1: FEW–C : Wheelchair/Scooter Stability, Durability, and Dependability

Task Conditions: Clinic/laboratory area
Consumer seated in wheelchair/scooter, and positioned next to therapist.

Instructions: "The stability, durability, and dependability features of a wheelchair/scooter can affect how you carry out your daily routines. I will ask you to respond to various questions regarding how stable, durable, and dependable your wheelchair/scooter is".

Type of mobility device: ☐ **Manual** ☐ **Power** ☐ **Scooter** ☐ **Had current wheelchair/scooter for less than 1 month**

Task Instructions & Therapist Task Guide		
1. **Stability**	**(a) Using this table, in the last month, how many times while seated or moving to or from your wheelchair/scooter has it tipped, or the wheels lost contact with the ground/floor? For example, your wheelchair tipped to one side, tipped to the front or back, or completely tipped over.** ____ **0 [Proceed to #2 Durability]** ____ **1 – 5** ____ **6 – 10** ____ **11 – 15** ____ **16 – 20** ____ **≥ 20** **(b) Using this list, tell me the reason why your wheelchair/scooter tipped. You can select as many as apply. If your reason is not listed here, please describe.** ____ **Contact with an obstacle, barrier, or object in environment** ____ **Human error (e.g., physical, cognitive)** ____ **Unstable ground/floor/terrain** ____ **Level or height of incline (ground/floor/terrain)** ____ **Weather condition** ____ **Transferring with or without assistance** ____ **Positioning in wheelchair/scooter with or without assistance** ____ **Other:** ________________________________ ________________________________	**Using this table/list** *[Hand stability item sheet to consumer -- point to respective tables on sheet for items 1a, b, & e]* **(a) Number of times consumer tipped** *[Indicate by marking provided space]* **(b) Tell me the reason why wheelchair/scooter tipped** *[Indicate by marking provided space(s) -- if consumer's reason is not listed, write cause or reason in provided space]* **(c) Were you or anyone else injured as a result of wheelchair/scooter tipping** *[Mark 'Yes' or 'No']* **(d) Who was injured** *[Mark 'User', 'Other person', or 'Both']* **(e) Severity of injury?** *[Mark 'Minimal', 'Moderate', or 'Severe']*

	(c) Were you or anyone else injured as a result of your wheelchair/scooter being tipped? ☐ **Yes** ☐ **No** **(d) Who was injured?** ☐ **User** ☐ **Other person** ☐ **Both** **(e) Severity of injury?** ☐ **Minimal** ☐ **Moderate** ☐ **Severe**	

<table>
<tr><th colspan="3">Task Instructions & Therapist Task Guide</th></tr>
<tr>
<td>2.

Durability</td>
<td>(a) Using this table, in the last month, how many times have you not been able to do the tasks you wanted to do, needed to do, or are required to do because of the durability features of your wheelchair/scooter? For example, your wheelchair/scooter features had broken down, or were not able to withstand/hold up against daily use?

____ 0 [Proceed to #3 Dependability]
____ 1 – 5
____ 6 – 10
____ 11 – 15
____ 16 – 20
____ ≥ 20

(b) Using this list, tell me the reason why your wheelchair/scooter became inoperable or broke down. You can select as many as apply. If your reason is not listed here, please describe.

____ Wheelchair/scooter frame or hardware
____ Hardware or electronic problem with the controller
____ Motor/gear/brake problem
____ Wheel/caster/tire components
____ Seating system/positioning devices
____ Accessories
____ Upper/lower body supports
____ Other:

____

____</td>
<td>Using this table/list [Hand durability item sheet to consumer -- point to respective tables on sheet]

(a) Number of times consumer has not been able to perform a task because of a wheelchair/scooter durability feature [Indicate by marking provided space]
(b) Tell me the reason why wheelchair/scooter became inoperable or broke down [Indicate by marking provided space(s) -- if consumer's reason is not listed, write cause or reason in provided space]</td>
</tr>
</table>

Task Instructions & Therapist Task Guide		
3. **Dependability**	**(a) Using this table, in the last month, how many times have you *not* been able to do the tasks you wanted to do, needed to do, or are required to do because you could *not* depend on your wheelchair/scooter? For example, your wheelchair/scooter was *not* dependable because it was in for repairs or performed inconsistently from day-to-day or over a period of time?** ____ **0** ____ **1 – 5** ____ **6 – 10** ____ **11 – 15** ____ **16 – 20** ____ **≥ 20** **(b) Using this list, tell me the reason why you could not depend on your wheelchair/scooter. You can select as many as apply. If your reason is not listed here, please describe.** ____ **New wheelchair/scooter service call/adjustment** ____ **Repairs for unexpected problems** ____ **Maintenance problems** ____ **Problems with charging/maintaining needed charge life** ____ **Wheelchair/scooter frame or hardware** ____ **Hardware or electronic problem with the controller** ____ **Motor/gear/brake problem** ____ **Wheel/caster/tire components** ____ **Seating system/positioning devices** ____ **Accessories** ____ **Upper/lower body supports** ____ **Other:** ____ ____	**Using this table/list** *[Hand dependability item sheet to consumer -- point to respective tables on sheet]* **(a) Number of times consumer has not been able to perform a task because of a wheelchair/scooter dependability feature** *[Indicate by marking provided space]* **(b) Tell me the reason why you could not depend on your wheelchair/scooter** *[Indicate by marking provided space(s) -- if consumer's reason is not listed, write cause or reason in provided space]*

STABILITY

(1a.) In the last month, how many times while seated or moving to or from your wheelchair/scooter has it tipped, or the wheels lost contact with the ground/floor?

0 times	1 – 5 times	6 – 10 times	11 – 15 times	16 – 20 times	≥ 20 times

(1b.) Why did you your wheelchair/scooter tip? Select as many as apply. If your reason is not listed here, please describe.

Contact with an obstacle, barrier, or object in environment	Weather condition
Human error	Transferring with or without assistance
Unstable ground/floor/terrain	Positioning in wheelchair/scooter with or without assistance
Level or height of incline (ground/floor/terrain)	Other

(1e.) Severity of injury?

Minimal: No medical attention necessary	Moderate: Some attention required to care for injury	Severe: Medical attention necessary

DURABILITY

(2a.) In the last month, how many times have you *not* been able to do the tasks you wanted to do, needed to do, or are required to do because of the durability features of your wheelchair/scooter?

0 times	1 – 5 times	6 – 10 times	11 – 15 times	16 – 20 times	≥ 20 times

(2b.) Why did your wheelchair/scooter became inoperable or break down? Select as many as apply. If your reason is not listed here, please describe.

New wheelchair/scooter service call/adjustment	Seating system/positioning devices
Wheelchair/scooter frame or hardware	Accessories
Hardware or electronic problem with the controller	Upper/lower body supports
Motor/gear/brake problem	Other
Wheel/caster/tire components	

DEPENDABILITY

(3a.) In the last month, how many times have you *not* been able to do the tasks you wanted to do, needed to do, or are required to do because you <u>could not depend</u> on your wheelchair/scooter?

0 times	1 – 5 times	6 – 10 times	11 – 15 times	16 – 20 times	≥ 20 times

(3b.) Why could you <u>not depend</u> on your wheelchair/scooter? Select as many as apply. If your reason is not listed here, please describe.

New wheelchair/scooter service call/adjustment	Motor/gear/brake problem
Repairs for unexpected problems	Wheel/caster/tire components
Maintenance problems	Seating system/positioning devices
Problems with charging/maintaining needed charge life	Accessories
Wheelchair/scooter frame or hardware	Upper/lower body supports
Hardware or electronic problem with the controller	Other

Task # 2: FEW–C : Comfort Needs

Task Conditions: Clinic/laboratory area
Consumer seated in wheelchair/scooter typically used for tasks, and positioned next to therapist.

Instructions: "Your comfort while seated in your wheelchair/scooter is important. I am going to ask you to show me how you improve comfort in your wheelchair/scooter.
I will provide you with instructions before each question. Please wait until I say ***READY*** before you begin a task.
If there are assistive devices you usually use to improve your comfort, feel free to use them". *[Wait for response]*

	Task Instructions
1. **Comfort: Method I**	**I need you to show me two methods or things you do to improve your comfort while seated in your wheelchair/scooter. You can show me the best or most often used method that works for you.** **Please describe one method you use to improve your comfort** *[Wait for response].* **Now, show me how you do it. Ready?** *[Wait for response]* **Method/Feature(s) Used:** ______________________________
2. **Comfort: Method II**	**Describe another method you use to improve your comfort** *[Wait for response].* **Now, show me how you do it. Ready?** *[Wait for response]* **Method/Feature(s) Used:** ______________________________

SCORE	INDEPENDENCE DATA	SAFETY DATA	QUALITY DATA
3	No assists given for task initiation, continuation, or completion	**SP** = Safe practices observed	**SM** = Acceptable (Standards met)
2	**VA** = No physical assists given, **but** $\leq$ 2 verbal assists or $\leq$ 2 visual assists; **or** $\leq$ 4 verbal and visual assists given	**MR** = Minor risks evident – no assistance provided	**IP** = Acceptable (Standards met – improvement possible)
1	**V^{S}A** = $\leq$ 2 physical assists given, **but no** total assistance; or 3 verbal assists or 3 visual assists, **or** $\geq$ 5 verbal and visual assists given	**PH** = Risks to safety evident – assistance provided to prevent potential harm	**PM** = Marginal (Standards partially met)
0	**PA** = 3 physical assists given; **or** total assistance required for task initiation, continuation, or completion	**SR** = Severe risks evident – assistance provided to prevent harm	**NM** = Unacceptable (Standards not met)

	Based on the ***size, fit, postural support, and functional features*** of the wheelchair/scooter: **Mobility Device used during task:** ☐ Manual ☐ Power ☐ Scooter **Assistive Technology Devices (ATDs) used during task:** **1.** **2.** **Total # of ATDs used: ________**	**INDEPENDENCE DATA**			**SAFETY DATA**				**QUALITY DATA**				**SUMMARY SCORES**			**FEATURES**		
		Verbal Assist	Visual Assist	Physical Assist	Safe practices	Minor risk- no assist	Risk- potential harm	Severe risk- prevent harm	Standards met	SM, Improvement possible	Standards partially met	Standards not met	INDEPENDENCE	SAFETY	QUALITY	STABILITY	DURABILLITY	DEPENDABILITY
		VA	**V^SA**	**PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**						
Subtasks	**FEW–C Subtasks**																	
1. **Comfort: Method I**	Adjusts comfort level in wheelchair/scooter adequately (achieves perceived improvement in comfort, does not lose balance) and efficiently (within 1 try, does not struggle)	**VA** **VA** **VA**	**V^SA** **V^SA** **V^SA**	**PA** **PA** **PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**	**3** **2** **1** **0**					
2. **Comfort: Method II**	Adjusts comfort level in wheelchair/scooter adequately (achieves perceived improvement in comfort, does not lose balance) and efficiently (within 1 try, does not struggle)	**VA** **VA** **VA**	**V^SA** **V^SA** **V^SA**	**PA** **PA** **PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**	**3** **2** **1** **0**					

Task # 3: FEW–C : Health Needs

Task Conditions:	Clinic/laboratory area. Consumer seated in wheelchair/scooter typically used to perform tasks, and positioned next to therapist.
Instructions:	"A wheelchair/scooter can support various health functions, and allow you to perform necessary health maintenance tasks. This task involves demonstrating how you carry out health-related functions, such as pressure relief, while seated in your wheelchair/scooter". I will provide you with instructions before each task. Please wait until I say ***READY*** before you begin a task. If there are assistive devices you usually use to perform these tasks, feel free to use them". *[Wait for response]*

1. **Weight Shift**	**I need you to show me one method you use to shift your weight off your bottom, or re-distribute/relieve pressure from your sitting surface while seated in your wheelchair/ scooter. You can show me the best or most often used method that works for you.** **Please *describe one method you use to shift your weight. Now show me how you do it. Ready?** *[Wait for response]*
2. **Leg Elevation**	**Elevating your legs, particularly above heart level can be an important function for health, for example, improving circulation or reducing edema/swelling.** **Do you typically elevate your legs while seated in your wheelchair/scooter?** ☐ **Yes** ☐ **No** ☐ **Not applicable** **If No, please *describe why** *[Wait for response].* **If you were to elevate your legs, describe what you would do** *[Wait for response]*. **Now, show me. Ready?** *[Wait for response]* **If Yes, *describe one method you use** *[Wait for response].* **Please show me how you elevate your legs. Ready?** *[Wait for response]*
3. **Medical/ Health-related (MHR) Function**	**The next item is about performing medical/health-related functions, which may be important to maintain or improve your health.** **Do you have any medical/health-related functions you usually perform or need to perform while seated in your wheelchair/scooter?** For example, wound care, using respiratory-related equipment or implanted medical device, administering medications or injections, or taking your temperature, blood pressure, oxygen, or sugar/glucose level. ☐ **Yes** ☐ **No** ☐ **Not applicable** **Do you carry/stow any medication or medical equipment/devices with you when using your wheelchair/scooter?** ☐ **Yes** ☐ **No** ☐ **Not applicable** **If yes, *describe what it is or what you do** *[Wait for response]*. **Now, show me how you perform this function, and/or retrieve, use, and stow your medicine/medical equipment-devices while seated in your wheelchair/scooter. Ready?** *[Wait for response]*

SCORE	INDEPENDENCE DATA	*SAFETY DATA*	*QUALITY DATA*
3	No assists given for task initiation, continuation, or completion	**SP** = Safe practices observed	**SM** = Acceptable (Standards met)
2	**VA** = No physical assists given, **but** ≤ 2 verbal assists or ≤ 2 visual assists; **or** ≤ 4 verbal and visual assists given	**MR** = Minor risks evident – no assistance provided	**IP** = Acceptable (Standards met – improvement possible)
1	**V^S^A** = ≤ 2 physical assists given, **but no** total assistance; or 3 verbal assists or 3 visual assists, **or** ≥ 5 verbal and visual assists given	**PH** = Risks to safety evident – assistance provided to prevent potential harm	**PM** = Marginal (Standards partially met)
0	**PA** = 3 physical assists given; **or** total assistance required for task initiation, continuation, or completion	**SR** = Severe risks evident – assistance provided to prevent harm	**NM** = Unacceptable (Standards not met)

	Based on the ***size, fit, postural support, and functional features*** *of the wheelchair/scooter:* **Mobility Device used during task:** ☐ Manual ☐ Power ☐ Scooter **Assistive Technology Devices (ATDs) used during task:** **1.** **2.** **Total # of ATDs used: ________**	**INDEPENDENCE DATA**			**SAFETY DATA**				**QUALITY DATA**				**SUMMARY SCORES**			**FEATURES**		
		Verbal Assist	Visual Assist	Physical Assist	Safe practices	Minor risk- no assist	Risk- potential harm	Severe risk- prevent harm	Standards met	SM, Improvement possible	Standards partially met	Standards not met	INDEPENDENCE	SAFETY	QUALITY	STABILITY	DURABILLITY	DEPENDABILITY
		VA	**$V^{S}A$**	**PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**						
Subtasks	**FEW–C Subtasks**																	
1. **Weight Shift**	Shifts or redistributes weight off sitting surface while seated in wheelchair/scooter adequately (achieves complete pressure distribution of sitting surface, able to maintain/hold position to achieve effective weight shift, does not lose balance) and efficiently (within 1 try, does not struggle)	**VA** **VA** **VA**	**$V^{S}A$** **$V^{S}A$** **$V^{S}A$**	**PA** **PA** **PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**	**3** **2** **1** **0**					
2. **Leg Elevation**	Elevates legs while seated in wheelchair/ scooter adequately (legs are elevated at appropriate height/level to meet health needs, does not lose balance, bump into or scrape body parts on surrounding surfaces) and efficiently (within 1 try, does not struggle)	**VA** **VA** **VA**	**$V^{S}A$** **$V^{S}A$** **$V^{S}A$**	**PA** **PA** **PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**	**3** **2** **1** **0**					
3. **MHR Function**	Demonstrates medical/health-related function(s) and/or retrieval, use, and stowing of medicine/ medical equipment-devices while seated in wheelchair/ scooter adequately (achieve desired health needs, carries out steps necessary to achieve health needs, does not lose balance) and efficiently (controlled manner, does not over-reach or drop items, no missing steps)	**VA** **VA** **VA**	**$V^{S}A$** **$V^{S}A$** **$V^{S}A$**	**PA** **PA** **PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**	**3** **2** **1** **0**					

1. **Weight Shift**	**Method and Feature(s) Used:** ______________________________
2. **Leg Elevation** ------------------ ☐ **Does elevate** ☐ **Does not elevate**	**If No or Not applicable, describe why:** ______________________________ **Method and Feature(s) Used:** ______________________________
3. **MHR Function**	**If yes, write description of what it is or method of how it is performed, and/or feature(s) used:** ______________________________

Task # 4: FEW–C : Operate Wheelchair/Scooter

Task Conditions: Clinic/laboratory area.
Consumer seated in wheelchair/scooter typically used to perform tasks, and positioned next to therapist.
*Prior to starting, therapist will identify an area that is 8 ft in length with a 90^{o} turn to the L or R and a 6 ft long path [all having a minimum of 36" width (e.g., a hallway with a turn; an unobstructed open clinic/laboratory space)] -- see Task #4 Diagram.

Instructions: "The next task is about how your wheelchair/scooter operates, meaning it does the things you want it to do, when and where you want it to do it.
I will ask you to perform common operations using your wheelchair/scooter, such as moving forward and backward.
I will provide you with instructions for each task. Please wait until I say ***READY*** before you begin a task". *[Wait for response]*

Task Instructions	
Common Operations: **1. Forward/ Reverse** **2. Turns** **3. Stops** **4. On/Off and Brakes**	**Starting from *this location, I want you to travel this route as outlined on the diagram. You can carry it with you, but I will provide step-by-step directions along the way.** **First, please position your wheelchair/scooter facing *this direction. [WAIT]** **Now, travel forward to that corner [*this point/location] and make a [*right turn or left turn]. Ready?** *[Wait for response]* **Continue traveling forward until you get to *this point/location and stop -- then without turning your wheelchair/scooter around, travel in reverse back to *here and stop [WAIT]. Now, turn off your wheelchair/scooter or lock your brakes.** **Turn your wheelchair/scooter back on, or unlock your brakes. [WAIT]** **Now, turning in *this direction [right turners = counter clockwise direction; left turners = clockwise direction], turn around and return to *where we started and then stop. Ready?** *[Wait for response]* **[WAIT]** **Location/Route/Feature(s) Used:** ____________________ ____________________ ____________________

SCORE	INDEPENDENCE DATA	*SAFETY DATA*	*QUALITY DATA*
3	No assists given for task initiation, continuation, or completion	**SP** = Safe practices observed	**SM** = Acceptable (Standards met)
2	**VA** = No physical assists given, **but** ≤ 2 verbal assists or ≤ 2 visual assists; **or** ≤ 4 verbal and visual assists given	**MR** = Minor risks evident – no assistance provided	**IP** = Acceptable (Standards met – improvement possible)
1	**V^{S}A** = ≤ 2 physical assists given, **but no** total assistance; or 3 verbal assists or 3 visual assists, **or** ≥ 5 verbal and visual assists given	**PH** = Risks to safety evident – assistance provided to prevent potential harm	**PM** = Marginal (Standards partially met)
0	**PA** = 3 physical assists given; **or** total assistance required for task initiation, continuation, or completion	**SR** = Severe risks evident – assistance provided to prevent harm	**NM** = Unacceptable (Standards not met)

	*Based on the **size, fit, postural support, and functional features** of the wheelchair/scooter:* **Mobility Device used during task:** ☐ Manual ☐ Power ☐ Scooter **Assistive Technology Devices (ATDs) used during task:** **1.** **2.** **Total # of ATDs used: ________**	**INDEPENDENCE DATA**			**SAFETY DATA**				**QUALITY DATA**				**SUMMARY SCORES**			**FEATURES**		
		Verbal Assist	Visual Assist	Physical Assist	Safe practices	Minor risk- no assist	Risk- potential harm	Severe risk- prevent harm	Standards met	SM, Improvement possible	Standards partially met	Standards not met	INDEPENDENCE	SAFETY	QUALITY	STABILITY	DURABILLITY	DEPENDABILITY
		VA	**V^{S}A**	**PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**						
Subtasks	**FEW–C Subtasks**																	
1. **Forward/ Reverse**	Moves wheelchair/scooter into position and in forward and reverse directions as indicated on course diagram adequately (does not bump into or scrape body parts on surrounding surfaces, maintains balance, maintains appropriate speed/propulsion for terrain) and efficiently (does not need to stop, back up, etc., straight trajectory, controlled manner)	**VA** **VA** **VA**	**V^{S}A** **V^{S}A** **V^{S}A**	**PA** **PA** **PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**	**3** **2** **1** **0**					
2. **Turns**	Moves wheelchair/scooter into position and demonstrates a right or left turn and a 180º turn adequately (does not bump into or scrape body parts on surrounding surfaces, maintains balance, maintains appropriate speed/ propulsion for terrain) and efficiently (does not need to stop, back up, etc., controlled manner)	**VA** **VA** **VA**	**V^{S}A** **V^{S}A** **V^{S}A**	**PA** **PA** **PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**	**3** **2** **1** **0**					
3. **Stops**	Brings wheelchair/scooter to stop position after traveling in forward/reverse directions as indicated by therapist adequately (does not travel beyond indicated stopping point, maintains balance) and efficiently (within 1 try, does not struggle, controlled manner)	**VA** **VA** **VA**	**V^{S}A** **V^{S}A** **V^{S}A**	**PA** **PA** **PA**	**SP**	**MR**	**RI**	**SR**	**SM**	**IP**	**PM**	**NM**	**3** **2** **1** **0**					
4. **On/Off and Brakes**	Turns wheelchair/scooter on and off or locks and unlocks brakes on wheelchair adequately (does not bump into or scrape body parts on surrounding surfaces, maintains balance, no unplanned movements) and efficiently (within 1 try, does not struggle, controlled manner)	**VA** **VA** **VA**	**V^{S}A** **V^{S}A** **V^{S}A**	**PA** **PA** **PA**	**SP**	**MR**	**RI**	**SR**	**SM**	**IP**	**PM**	**NM**	**3** **2** **1** **0**					

Task # 5: FEW–C : Reach and Carry Out Tasks at Different Surface Heights

Task Conditions: Clinic/laboratory area, table/counter/desk, and drawer/cupboard nearby.
Consumer seated in wheelchair/scooter typically used to perform task, and positioned next to therapist.
Common items in the clinic/ laboratory will be used for this task.
*Each item must not exceed a maximum weight of 2 pounds (e.g. bag of beans, stapler), and a maximum size of 12" x 12" inches (e.g. box of cereal, 3-ring binder).
Prior to starting, therapist will survey the area, and identify locations and items for each subtask.

Instructions: "Certain features of a wheelchair/scooter can be useful in allowing a person to reach items and carry out tasks at different surface heights. I will ask you to demonstrate these tasks. There are a total of three tasks and I will provide you with instructions before each one. Please wait until I say ***READY*** before you begin a task. If there are assistive devices you usually use when you reach for items, feel free to use them." *[Wait for response]*

Task Instructions & Therapist Task Guide	
1. **High** **↓** **Mid-Level**	**Please describe how you would retrieve _*__ from here** *[Point to item on surface above Ss shoulder height -- within Ss arm's length]* **and then place it here** *[Point to surface at Ss shoulder level -- directly below area where item was retrieved] [Wait for response].* **Now show me. Ready?** *[Wait for response]* **Item/Location/Feature(s) Used:** ____
2. **Mid-Level** **Side → Side**	**Please describe how you would retrieve the _*__ from here** *[Point to item far back in drawer/on countertop -- at Ss shoulder level]* **and then hand it to me** *[Wait for response].* **Now show me. Ready?** *[Therapist holds out hand, palm up, approximately arm's length away from Ss -- at the same height as the drawer/ countertop, but on opposite side Ss used to retrieve item]* **Item/Location/Feature(s) Used:** ____
3. **Deep** **Mid-Level** **↑** **Floor**	**Please describe how you would retrieve the _*__** *[Point to item on floor]* **and then place it here** *[Point to nearby counter/table surface at Ss shoulder level -- just beyond Ss arm length] [Wait for response].* **Now show me. Ready?** *[Wait for response]* **Item/Location/Feature(s) Used:** ____

SCORE	INDEPENDENCE DATA	SAFETY DATA	QUALITY DATA
3	No assists given for task initiation, continuation, or completion	**SP** = Safe practices observed	**SM** = Acceptable (Standards met)
2	**VA** = No physical assists given, **but** $\leq$ 2 verbal assists or $\leq$ 2 visual assists; **or** $\leq$ 4 verbal and visual assists given	**MR** = Minor risks evident – no assistance provided	**IP** = Acceptable (Standards met – improvement possible)
1	**V^{S}A** = $\leq$ 2 physical assists given, **but no** total assistance; or 3 verbal assists or 3 visual assists, **or** $\geq$ 5 verbal and visual assists given	**PH** = Risks to safety evident – assistance provided to prevent potential harm	**PM** = Marginal (Standards partially met)
0	**PA** = 3 physical assists given; **or** total assistance required for task initiation, continuation, or completion	**SR** = Severe risks evident – assistance provided to prevent harm	**NM** = Unacceptable (Standards not met)

	*Based on the **size, fit, postural support, and functional features** of the wheelchair/scooter:* **Mobility Device used during task:** ☐ Manual ☐ Power ☐ Scooter **Assistive Technology Devices (ATDs) used during task:** **1.** **2.** **Total # of ATDs used: ________**	**INDEPENDENCE DATA**			**SAFETY DATA**				**QUALITY DATA**				**SUMMARY SCORES**			**FEATURES**		
		Verbal Assist	Visual Assist	Physical Assist	Safe practices	Minor risk- no assist	Risk- potential harm	Severe risk- prevent harm	Standards met	SM, Improvement possible	Standards partially met	Standards not met	INDEPENDENCE	SAFETY	QUALITY	STABILITY	DURABILLITY	DEPENDABILITY
		VA	**V^{S}A**	**PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**						
Subtasks	**FEW–C Subtasks**																	
1. **High** ↓ **Mid-Level**	<u>Retrieves item from high surface and places it on mid-level surface</u> <u>adequately</u> (holds and places securely, does not over-reach) and <u>efficiently</u> (without dropping, within 1 try, does not struggle) -- Ss position during item retrieval **[CHECK ONE]:** ___ **Right side of Ss wheelchair/scooter closest to item** ___ **Left side** ___ **Front** **Draw line (→) for angle of item retrieval.**	**VA** **VA** **VA**	**V^{S}A** **V^{S}A** **V^{S}A**	**PA** **PA** **PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**	**3** **2** **1** **0**					
2. **Mid-Level** **S → S**	<u>Retrieves item from drawer/countertop and hands it to therapist</u> <u>adequately</u> (holds and places securely, does not over-reach) and <u>efficiently</u> (without dropping, within 1 try, does not struggle) -- Ss position during item retrieval **[CHECK ONE]:** ___ **Right side of Ss wheelchair/scooter closest to item** ___ **Left side** ___ **Front**  **Draw line (→) for angle of item retrieval.**	**VA** **VA** **VA**	**V^{S}A** **V^{S}A** **V^{S}A**	**PA** **PA** **PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**	**3** **2** **1** **0**					
3. **Deep Mid-Level** ↑ **Floor**	<u>Retrieves item from floor and places it deep on mid-level surface</u> <u>adequately</u> (holds and places securely, does not over-reach) and <u>efficiently</u> (without dropping, within 1 try, does not struggle) -- Ss position during item retrieval **[CHECK ONE]:** ___ **Right side of Ss wheelchair/scooter closest to item** ___ **Left side** ___ **Front**  **Draw line (→) for angle of item retrieval.**	**VA** **VA** **VA**	**V^{S}A** **V^{S}A** **V^{S}A**	**PA** **PA** **PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**	**3** **2** **1** **0**					

Task # 6: FEW–C : Transfers

Task Conditions: Clinic/laboratory area.
Consumer seated in wheelchair/scooter typically used to perform task, and positioned next to therapist.
Two transfer surfaces will be used for this task: **easy transfer = same level as consumer's seated surface* and ***complex transfer = 3" above or 3" below consumer's seated surface.*
Prior to starting, therapist will survey the area, and identify locations for each transfer surface.
[N.B. Adjustable height exam/mat tables can be used for both tasks]

Instructions: "This task involves transferring from your wheelchair/scooter to a same level surface and a high or low surface.
I will provide you with instructions for each transfer. Please wait until I say ***READY*** before you begin a task.
If there are assistive devices you usually use when you transfer, feel free to use them." *[Wait for response]*

	Task Instructions
1–2. ***easy**	**The first transfer is from your wheelchair/scooter to ___. Please describe how you would perform this transfer** *[Wait for response].* **Now, place your wheelchair/scooter in the position you would typically use for this transfer, and transfer from your wheelchair/scooter to ___. Ready?** *[Wait for response]* **[WAIT]. Now, transfer back to your wheelchair/scooter.** ***Transfer Surface/Location/Feature(s) Used: ______________________________** ______________________________
3–4. ******complex*** ☐ **3" above** ☐ **3" below**	**The next transfer is from your wheelchair/scooter to ___. Please describe how you would perform this transfer** *[Wait for response].* **Now, place your wheelchair/scooter in the position you would typically use for this transfer, and transfer from your wheelchair/scooter to ___. Ready?** *[Wait for response]* **[WAIT]. Now, transfer back to your wheelchair/scooter.** ****Transfer Surface/Location/Feature(s) Used: ______________________________** ______________________________

SCORE	*INDEPENDENCE DATA*	***SAFETY DATA***	***QUALITY DATA***
3	No assists given for task initiation, continuation, or completion	**SP** = Safe practices observed	**SM** = Acceptable (Standards met)
2	**VA** = No physical assists given, **but** $\leq$ 2 verbal assists or $\leq$ 2 visual assists; **or** $\leq$ 4 verbal and visual assists given	**MR** = Minor risks evident – no assistance provided	**IP** = Acceptable (Standards met improvement possible)
1	**V^{S}A** = $\leq$ 2 physical assists given, **but no** total assistance; or 3 verbal assists or 3 visual assists, **or** $\geq$ 5 verbal and visual assists given	**PH** = Risks to safety evident – assistance provided to prevent potential harm	**PM** = Marginal (Standards partially met)
0	**PA** = 3 physical assists given; **or** total assistance required for task initiation, continuation, or completion	**SR** = Severe risks evident – assistance provided to prevent harm	**NM** = Unacceptable (Standards not met)

	Based on the ***size, fit, postural support, and functional features*** of the wheelchair/scooter: **Mobility Device used during task:** ☐ Manual ☐ Power ☐ Scooter **Assistive Technology Devices (ATDs) used during task:** **1.** **2.** **Total # of ATDs used: ________**	**INDEPENDENCE DATA**			**SAFETY DATA**				**QUALITY DATA**				**SUMMARY SCORES**			**FEATURES**		
		Verbal Assist	Visual Assist	Physical Assist	Safe practices	Minor risk- no assist	Risk- potential harm	Severe risk- prevent harm	Standards met	SM, Improvement possible	Standards partially met	Standards not met	INDEPENDENCE	SAFETY	QUALITY	STABILITY	DURABILLITY	DEPENDABILITY
		VA	**V^SA**	**PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**						
Subtasks	**FEW–C Subtasks**																	
1. ***easy***	Positions wheelchair/scooter adequately (secures wheelchair/scooter for transfer) and with ease (does not struggle, within 1 try, controlled manner) and transfers from wheelchair/scooter to identified surface adequately (does not bump into or scrape body parts on surrounding surfaces, does not plop down onto surface) and efficiently (does not struggle, within 1 try, controlled manner, no unplanned stops)	**VA** **VA** **VA**	**V^SA** **V^SA** **V^SA**	**PA** **PA** **PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**	**3** **2** **1** **0**					
2. ***easy***	Repositions wheelchair/scooter (as needed) with ease (does not struggle, within 1 try, controlled manner) and transfers from identified surface to wheelchair/scooter adequately (does not bump into or scrape body parts on surrounding surfaces, does not plop down onto surface) and efficiently (does not struggle, within 1 try, controlled manner, no unplanned stops)	**VA** **VA** **VA**	**V^SA** **V^SA** **V^SA**	**PA** **PA** **PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**	**3** **2** **1** **0**					
3. *****complex*** ☐ **3" above** ☐ **3" below**	Positions wheelchair/scooter adequately (secures wheelchair/scooter for transfer) and with ease (does not struggle, within 1 try, controlled manner) and transfers from wheelchair/scooter to identified surface adequately (does not bump into or scrape body parts on surrounding surfaces, does not plop down onto surface) and efficiently (does not struggle, within 1 try, controlled manner, no unplanned stops)	**VA** **VA** **VA**	**V^SA** **V^SA** **V^SA**	**PA** **PA** **PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**	**3** **2** **1** **0**					
4. *****complex***	Repositions wheelchair/scooter (as needed) with ease (does not struggle, within 1 try, controlled manner) and transfers from identified surface to wheelchair/scooter adequately (does not bump into or scrape body parts on surrounding surfaces, does not plop down onto surface) and efficiently (does not struggle, within 1 try, controlled manner, no unplanned stops)	**VA** **VA** **VA**	**V^SA** **V^SA** **V^SA**	**PA** **PA** **PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**	**3** **2** **1** **0**					

Task # 7: FEW–C : Personal Care Tasks

Task Conditions:	Clinic/laboratory area, sink nearby. Consumer seated in wheelchair/scooter typically used to perform tasks, and positioned next to therapist. Shirt/coat/jacket (open front or pull-over) will be available for consumer use or consumer can use own clothing. The hand washing items available in the clinic/laboratory area will be used, but therapist will also have items available for consumer use.
Instructions:	"As a wheelchair/scooter user, you may perform certain personal care tasks while seated in your wheelchair/scooter. We have selected upper body dressing and hand washing as two common personal care tasks. I will provide you with instructions for each task. Please wait until I say ***READY*** before you begin a task. If there are assistive devices you usually use when performing these personal care tasks, feel free to use them". *[Wait for response]*

	Task Instructions
1a–b. **Upper Body Dressing**	**First, I would like to see you put on a shirt/coat/jacket. You can use your own, or we have one that you can use** *[Wait for response].* **Please describe how you would put on this shirt/coat/jacket** *[Wait for response].* *[Therapist hands consumer a shirt/coat/jacket if necessary]* **Now, put it on and [zip, button, or fasten it] the way you would typically wear it. Ready?** *[Wait for response]* **[WAIT] Now take it off.** ☐ **Shirt/coat/jacket provided by therapist** ☐ **Type of shirt/coat/jacket:** ________________ **Location/Feature(s) Used:** ________________
2. **Personal Hygiene**	**The next task involves personal hygiene. Please follow me to the sink.** **Describe how you would wash your hands with soap, and then rinse and dry your hands** *[Wait for response].* **Now, show me how you do it. Ready?** *[Wait for response]* ☐ **Hygiene products provided by therapist** **Location/Feature(s) Used:** ________________

SCORE	INDEPENDENCE DATA	***SAFETY DATA***	***QUALITY DATA***
3	No assists given for task initiation, continuation, or completion	**SP** = Safe practices observed	**SM** = Acceptable (Standards met)
2	**VA** = No physical assists given, **but** $\leq$ 2 verbal assists or $\leq$ 2 visual assists; **or** $\leq$ 4 verbal and visual assists given	**MR** = Minor risks evident – no assistance provided	**IP** = Acceptable (Standards met – improvement possible)
1	**V^{S}A** = $\leq$ 2 physical assists given, **but no** total assistance; or 3 verbal assists or 3 visual assists, **or** $\geq$ 5 verbal and visual assists given	**PH** = Risks to safety evident – assistance provided to prevent potential harm	**PM** = Marginal (Standards partially met)
0	**PA** = 3 physical assists given; **or** total assistance required for task initiation, continuation, or completion	**SR** = Severe risks evident – assistance provided to prevent harm	**NM** = Unacceptable (Standards not met)

	*Based on the **size, fit, postural support, and functional features** of the wheelchair/scooter:* **Mobility Device used during task:** ☐ Manual ☐ Power ☐ Scooter **Assistive Technology Devices (ATDs) used during task:** **1.** **2.** **Total # of ATDs used: ________**	**INDEPENDENCE DATA**			**SAFETY DATA**				**QUALITY DATA**				**SUMMARY SCORES**			**FEATURES**		
		Verbal Assist	Visual Assist	Physical Assist	Safe practices	Minor risk- no assist	Risk- potential harm	Severe risk- prevent harm	Standards met	SM, Improvement possible	Standards partially met	Standards not met	INDEPENDENCE	SAFETY	QUALITY	STABILITY	DURABILLITY	DEPENDABILITY
		VA	**V^{S}A**	**PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**						
Subtasks	**FEW–C Subtasks**																	
1a. **Upper Body Dressing**	Donns shirt/coat/jacket while seated in wheelchair/ scooter adequately (maintains balance) and efficiently (does not struggle, controlled manner)	**VA** **VA** **VA**	**V^{S}A** **V^{S}A** **V^{S}A**	**PA** **PA** **PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**	**3** **2** **1** **0**					
1b. **Upper Body Dressing**	Doffs shirt/coat/jacket while seated in wheelchair/ scooter adequately (maintains balance) and efficiently (does not struggle, controlled manner)	**VA** **VA** **VA**	**V^{S}A** **V^{S}A** **V^{S}A**	**PA** **PA** **PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**	**3** **2** **1** **0**					
2. **Personal Hygiene**	Positions wheelchair/scooter and retrieves and applies soap to hands, rinses hands with water, and dries hands while seated in wheelchair/ scooter adequately (reaches all items, does not spill on self/floor, does not bump into or scrape body parts on surrounding surfaces, maintains balance) and efficiently (does not drop items, does not struggle, controlled manner)	**VA** **VA** **VA**	**V^{S}A** **V^{S}A** **V^{S}A**	**PA** **PA** **PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**	**3** **2** **1** **0**					

Task # 8: FEW–C : Indoor Mobility

Task Conditions: Clinic/laboratory area.
Consumer seated in wheelchair/scooter typically used to perform task, and positioned next to therapist.
*Prior to starting, therapist will survey the area, and identify locations for each subtask -- including carpeted and non-carpeted surfaces large enough to make a 90° turn (minimum), and a doorway wide enough to accommodate a wheelchair -- and a door equipped with a lever handle or knob.

Instructions: "The next task involves showing me how you get around within an indoor environment while seated in your wheelchair/scooter.
I will provide you with instructions before each task. Please wait until I say ***READY*** before you begin a task.
If there are assistive devices you usually use for indoor mobility, feel free to use them". *[Wait for response]*

Use provided form for additional space	**Task Instructions**
1. ****Carpeted Surface**	**First, starting from here travel in *this direction, make a turn at *this point/location, and then open and go through *that door and close it behind you. Ready?** *[Wait for response]* **[WAIT]** **Now, open the door, come out, and close the door behind you. Ready?** *[Wait for response]* **[WAIT]. Then return to *where you started following the same course and then stop.** **Location/Route/Door/Feature(s) Used:** ________________________________ ________________________________
2. ****Non-Carpeted Surface**	**Next, we will move onto a non-carpeted surface.** **First, starting from here travel in *this direction, make a turn at *this point/location, and then open and go through *that door and close it behind you. Ready?** *[Wait for response]* **[WAIT]** **Now, open the door, come out, and close the door behind you. Ready?** *[Wait for response]* **[WAIT]. Then return to *where you started following the same course and then stop.** **Location/Route/Door/Feature(s) Used:** ________________________________ ________________________________

SCORE	INDEPENDENCE DATA	***SAFETY DATA***	***QUALITY DATA***
3	No assists given for task initiation, continuation, or completion	**SP** = Safe practices observed	**SM** = Acceptable (Standards met)
2	**VA** = No physical assists given, **but** ≤ 2 verbal assists or ≤ 2 visual assists; **or** ≤ 4 verbal and visual assists given	**MR** = Minor risks evident – no assistance provided	**IP** = Acceptable (Standards met – improvement possible)
1	**V^{S}A** = ≤ 2 physical assists given, **but no** total assistance; or 3 verbal assists or 3 visual assists, **or** ≥ 5 verbal and visual assists given	**PH** = Risks to safety evident – assistance provided to prevent potential harm	**PM** = Marginal (Standards partially met)
0	**PA** = 3 physical assists given; **or** total assistance required for task initiation, continuation, or completion	**SR** = Severe risks evident – assistance provided to prevent harm	**NM** = Unacceptable (Standards not met)

Based on the ***size, fit, postural support, and functional features*** *of the wheelchair/scooter:*

Mobility Device used during task:

☐ Manual ☐ Power ☐ Scooter

Assistive Technology Devices (ATDs) used during task:
1.
2.

Total # of ATDs used: ________

		INDEPENDENCE DATA			SAFETY DATA				QUALITY DATA				SUMMARY SCORES			FEATURES		
		Verbal Assist	Visual Assist	Physical Assist	Safe practices	Minor risk- no assist	Risk- potential harm	Severe risk- prevent harm	Standards met	SM, Improvement possible	Standards partially met	Standards not met	INDEPENDENCE	SAFETY	QUALITY	STABILITY	DURABILITY	DEPENDABILITY
		VA	V^SA	PA	SP	MR	PH	SR	SM	IP	PM	NM						
Subtasks	**FEW–C Subtasks**																	
1. **Carpeted Surface**	Travels from and returns to starting location following course identified by therapist adequately (maintains appropriate speed/propulsion for terrain, does not bump into or scrape body parts on surrounding surfaces, maintains balance, avoids obstacles) and efficiently (does not need to stop, back up, etc., controlled manner)	**VA** **VA** **VA**	**V^SA** **V^SA** **V^SA**	**PA** **PA** **PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**	**3** **2** **1** **0**					
2. **Non-Carpeted Surface**	Travels from and returns to starting location following course identified by therapist adequately (maintains appropriate speed/propulsion for terrain, does not bump into or scrape body parts on surrounding surfaces, maintains balance, avoids obstacles) and efficiently (does not need to stop, back up, etc., controlled manner)	**VA** **VA** **VA**	**V^SA** **V^SA** **V^SA**	**PA** **PA** **PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**	**3** **2** **1** **0**					
****3.** **Open/Close Door**	Opens and closes door adequately (does not scrape body parts on surrounding surfaces, no damage/harm to wheelchair/scooter or surrounding surfaces, maintains balance) and efficiently (does not need to stop, back up, etc., within 1 try, controlled manner)	**VA** **VA** **VA**	**V^SA** **V^SA** **V^SA**	**PA** **PA** **PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**	**3** **2** **1** **0**					
****4.** **Enter/Exit Door**	Enters and exits door adequately (does not scrape body parts on surrounding surfaces, no damage/harm to wheelchair/scooter or surrounding surfaces, maintains balance) and efficiently (does not need to stop, back up, etc., within 1 try, controlled manner)	**VA** **VA** **VA**	**V^SA** **V^SA** **V^SA**	**PA** **PA** **PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**	**3** **2** **1** **0**					

Additional Space for Location/Route/Door/Feature(s) Used **Description:**

1. **Carpeted Surface	
2. **Non-Carpeted Surface	

Task # 9: FEW–C : Outdoor Mobility

Task Conditions: Outdoor clinic/laboratory area.
Consumer seated in wheelchair/scooter typically used to perform task, and positioned next to therapist.
*Prior to starting, therapist will have identified a 3 block (1/4 mile) route that includes flat easy terrain, an inclined terrain, curb cuts/sidewalks, and flat difficult (uneven) terrain.

Instructions: "The next task involves showing me how you get around outside while seated in your wheelchair/scooter.
I will provide you with instructions before each task. Please wait until I say ***READY*** before you begin a task.
If there are assistive devices you usually use for outdoor mobility, feel free to use them". *[Wait for response]*

1. **Flat Easy Terrain**	**First, I want to see how you get around on a flat surface. Starting from here travel to *this point/location, and then turn around and return to where you started. Ready?** *[Wait for response]* **Location/Terrain/Feature(s) Used:** ____________________
2. **Inclined Easy Terrain**	**Now, show me how you move on an inclined surface (e.g., ADA compliant ramp -- 1:12 ratio -- at least 6 feet long). Starting from here travel to *this point/location, and then turn around and return to where you started. Ready?** *[Wait for response]* **Location/Terrain/Feature(s) Used:** ____________________
3. **Curb Cut/ Sidewalk/ Terrain Transition**	**Next, I would like to see how you negotiate a curb cut or sidewalk. Starting from here, please go down *this curb cut/sidewalk, and then turn around and come back up the curb cut/sidewalk. Ready?** *[Wait for response]* **Location/Terrain/Feature(s) Used:** ____________________ ☐ **Curb Cut** ☐ **Sidewalk** ☐ **Terrain Transition (e.g., even to uneven ground, grass to sidewalk)**
4. **Flat Difficult Terrain**	**The final task involves getting around on more complex terrain, such as grass, dirt, gravel, uneven sidewalk, or snow/ice lumps. Starting from here, travel to *this point/location, and then turn around and return to where you started. Ready?** *[Wait for response]* **Location/Terrain/Feature(s) Used:** ____________________

SCORE	INDEPENDENCE DATA	***SAFETY DATA***	***QUALITY DATA***
3	No assists given for task initiation, continuation, or completion	**SP** = Safe practices observed	**SM** = Acceptable (Standards met)
2	**VA** = No physical assists given, **but** ≤ 2 verbal assists or ≤ 2 visual assists; **or** ≤ 4 verbal and visual assists given	**MR** = Minor risks evident – no assistance provided	**IP** = Acceptable (Standards met – improvement possible)
1	**V^{S}A** = ≤ 2 physical assists given, **but no** total assistance; or 3 verbal assists or 3 visual assists, **or** ≥ 5 verbal and visual assists given	**PH** = Risks to safety evident – assistance provided to prevent potential harm	**PM** = Marginal (Standards partially met)
0	**PA** = 3 physical assists given; **or** total assistance required for task initiation, continuation, or completion	**SR** = Severe risks evident – assistance provided to prevent harm	**NM** = Unacceptable (Standards not met)

Based on the ***size, fit, postural support, and functional features*** *of the wheelchair/scooter:*

Mobility Device used during task:

☐ Manual ☐ Power ☐ Scooter

Assistive Technology Devices (ATDs) used during task:
1.
2.

Total # of ATDs used: ________

		INDEPENDENCE DATA			SAFETY DATA				QUALITY DATA				SUMMARY SCORES			FEATURES		
		Verbal Assist	Visual Assist	Physical Assist	Safe practices	Minor risk- no assist	Risk- potential harm	Severe risk- prevent harm	Standards met	SM, Improvement possible	Standards partially met	Standards not met	INDEPENDENCE	SAFETY	QUALITY	STABILITY	DURABILLITY	DEPENDABILITY
		VA	**$V^{S}A$**	**PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**						
Subtasks	**FEW–C Subtasks**																	
1. **Flat Easy Terrain**	<u>Travels to location identified by therapist, turns around, and returns to starting location adequately</u> (maintains appropriate speed/ propulsion for terrain, does not bump into surrounding surfaces, maintains balance, avoids obstacles) and <u>efficiently</u> (does not need to stop, back up, etc., straight trajectory)	**VA** **VA** **VA**	**$V^{S}A$** **$V^{S}A$** **$V^{S}A$**	**PA** **PA** **PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**	**3** **2** **1** **0**					
2. **Inclined Easy Terrain**	<u>Travels to location identified by therapist, turns around, and returns to starting location adequately</u> (maintains appropriate speed/ propulsion for terrain, does not bump into surrounding surfaces, maintains balance, avoids obstacles) and <u>efficiently</u> (does not need to stop, back up, etc., straight trajectory)	**VA** **VA** **VA**	**$V^{S}A$** **$V^{S}A$** **$V^{S}A$**	**PA** **PA** **PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**	**3** **2** **1** **0**					
3. ☐ Curb Cut ☐ Sidewalk ☐ Terrain Transition	<u>Negotiates up and down curb cut/sidewalk</u> or <u>over terrain transition</u> <u>adequately</u> (uses enough speed/propulsion, does not bump into surrounding surfaces, maintains balance, avoids obstacles) and <u>efficiently</u> (does not need to stop, back up, etc., straight trajectory, controlled manner, within 1 try)	**VA** **VA** **VA**	**$V^{S}A$** **$V^{S}A$** **$V^{S}A$**	**PA** **PA** **PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**	**3** **2** **1** **0**					
4. **Flat Difficult Terrain**	<u>Travels to location identified by therapist and returns to starting location</u> <u>adequately</u> (maintains appropriate speed/propulsion for terrain, does not bump into surrounding surfaces or get stopped/stuck by terrain, maintains balance, avoids obstacles) and <u>efficiently</u> (does not struggle excessively, controlled manner)	**VA** **VA** **VA**	**$V^{S}A$** **$V^{S}A$** **$V^{S}A$**	**PA** **PA** **PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**	**3** **2** **1** **0**					

Additional Space for Location/Terrain:

1. **Flat Easy Terrain**	
2. **Inclined Easy Terrain**	
3. **Curb Cut/ Sidewalk/ Terrain Transition**	
4. **Flat Difficult Terrain**	

Task # 10: FEW–C : Personal/Public Transportation

Task Conditions: Begin in clinic/laboratory area.
Consumer seated in wheelchair/scooter typically used to perform task, and positioned next to therapist.

Instructions: "Next is transportation. I want you to show me how you access personal and/or public transportation, and transport your wheelchair/scooter.
I will provide you with instructions before each task. Please wait until I say ***READY*** before you begin a task.
If there are assistive devices you usually use for riding personal/public transportation and transporting your wheelchair/scooter, feel free to use them". *[Wait for response]*

1a–c. **Personal Transportation (trans.)** ☐ Yes ☐ No	**First, take me to the vehicle you use for personal transportation. [WAIT]** **Please describe how you use this vehicle for personal transportation (i.e., enter/exit and secure/unsecure self and wheelchair/scooter)** *[Wait for response]* **Show me how you and your wheelchair/scooter get in the vehicle, and then how you secure yourself and your wheelchair/scooter for transportation. Ready?** *[Wait for response]* **[WAIT]** **Now, show me how you and your wheelchair/scooter get out of the vehicle. Ready?** *[Wait for response]* **Location/Vehicle & Wheelchair/Scooter Feature(s) Used:** ____________
2a–c. **Public Transportation** ☐ Yes ☐ No	**Next, take me [follow me] to where you would catch a bus/van, or meet a public transportation vehicle. [WAIT]** **Please describe how you typically use a public transportation vehicle (i.e., enter/exit and secure/unsecure self and wheelchair/scooter)** *[Wait for response]* **When the bus/van arrives, show me how you get on the bus/van, and how you usually secure yourself and your wheelchair/scooter while riding the bus/van. Ready?** *[Wait for response]* **[WAIT]** *[N.B. ACCESS -- ask the driver to allow the consumer to show how s/he boards/secures/unsecures/exits the van. [N.B. BUS -- board the bus first and ask the driver to assist by going only 2 stops before disembarking -- or -- pay the fare and go 2 stops and disembark].* **Now, show me how you exit the bus/van in your wheelchair/scooter. Ready?** *[Wait for response]*____________

SCORE	INDEPENDENCE DATA	SAFETY DATA	QUALITY DATA
3	No assists given for task initiation, continuation, or completion	**SP** = Safe practices observed	**SM** = Acceptable (Standards met)
2	**VA** = No physical assists given, **but** ≤ 2 verbal assists or ≤ 2 visual assists; **or** ≤ 4 verbal and visual assists given	**MR** = Minor risks evident – no assistance provided	**IP** = Acceptable (standards met improvement possible)
1	$\mathbf{V^SA}$ = ≤ 2 physical assists given, **but no** total assistance; or 3 verbal assists or 3 visual assists, **or** ≥ 5 verbal and visual assists given	**PH** = Risks to safety evident – assistance provided to prevent potential harm	**PM** = Marginal (Standards partially met)
0	**PA** = 3 physical assists given; **or** total assistance required for task initiation, continuation, or completion	**SR** = Severe risks evident – assistance provided to prevent harm	**NM** = Unacceptable (Standards not met)

	Based on the ***size, fit, postural support, and functional features*** *of the wheelchair/scooter:* **Mobility Device used during task:** ☐ Manual ☐ Power ☐ Scooter **Assistive Technology Devices (ATDs) used during task:** **1.** **2.** **Total # of ATDs used: ________**	**INDEPENDENCE DATA**			**SAFETY DATA**				**QUALITY DATA**				**SUMMARY SCORES**			**FEATURES**		
		Verbal Assist	Visual Assist	Physical Assist	Safe practices	Minor risk- no assist	Risk- potential harm	Severe risk- prevent harm	Standards met	SM, Improvement possible	Standards partially met	Standards not met	INDEPENDENCE	SAFETY	QUALITY	STABILITY	DURABILLITY	DEPENDABILITY
		VA	**V^SA**	**PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**						
Subtasks	**FEW–C Subtasks**																	
1a. **Personal Trans.** ☐**Y** ☐**N**	(Instructs another) Moves self and wheelchair/scooter into position and enters vehicle adequately (does not bump into or scrape body parts on surrounding surfaces, maintains balance/wheel contact with surface) and efficiently (does not struggle, controlled manner)	**VA** **VA** **VA**	**V^SA** **V^SA** **V^SA**	**PA** **PA** **PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**	**3** **2** **1** **0**					
1b. **Personal Trans.**	(Instructs another) Moves into position and secures self and wheelchair/scooter in vehicle adequately (does not bump into or scrape body parts on surrounding surfaces, maintains balance/wheel contact with surface) and efficiently (does not struggle, controlled manner)	**VA** **VA** **VA**	**V^SA** **V^SA** **V^SA**	**PA** **PA** **PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**	**3** **2** **1** **0**					
1c. **Personal Trans.**	(Instructs another) Unsecures self and wheelchair/ scooter, moves into position and exits vehicle adequately (does not bump into or scrape body parts on surrounding surfaces, maintains balance/wheel contact with surface) and efficiently (does not struggle, controlled manner)	**VA** **VA** **VA**	**V^SA** **V^SA** **V^SA**	**PA** **PA** **PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**	**3** **2** **1** **0**					
2a. **Public Trans.** ☐**Y** ☐**N**	(Instructs another) Moves self and wheelchair/scooter into position and enters bus/van adequately (does not bump into or scrape body parts on surrounding surfaces, maintains balance/wheel contact with surface) and efficiently (does not struggle, controlled manner)	**VA** **VA** **VA**	**V^SA** **V^SA** **V^SA**	**PA** **PA** **PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**	**3** **2** **1** **0**					
2b. **Public Trans.**	(Instructs another) Moves into position and secures self and wheelchair/scooter in bus/van adequately (does not bump into or scrape body parts on surrounding surfaces, maintains balance/wheel contact with surface) and efficiently (does not struggle, controlled manner)	**VA** **VA** **VA**	**V^SA** **V^SA** **V^SA**	**PA** **PA** **PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**	**3** **2** **1** **0**					
2c. **Public Trans.**	(Instructs another) Unsecures self and wheelchair/ scooter, moves into position and exits bus/van adequately (does not bump into or scrape body parts on surrounding surfaces, maintains balance/wheel contact with surface) and efficiently (does not struggle, controlled manner)	**VA** **VA** **VA**	**V^SA** **V^SA** **V^SA**	**PA** **PA** **PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**	**3** **2** **1** **0**					

3. **Personal Transportation**	**(a) Using this chart, in a typical week, how often do you drive or are driven in a personal transportation vehicle, while either seated in your wheelchair/scooter or a passenger seat?** ____ **0** ____ **1 – 3** ____ **4 – 6** ____ **7 – 9** ____ **10 – 12** ____ **≥ 13** **(b) Does your wheelchair/scooter have secure attachment points for tie-down restraints?** ☐ **Yes** ☐ **No** ☐ **Not applicable** **(c) What type of vehicle do you typically drive or are driven in while either seated in your wheelchair/scooter or a passenger seat?** ____ **Modified vehicle with lift or ramp** ____ **Modified vehicle with lift or ramp, and adaptive driving technology** ____ **Modified vehicle with external stowing device (e.g., rooftop, under chaise, rear platform attachment)** ____ **Non-modified vehicle** ____ **Other: ____________________** **(d) Using this chart, based on the vehicle you typically use (same as 3c.), how much assistance do you need for you and your wheelchair/scooter to:** **Enter the vehicle 5 4 3 2 1 N/A** **Be secured in the vehicle 5 4 3 2 1 N/A** **Be unsecured in the vehicle 5 4 3 2 1 N/A** **Exit the vehicle 5 4 3 2 1 N/A** **(e) Using this chart, based only on the features of your wheelchair/scooter, not the vehicle, how safe do you feel while driving or being driven in this vehicle while seated in your wheelchair/scooter for each of the following tasks:** **Entering the vehicle 6 5 4 3 2 1 N/A** **Being secured in the vehicle 6 5 4 3 2 1 N/A** **Being unsecured in the vehicle 6 5 4 3 2 1 N/A** **Exiting the vehicle 6 5 4 3 2 1 N/A**	**Using this table** *[Hand personal transportation item sheet to consumer -- point to respective tables on sheet for items 3a, d–f]* **(f) How often do you drive or are driven in a personal transportation vehicle** *[Indicate by marking provided space]* **(g) Does wheelchair/scooter have secure attachment points for tie-down restraints** *[Mark 'Yes', 'No', or 'Not applicable']* **(h) Type of vehicle typically driven or driven in** *[Indicate by marking provided space(s) -- if vehicle is not listed, write consumer response for 'Other' in provided space]* **(i) How much assistance do you need for you and your wheelchair/scooter** *[Circle consumer response]* **(j) How safe do you feel while driving or being driven in this vehicle** *[Circle consumer response]* **(k) How satisfied are you with your performance** *[Circle consumer response]*

	(f) Using this chart, based only on the features of your wheelchair/scooter, not the vehicle, how satisfied are you, even if you receive help, with how you perform the following tasks with your wheelchair/scooter: Entering the vehicle 6 5 4 3 2 1 N/A Being secured in the vehicle 6 5 4 3 2 1 N/A Being unsecured in the vehicle 6 5 4 3 2 1 N/A Exiting the vehicle 6 5 4 3 2 1 N/A	
Task Instructions & Therapist Task Guide		
4. **Public Transportation**	**(a) Using this chart, in a typical week, how often do you use a public transportation vehicle, excluding a disability accessible van/bus/car (e.g., ACCESS), while either seated in your wheelchair/scooter or a passenger seat?** ____ 0 ____ 1 – 3 ____ 4 – 6 ____ 7 – 9 ____ 10 – 12 ____ ≥ 13 **(b) Using this chart, how much assistance do you need for you and your wheelchair/ scooter to:** Enter the vehicle 5 4 3 2 1 N/A Be secured in the vehicle 5 4 3 2 1 N/A Be unsecured in the vehicle 5 4 3 2 1 N/A Exit the vehicle 5 4 3 2 1 N/A **(c) Using this chart, based only on the features of your wheelchair/scooter, not the vehicle, how safe do you feel while riding in a public trans. vehicle seated in your wheelchair/scooter for each of the following tasks:** Entering the vehicle 6 5 4 3 2 1 N/A Being secured in the vehicle 6 5 4 3 2 1 N/A Being unsecured in the vehicle 6 5 4 3 2 1 N/A	**Using this table** *[Hand public transportation item sheet to consumer -- point to respective tables on sheet for items 4a–d]* **(a) How often do you use a public transportation vehicle** *[Indicate by marking provided space]* **(b) How much assistance do you need for you and your wheelchair/scooter** *[Circle consumer response]* **(c) How safe do you feel while riding a public transportation vehicle** *[Circle consumer response]* **(d) How satisfied are you with your performance** *[Circle consumer response]*

	Exiting the vehicle 6 5 4 3 2 1 N/A (d) Using this chart, based only on the features of your wheelchair/scooter, not the vehicle, how satisfied are you, even if you receive help, with how you perform the following tasks with your wheelchair/scooter on a public trans. vehicle: Entering the vehicle 6 5 4 3 2 1 N/A Being secured in the vehicle 6 5 4 3 2 1 N/A Being unsecured in the vehicle 6 5 4 3 2 1 N/A Exiting the vehicle 6 5 4 3 2 1 N/A	

Additional Space for Location and Vehicle and Wheelchair/Scooter Feature(s) Used:

1. **Personal Trans. 1a–c.**	
2.	

Public Trans. 2a–c.	

(3a.) In a typical week, how often do you drive or are driven in a personal transportation vehicle, while either seated in your wheelchair/scooter or a passenger seat?

0 times	1 – 3 times	4 – 6 times	7 – 9 times	10 – 12 times	≥ 13 times

---

(3d.) Based on the vehicle you typically use, how much assistance do you need for you and your wheelchair/scooter to:

Enter the vehicle

Be secured in the vehicle

Be unsecured in the vehicle

Exit the vehicle

5	4	3	2	1
Independent/No assistance or supervision	**Supervision/ Verbal Assists**	**Minimal Physical Assistance**	**Moderate Physical Assistance**	**Total Assist/ Dependent**

(3e.) Based only on the features of your wheelchair/scooter, not the vehicle, how safe do you feel while driving or being driven in this vehicle while seated in your wheelchair/scooter for each of the following tasks:

Entering the vehicle

Being secured in the vehicle

Being unsecured in the vehicle

Exiting the vehicle

6	5	5	3	2	1
Completely Safe	**Mostly Safe**	**Slightly Safe**	**Slightly Unsafe**	**Mostly Unsafe**	**Completely Unsafe**

(3f.) Based only on the features of your wheelchair/scooter, not the vehicle, how satisfied are you, even if you receive help, with how you perform the following tasks with your wheelchair/scooter:

6	5	5	3	2	1
Completely Satisfied	**Mostly Satisfied**	**Slightly Satisfied**	**Slightly Unsatisfied**	**Mostly Unsatisfied**	**Completely Unsatisfied**

(4a.) In a typical week, how often do you how often do you ride in a public transportation vehicle, excluding a disability accessible van/bus/car (e.g., ACCESS), while either seated in your wheelchair/scooter or a passenger seat?

0 times	**1 – 3 times**	**4 – 6 times**	**7 – 9 times**	**10 – 12 times**	**≥ 13 times**

(4b.) How much assistance do you need for you and your wheelchair/scooter to:

Enter the vehicle

Be secured in the vehicle

Be unsecured in the vehicle

Exit the vehicle

5	4	3	2	1
Independent/No assistance or supervision	**Supervision/ Verbal Assists**	**Minimal Physical Assistance**	**Moderate Physical Assistance**	**Total Assist/ Dependent**

(4c.) Based only on the features of your wheelchair/scooter, not the vehicle, how safe do you feel while riding in a public trans. vehicle
seated in your wheelchair/scooter for each of the following tasks:

Entering the vehicle

Being secured in the vehicle

Being unsecured in the vehicle

Exiting the vehicle

6	5	5	3	2	1
Completely Safe	**Mostly Safe**	**Slightly Safe**	**Slightly Unsafe**	**Mostly Unsafe**	**Completely Unsafe**

(4d.) Based only on the features of your wheelchair/scooter, not the vehicle, how satisfied are you, even if you receive help, with how you perform the following tasks with your wheelchair/scooter on a public trans. vehicle:

6	5	5	3	2	1
Completely Satisfied	**Mostly Satisfied**	**Slightly Satisfied**	**Slightly Unsatisfied**	**Mostly Unsatisfied**	**Completely Unsatisfied**

APPENDIX C: Telerehabilitation Questionnaire

Participant's ID #:____

Evaluation Date:______/______/______

Wheelchair Clinic:____

Evaluation questions to be answered by the participant to determine satisfaction with the teleconferencing assessment. Please circle the number 1-6 whether you strongly disagree to strongly agree.

Question 1: I was comfortable being evaluated through this means?

1 2 3 4 5 6

Strongly Disagree Strongly Agree

Additional Comments:

____

____

____

Question 2: The results of the evaluation through the tele-video conference would be as accurate as an evaluation being completed in-person by a certified practitioner?

1 2 3 4 5 6

Strongly Disagree Strongly Agree

Additional Comments:

____

____

____

Question 3: All areas of your lifestyle were considered with this process?

1 2 3 4 5 6

Strongly Disagree Strongly Agree

Additional Comments:

Question 4: The technology did not interfere with the assessment?

1 2 3 4 5 6

Strongly Disagree Strongly Agree

Additional Comments:

Question 5: The quality and clarity of the video and audio was acceptable?

1 2 3 4 5 6

Strongly Disagree Strongly Agree

Additional Comments:

Question 6: Consulting with an expert clinician through tele-video conferencing saved you monetary expenses (i.e. travel time, gas, taking off of work, family, etc..)

1 2 3 4 5 6

Strongly Disagree Strongly Agree

Additional Comments:

____

____

____

Question 7: Would you be willing to use this tele-video evaluation process again?

1 2 3 4 5 6

Strongly Disagree Strongly Agree

Additional Comments:

____

____

____

RERC on Telerehabilitation Use Only: TR Assessment #:________________

APPENDIX D: Demographic Data Form – Pre

Subject #: ______

DEMOGRAPHIC DATA FORM–PRE

ge: ______________________________

Gender: ______________________________

Race: ______________________________

Primary Diagnosis: ____

☐ Manual wheelchair user
 ☐ Primary
 ☐ Secondary

☐ Power wheelchair user
 ☐ Primary
 ☐ Secondary

☐ Scooter user
 ☐ Primary
 ☐ Secondary

________ How long have you been a wheelchair/scooter user?

________ How old is your current wheelchair/scooter?

________ How old is your current seating system (seat cushion and back support)?

________ How many wheelchairs or personal mobility devices do you have now?

Please describe: ____

____

How satisfied were you with your evaluation and prescription process for your current wheelchair/scooter?

_____ Very satisfied

_____ Satisfied

_____ Neither satisfied nor dissatisfied

_____ Dissatisfied

_____ Very dissatisfied

Subject #: ______

DEMOGRAPHIC DATA FORM–PRE

;ushion/Seat Type: ______________________________

Wheelchair/Scooter Manufacturer & Brand: ______________________________

____

	Manual Wheelchair		Power Wheelchair		Scooter
	Standard		Front-wheel drive		3-wheel
	Lightweight		Mid-wheel drive		4-wheel
	High strength lightweight		Rear-wheel drive		
	Ultra-lightweight				

ıeelchair/Scooter Features (check all that apply)

	Controller:		Foot Supports:
	Programmable joystick		Power elevating
	Non-programmable joystick		Manual elevating
	Tiller		Fixed
	Alternative control/input device		Swing-away
	Other:		Other:
	Accessories:		**Back supports:**
	Basket		Sling upholstery
	Laptray		Adjustable tension back
	Horn		Rigid back
	Lights		Custom-contoured back
	O^2 carrier/vent-tray		Captain-style seat
	Other:		Other:
	Seat Functions:		**Arm Supports:**
	Tilt-in-space		Full-length, fixed height
	Reclining back		Full-length, adjustable height
	Seat elevator		Desk-length, fixed height
	Other:		Desk-length, adjustable height
			Swing-away
			Flip-up
			Other:

APPENDIX E: Demographic Data Form – Post

Subject #: ______

DEMOGRAPHIC DATA FORM–POST

☐ New manual wheelchair ☐ New power wheelchair ☐ New scooter

__________________ When did you receive your new wheelchair/scooter?

__________________ How long have you been using your new wheelchair/ scooter?

☐ New seating system (seat cushion and back support)?

☐ Previous seating system (same as identified during pretest)

·ow satisfied were you with your evaluation and prescription process for your new ..heelchair/scooter?

______ Very satisfied

_____ Satisfied

______ Neither satisfied nor dissatisfied

______ Dissatisfied

______ Very dissatisfied

Subject #: ______

DEMOGRAPHIC DATA FORM–POST

Cushion/Seat Type: ____

Wheelchair/Scooter Manufacturer & Brand: ____________________________

____

	Manual Wheelchair
	Standard
	Lightweight
	High strength lightweight
	Ultra-lightweight

	Power Wheelchair
	Front-wheel drive
	Mid-wheel drive
	Rear-wheel drive

	Scooter
	3-wheel
	4-wheel

Wheelchair/Scooter Features (check all that apply)

	Controller:		**Foot Supports:**
	Programmable joystick		Power elevating
	Non-programmable joystick		Manual elevating
	Tiller		Fixed
	Alternative control/input device		Swing-away
	Other:		Other:
	Accessories:		**Back support:**
	Basket		Sling upholstery
	Laptray		Adjustable tension back
	Horn		Rigid back
	Lights		Custom-contoured back
	O^2 carrier/vent-tray		Captain-style seat
	Other:		Other:
	Seat Functions:		**Arm Supports:**
	Tilt-in-space		Full-length, fixed height
	Reclining back		Full-length, adjustable height
	Seat elevator		Desk-length, fixed height
	Other:		Desk-length, adjustable height
			Swing-away
			Flip-up
			Other:

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