TEST-RETEST RELIABILITY OF THE FUNCTIONAL MOBILITY ASSESMENT (FMA)

by

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The Functional Mobility Assessment (FMA) instrument is a self-report outcome tool, designed to measure the effectiveness of Wheeled Mobility and Seating (WMS) interventions for people with disabilities (PWD). To describe the psychometric properties of the FMA's test-retest reliability, a repeated-measures cohort study was conducted. The specific aims of the study included examining the test-retest reliability of the FMA and determining to what extent each self-reported performance item remained stable when clients responded twice to the same questions over a time period of no less than one week and no more than three weeks. Participants were recruited from the University of Pittsburgh Medical Center's (UPMC) Center for Assistive Technology (CAT). The study sample involved 20 participants who were non-wheelchair or scooter users but in the process of being evaluated for a device (Non-WMS users) and 21 participants who were being evaluated for a replacement device (Existing WMS users). These 41 participants completed an initial FMA questionnaire. After obtaining the initial assessment, the FMA was administered a second time, within 7-21 days. Intra-class correlation coefficients (ICC) were computed to determine agreement between the two scores. Test-retest reliability scores for all items and participants were above the acceptable value of $\geq$ 0.80 for a clinical assessment tool, except "Health Needs" and "Reach" for the Non-WMS users, and "Transfers" and "Carry out daily routine" for Existing WMS users. Existing WMS users had higher total scores (greater satisfaction) on the FMA than Non-WMS users. Results indicate that the FMA was a reliable and stable tool for assessing satisfaction of individuals who use or need WMS interventions. Future studies should include larger samples and recruit participants from multiple sites.

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1.0 INTRODUCTION

Mobility is necessary to perform daily activities and to enhance social or community participation (Lilja & Borell, 1997; Mollenkopf, Marcellini, Ruoppila, Flaschentrager, Gagliardi, & Soazzafumo, 1997). Clinical conditions resulting in impairments, such as limited walking ability due to shortness of breath or obesity, may lead to restricted functional activities and limited participation (World Health Organization, 2001). Often restoring body functions (i.e., eliminating all impairments) is not possible; therefore, assistive technology, including WMS devices such as manual wheelchairs, power wheelchairs or scooters, is used to enhance functional performance and participation (Bunning, Angelo, & Schmeler, 2001; Evans, 2000; Slangen-de, Midden, & Wagenberg, 1998; Smith, 1996). Ameliorating disability and enhancing functional outcomes are an integral part of rehabilitation and require reliable measurement of consumer satisfaction and functional changes. Mobility devices are often required by older adults or people with limited lower extremity function, pain, or other clinical conditions to enable them to move about and perform their functional activities independently. Given this function, mobility devices and assistive technologies can reduce dependence on personal care assistants and caregivers (Agree, Freedman, Cornman, Wolf, & Marcotte, 2005).

The Center for Medicare and Medicaid Services (CMS) policy requires function-based criteria for prescription of a mobility device and for providing assistance for users in performing the mobility related activities of daily living (Center for Medicare and Medicaid Service, 2006).

Therefore, appropriate measurement of rehabilitation outcomes and evaluation of the effects of mobility device interventions for people with mobility- related problems is necessary to inform clinicians, third party payers, consumers, and policy makers (Schmeler, 2005; Schmeler, Holm, & Mills, 2006). With increasing demand for accountability of WMS device services in the field of rehabilitation, the need for research that focuses on psychometric properties of functional outcome measures has been strongly emphasized by policy makers (Frattali, 1993). In response, the demand for a greater quantity and higher quality of rehabilitation outcomes research has been increasing (DeRuyter, 1997; Furher, 2001). According to Gray (1997), the results obtained from outcomes data can support clinical justification and guide the process of service delivery, while also encouraging translational research in the field of Assistive Technology (AT). Therefore using reliable and valid outcome measurement tools is vital to the credibility and growth of rehabilitation technology (Dijkers et al., 2002).

The impact of outcome measurements influences multiple stakeholders at various levels, including the client as the end-user at a personal level; clinician and supplier at the professional level; and third party payers such as private insurance companies at the funding level. Moreover, at the national level, government agencies can use the results of outcome measures to analyze the impact of policy and sustainability of related programs (Lenker, Scherer, Fuhrer, Jutai, & DeRuyter, 2005).

Assistive Technology Abandonment

The lack of research in the area of mobility device interventions and growing practice of direct-to-consumer marketing by certain mobility device supplier of mobility devices outside of the healthcare setting could lead to a high incidence of poor matching of clients with appropriate equipment (Goodwin, Oghalai, Kuo, & Ottenbacher, 2007). Despite the potential advantages of AT, such devices are underused for multiple reasons, including a mismatch between the client's functional needs, mobility limitation, personal preferences, the environment, or any combination thereof (Phillips & Zhao, 1993). The authors found in their survey that one-third of mobility devices (e.g., crutches, walkers' canes, wheelchairs and scooters) were reported to be abandoned by the users. The authors also found that mobility aids tended to be abandoned more readily than other devices. The most common reasons for abandonment included the features of the device, change in user needs, and environmental or home setting factors where the device was used (Phillips & Zhao, 1993). Dissatisfaction with devices, and hence their abandonment, is related to poor feature matching and prescription practices (Hesse, Gahein-Sama, & Mauritz 1996; Scherer & Galvin, 1997). For example, a small group of Australian wheelchair users interviewed by Kittel et al. (2002) stated that an unsatisfactory interview process with the prescribing therapist led to the provision of inappropriate devices (Kittel, Di Marco, & Stewart, 2002). Users felt that the prescribing therapist did not spend enough time exploring options, assessing their functional needs and lifestyles, and asking for their opinions of the devices. To improve feature matching and prescriptive practices, consideration must be given to the consumers' satisfaction on functional needs within the environment in which the consumer uses the technology. High rates of abandonment are costly both in terms of money and outcome achievement (Scherer & Galvin, 1997); therefore, consumers need to be involved in the process of mobility device selection

(Cooper, 2006). To facilitate such involvement, self-reported outcome tools may be effectively used to assist the clinician in understanding personal, health, and functional needs in order to accurately match technology with consumers' needs and environments.

The Role of Conceptual Models in the Development of Outcomes Research

Various conceptual models exist in the field of AT and rehabilitation science including: (1) Matching Person and Technology model (MPT), (2) The Human Activity Assistive Technology (HAAT) model and (3) The Policy Human Activity Assistance Technology and Environment (PHAATE) model. These models are based on the World Health Organization's (WHO) International Classification of Functioning, Disability and Health (ICF) model. The ICF model lends itself well to the assessment and provision of assistive technology including wheeled mobility and wheeled mobility devices. This model also supports the need for client- centered feedback and serves as a framework for device justification. However, few self-report outcome tools exist which can obtain consumer-relevant data related to mobility devices, including a measurement of consumer satisfaction, therefore a gap has resulted in the ability to acquire post-intervention feedback after service delivery.

The current outcomes measurement tools in the area of WMS vary in scope of content and context including the Wheelchair Skills Test (Kirby et al., 2004), the Wheelchair User Functional Assessment (Stanley, Stafford, Rasch, & Rodgers, 2003) and the Wheelchair Physical Functional Performance Test (Cress, Kinne, Patrick, & Maher, 2002). Items on these performance based tools measure wheelchair skills such as propulsion, wheelies, negotiating obstacles, and power wheelchair operation. One self-report outcome tool, the Psychological Impact of Assistive

Device Scales (PIADS) (Jutai & Day, 2002) measures the psychosocial impact of assistive technology**.** Another tool the Quebec Users Evaluation of Satisfaction with Assistive Technology (QUEST) assesses the consumer's satisfaction with the assistive technology device and service delivery process (Demers, Monette, Lapierre, Arnold, & Wolfson, 2002). However, items on these self-report tools are general and not specific to function when using a WMS. A WMS conceptual model should include evaluation of wheeled mobility device use during functional performance, matching persons with their environments, and community participation. To date, no self-report outcome measures of self-perceived consumer satisfaction tools exist that focus on performance of functional activities for both wheeled and non-wheeled mobility interventions in the consumer's natural environment.

1.1 OVERVIEW OF MODELS

Matching Person and Technology Model (MPT)

The Matching Person and Technology model was developed by Marcia Scherer (1986). MPT is based on the principle of using consumer needs to select the appropriate device in order for the technology to be optimally used by the end users. MPT measures the interaction of specific features of personal preferences and contextual factors, such as the environment, with technology being considered. This model also takes into consideration the psychosocial aspect of technology usage by considering individual preferences and skill.

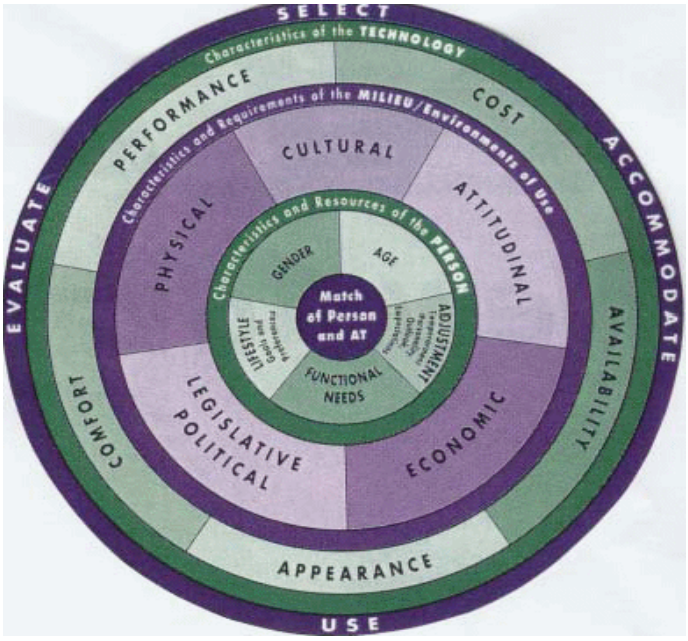

Figure 1 Matching Person and Technology Model (Scherer 1986)

Human Activity Assistive Technology (HAAT) Model

The Human Activity Assistive Technology (HAAT) model provides a framework to assess the 'Human' and the 'Activity' a person desires to complete within a defined context and environment. Based on this variables appropriate AT solution can be determined (Cook & Hussey, 2001). Serving as a guide, the HAAT model can assist in matching consumers with appropriate assistive technology. The HAAT model identifies the main components of a thorough evaluation and provides directions by which to define each component. For example, the 'Activity' component includes the consumer's desired goals based on their daily task, performance, and roles. The HAAT Model places the consumer (i.e. the Human) in a position to drive the evaluation process, emphasizing the consumer as the 'expert.'

Policy Human Activity Assistance Technology and Environment (PHAATE) Model

The PHAATE model also advocates for the consumer perspective as an important outcome indicator (Cooper, Onabe, & Hobson, 2007). In the PHAATE model, the consumer is at the center of the assessment process as an active member of the decision-making team. The underlying assumption of the PHAATE model is that the match between the person and the AT device depends on the specific needs of the consumer, activity, and environment or context where the device will be used. It goes further to consider policies that will affect the AT device selection and reimbursement.

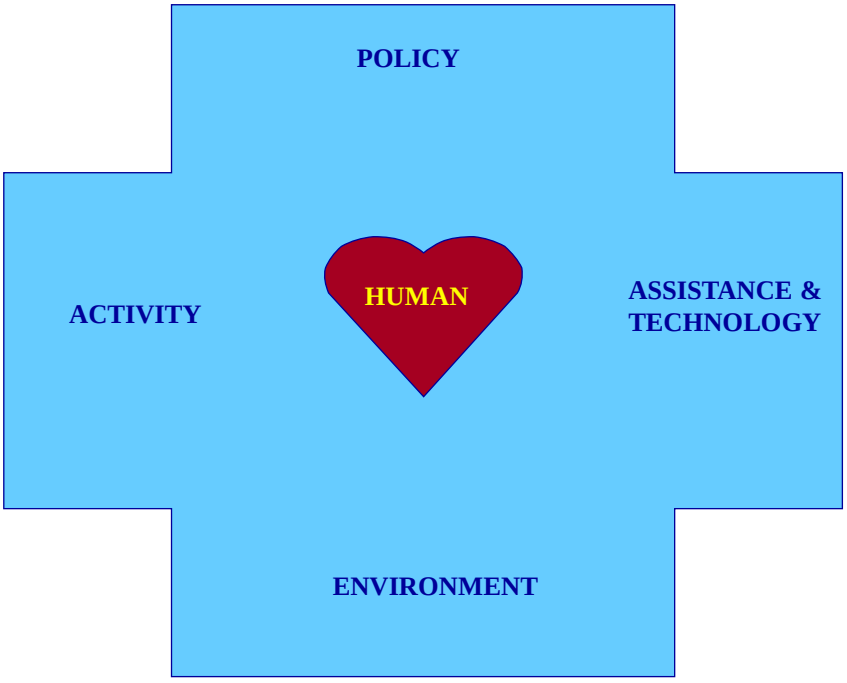

Figure 2 PHAATE Model (Cooper 2007)

International Classification of Functioning, Disability and Health (ICF)

The World Health Organization's ICF Model describes individuals in terms of health

(body functions and structures), activity/ activity limitations, participation/ participation restrictions, as well as functional capacity and performance (World Health Organization, 2001). The ICF also implies that AT can serve as a method to improve functional capacity , performance, and participation (Gray & Hendershot, 2000). Therefore, with the advent of the ICF Model in clinical practice, disability measurements are no longer focused only on impairments, but also on activity limitations and participation restrictions, which result from barriers in the physical or social environment (Iezzoni, McCarthy, Davis, & Siebens, 2000). However, most of the outcome measurements tools are performance-based, administered in a clinical setting, and therefore do not always provide feedback on performance in the real world such as the home and community. Thus there is a need for development of outcome tools to measure the impact of AT on functional capacity, performance, and participation within various contexst. The Functioning Everyday with a Wheelchair (FEW) is one example of a self reported outcome measure that has been shown to quantify the impact of WMS devices and evolved with consideration for environmental factors, consistent with the ICF (Holm et al, 2006).

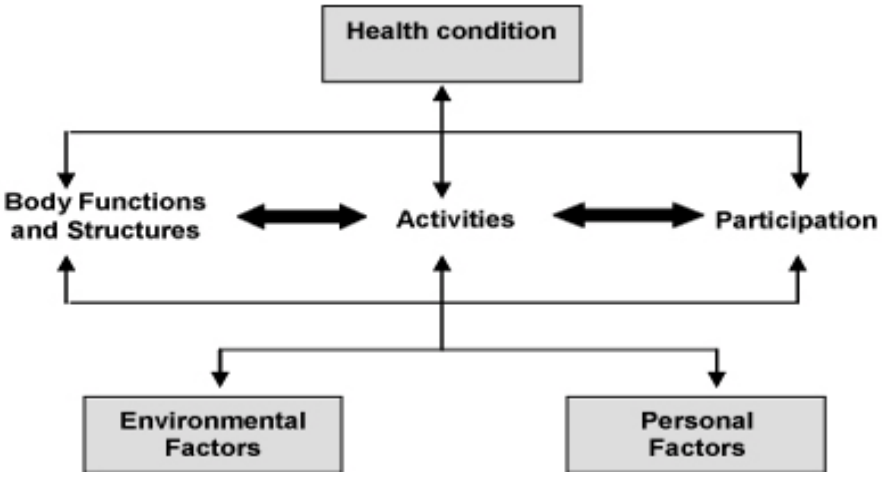

Figure 3 Interaction between the components of ICF (WHO & ESCAP 2009)

1.2 MOBILITY NEEDS

The primary purpose of a mobility device provision is to restore functional performance and mobility-related activities of daily living. Evaluating the psychometric properties of outcome measures for mobility devices is gaining importance due to growing number of people with mobility limitation including those aged 65 years and above. The largest and fastest growing users of wheelchairs and scooters is the aging population (Karmarkar, 2009). In the U.S., approximately 3.3 million people use wheelchairs (Brault, 2008). Approximately 58% of people who use wheelchairs use manual wheelchairs (Kaye, Kang, & LaPlante, 2002). Furthermore, approximately 1.8 million wheelchair users are over the age of 65 years. Further, approximately 10.2 million people in the US use ambulatory aids such as walkers, crutches and canes (Brault,2008). Powered mobility devices can enhance functional capacity, independence and increase participation in activities of daily living. Moreover, the author found that power mobility devices can improve quality of life for people with disabilities as they allow more control over indoor and outdoor mobility(Bunning & Schmeler, 1999). Additionally, power mobility device seat functions, including power tilt and seat elevators, encourage participation in the community (Dicianno et al., 2009; Sonenblum, Sprigle, & Maurer, 2009)

1.3 OUTCOMES MEASUREMENT

An outcome in the field of rehabilitation is defined as the measurement of change in the functional status after the intervention of therapy or assistive technology (Furher, 2001). DeRuyter defined outcomes as "an evaluation of assessment, delivery and measurement of change in functional capacity and efficiency," (DeRuyter, 1997, p-89-104). The advancement of rehabilitation technology combined with increased consumer utilization of mobility devices, and limited funding for these devices has resulted in the need to reliably measure change in function in order to justify necessity (Center for Medicare and Medicaid Service, 2006; Mortenson et al., 2007; Wilson et al., 2009). Outcome measures assist clinicians in determining whether a client's health and functional status improved after an intervention was provided as well as further assist in documenting the effects of the particular intervention (Roach, 2006). It is clear that outcomes associated with mobility interventions are important in rehabilitation to document their benefit to end-users, clinicians and third-party payers. Therefore, clinicians need quantifiable outcomes that justify the costs and resources associated with mobility devices and services (Mills, 2003).

1.4 RELIABILITY

Rehabilitation-related functional outcome measures can be used to assess the level of consumer satisfaction with assistive devices, functional mobility, and performance. These measures may also contain questions related to consumer's health and socio-demographic characteristics. The quality of the information provided in an outcome measures depends on the

psychometric properties of that tool, including reliability and validity (Fitch, Brooks, Stratford, & et, 2002; Portney & Watkins, 2000). A reliable instrument is consistent in its measurement, and unaffected by variation in testing conditions and procedures (Loewenthal, 1996). Reliability is one among several psychometric characteristics of any outcome measurement tool. Several types of reliability are examined to establish the psychometric properties of any outcome measurement tool such as test-retest reliability, inter-rater reliability, and intra-rater reliability. Portney & Watkins (2002) state good reliability values occur when the results have a very small measurement error, meaning test and retest values vary slightly. Self-report measures that require individuals to respond to a questionnaire must undergo all of these psychometric tests, including test-retest reliability (Portney & Watkins, 2000). Test-retest reliability is examined by having the same individuals complete the measure on more than one occasion, with the assumption that other factors (e.g., personal characteristics, health status, environment) will not change between sessions (Streiner & Norman, 2005). One important consideration of reliability is the that there be a "wash-out" period long enough between measurements for removing bias in self-report questionnaires (Portney & Watkins, 2000). Correlational statistics are used to determine the degree of test-retest reliability of an outcome measure, and include such statistical tests as kappa statistics or Intraclass Correlational Coefficients (ICC). The ICC between two sets of responses is often used as a quantitative measure to determine the relationship between sets or data and the test-retest reliability. A reliability coefficient of 1.0 represents perfect reliability, indicating no differences between two response scores. The calculation of the ICC produces a value between 0 and 1.00; values closer to 1.00 indicate less error variance and stronger reliability (Portney & Watkins, 2000). Recommendations for ICC interpretations are diverse. Anastasi recommends 0.60 as the minimum acceptable ICC value

(Anastasi, 1998). Portney and Watkins, on the other hand, suggests that ICCs greater than 0.75 represent good reliability and ICCs less than 0.75 reflect moderate reliability for a clinical assessment tool (Portney & Watkins, 1993).

Weighted Rank Order (WRO) statistics were another method used to assess the consistency among individual items between test and retest and are appropriate statistics for use with non-parametric statistics such as the ordinal data used with the FEW and FMA items (David & Nagaraja 2003, p-458; Sefling, 1980) The WRO statistics combine the rank and frequency of each rank. Mills and colleagues (2003) effectively employed this method to compare the consumer response for different items on the Functioning Everyday with a Wheelchair (FEW) questionnaire.

1.5 LITERATURE REVIEW OF MOBILITY OUTCOME MEASURES

A systematic literature review was done to describe the psychometric properties of various questionnaire-based outcome measurement tools and also to compare and contrast the outcome measurement tools from previous research to the FMA. The literature review was conducted to include published studies between 1996 and May 2010, using the following electronic databases: SCHOPUS, MEDLINE, CINAHL, and PUBMED. The keywords used were: outcomes measure AND wheelchair, assistive device, functional skills, test-retest, and reliability. The inclusion criteria for selection of a study for the literature review were if an article included the: (a) measurement of consumer satisfaction with respect to functional

performance and the level of activity of both manual and power wheelchair users, (b) a measurement tool that was based on self-reporting, and (c) psychometric properties were reported, including validity and reliability. The following six outcome measurement tools and their associated studies met the inclusion criteria:

1.5.1 The Quebec User Evaluation of Satisfaction with Assistive Technology

The Quebec User Evaluation of Satisfaction with Assistive Technology (QUEST 2) is a scale used for measuring satisfaction with assistive devices. The QUEST 2 includes 12 items rated on a 5-point satisfaction scale and yields three scores of satisfaction, including one for satisfaction with the device, a second for satisfaction with service delivery, and a third which is the cumulative combination of both scores. The test- retest reliability and validity study was conducted by Demers, Weiss-Lambrou, and Ska (2002) on individuals with multiple sclerosis who were using mobility devices, including walkers, wheelchairs, and scooters. The second QUEST 2 was administered after a one-week interval. ICCs from test-retest reliabilities were 0.82 for satisfaction with the device, 0.82 for satisfaction with the service delivery and 0.91 for the cumulative total scores of the QUEST. Although QUEST is reliable tool only design to measure satisfaction and feature of the devices, however not specific to the feature and function of mobility devices.

1.5.2 The Psychosocial Impact of Assistive Devices Scales

The Psychosocial Impact of Assistive Devices (PIADS) is a 26-item self-report questionnaire designed to assess the effects of an assistive device on functional independence, well-being, and quality of life. PIADS was developed by Demers and colleagues (2002) and examined the psychometric properties of a French version of the PIADS (Demers et al. 2002). They also found good test-retest reliability in the English version (Demers, Monette, Descent, Jutai, & Wolfson, 2002; Demers et al.,1996). The PIADS was completed twice, in an interval of one month, with persons who had mobility and visual impairments. French-PIADS had good test-retest reliability, with an ICC value of 0.90. Although the PIADS is a very reliable and generic tool to measure the impact of assistive technology, it does not specifically address the functional features of power wheelchairs in various settings.

1.5.3 The Wheelchair Seating Discomfort Assessment Tool

Crane et al. (2005) conducted test-retest reliability and concurrent validity of the Wheelchair Seating Discomfort Assessment Tool (WcS-DAT). WcS-DAT was developed to measure seating-related discomfort in a wheelchair (Crane, Hobson & Holm, 2003). WcS-DAT consists of three parts. Part 1 gathers information about seating duration in the wheelchair and types of activity performed from a seated position. Information related to comfort and discomfort is addressed in Part 2 of the tool. Lastly, Part 3 contains questions about the intensity of discomfort experienced in seven different body parts. Authors used the Cronbach alpha to

examine the internal consistency of the items within the WcS-DAT. Pearson product moment correlations were used to analyze the concurrent validity of this outcome measure. ICCs for the WcS-DAT for test-retest reliability was 0.86 (Crane et al., 2005). Although this tool is related to WMS however it does not directly consider other function associated with these devices.

1.5.4 Functioning Everyday with a Wheelchair

The Functioning Everyday with a Wheelchair (FEW) is a self-report tool used to measure consumer satisfaction levels with respect to functional performance of everyday tasks while seated in the wheeled mobility device. The 10 self-reported items were developed based on interviews with wheelchair users. The FEW has demonstrated good content validity and test-retest reliability (Mills et al., 2007). The FEW is commonly used by clinicians and researchers to assess consumers during the wheelchair prescription process and when evaluating the functional performance of individuals who use wheelchairs or scooters as their primary means of mobility. Although the FEW Version 1 was developed using only consumer-generated information, Version 2 was revised based on cross-validation studies of goals set by wheelchair users receiving rehabilitation (Mills et al., 2007). For data analyses, researchers used ICC values to determine the test-retest reliability of FEW versions 1 and 2. The FEW 2 achieved high stability and reliability in measuring mobility goals over a one-week interval. An ICC value of 0.86 and $p < 0.001$ was calculated for the FEW-2 and it captured 98.5% of rehabilitation mobility goals. Although the FEW-2 is a reliable and valid tool to measure needs and functional performance, it is designed for people who have existing wheelchair or scooter. The FEW-2 does not address

people who use non-WMS devices such as canes, crutches, walkers, orthotics, or prosthetics. Therefore the tool is not valid for people transitioning from non-WMS to WMS intervention.

1.5.5 The Wheelchair Outcome Measure

Miller et al. (2007) developed the Wheelchair Outcome Measure (WhOM) tool to measure participation level and physical discomfort while using wheelchair/ scooters in both home and community settings. The WhOM consists of two parts. The first part of the tool addresses home and community participation. The second part addresses physical condition and body structure including comfort, posture, and skin breakdown. The tool was devised as a semistructred interview, and scoring is completed on an 11-point scale (0 = not important at all to 10 = extremely important; 0 = not satisfied at all to 10 = extremely satisfied). Garden and Colleagues (2009) reported good test-retest reliability (ICC value of 0.90) and inter-rater reliability (0.89) on a spinal cord injury population using wheelchairs. Auger and colleague (2010) have also reported that the WhOM demonstrated good test-retest reliability (ICC= 0.77 - 1.00) when administered by telephone with participants of middle-aged and older populations using power mobility devices. But Auger and colleague (2010) have also reported that WhOM is a tool which is only complementary to existing tools and only moderately related to satisfaction with wheeled mobility devices. Another limitation of the WhOM is that it addresses only existing wheelchair users.

1.5.6 French-Canadian version of the Life-Space Assessment Questionnaire

Auger et al. (2009) studied the psychometric properties of the French – Canadian version of the Life-Space Assessment Questionnaire (LSA-F) for power mobility device users. Tests were administered through telephone interviews at 2-week intervals (Auger et al., 2009). Translation/back-translation from English to French and cultural adaptation were performed and pretested with five bilingual users. Test-retest reliability was examined with 40 French-speaking, current power mobility users. An ICC of 0.87 was achieved, which signifies excellent reliability.

Table 1. Wheelchair Self-Report & Performance-based Outcome Tools in Chronological Order

Reference	Type of tool	Target assistive technology	Study population	Scoring	Test-retest reliability
QUEST: ***Demers et al., 2002***	Self-reported or interview format	Assistive technology and service	Multiple sclerosis: (n=81) walkers, wheelchairs, and scooters	Ordinal scale from 1 to 5 (1- not satisfied at all to 5 –very satisfied)	ICC Service= 0.82 Device,= 0.82 Total= 0.91
PIADS: ***Demers et al., 2002***	Self reported	Assistive technology	Multiple sclerosis: (n=81) walkers, wheelchairs, and scooters	7 point scale ranging -3 to +3	ICC = 0.90
WcS-DAT: ***Crane et al., 2005***	Self- reported	Wheelchair user (manual & power)	Wheelchair users with intact sensation (n=30)	General discomfort score based 13 items on a 7-point Likert scale	ICC = 0.86
FEW: ***Mills et al .2007***	Self reported	Manual wheelchair, Power wheelchair, & Scooter	Manual wheelchair Power wheelchair Scooter (n=30)	Ordinal 0 to 7 = 0 =does not apply 6= completely agree 1= completely disagree	Test-retest: Total ICC=0.86 Range =0.41 to 0.83
WhOM***: Miller et al. 2007, Garden 2009 Auger et***	Self-reported semistructred	Wheelchair user (manual & power)	SCI: wheelchair user (n=50) Middle age & older Power wheelchair	11-point scale (0 - not important or not satisfied at all to 10- extremely	Test-retest SCI: ICC=0.90 Old user:

al.,2010			(n=40)	important or satisfied).	(ICC=0.77-1.00)
LSA-F*: Auger et al.2009*	Mobility assessment tool	Power wheelchair	Current power wheelchair user (n=40)	Based on ability to do or not: Yes/No	Test-retest: ICC=0.87

2.0 SPECIFIC AIMS

The purpose of this study was to establish the test-retest reliability of the Functional Mobility Assessment (FMA) instrument and outcome measurement tool, designed to assess the effectiveness of mobility device interventions on the functional performance of individuals who use canes, crutches, walkers, wheelchairs or scooters as their primary mobility device. The specific aims and hypothesis of this study were:

Aim 1: To examine the test-retest reliability of the FMA.

Specific Aim 1.1: Examine the extent to which each performance item rating remains stable when clients repeatedly respond to the same question.

Hypothesis: *The test-retest reliability will be established at* $\geq$ *0.80 using the intra-class correlation coefficient (ICC).*

Aim 2: To compare test and retest responses of Existing WMS and Non-WMS users

Hypothesis: *The Existing WMS users will show higher total scores (greater satisfaction) on the FMA than the Non-WMS users who currently use a cane, crutch, walkers or no mobility device.*

3.0 METHODS

3.1 STUDY DESIGN

This study was a single cohort repeated measures design to evaluate the test-retest reliability of the Functional Mobility Assessment (FMA).

3.2 SUBJECT RECRUITMENT

Participants were recruited from the University of Pittsburgh Medical Center's (UPMC) Center for Assistive Technology (CAT) in Pittsburgh, PA. To meet the inclusion criteria, potential participants had to be: 1) new or current user of a cane, walker, crutches, wheelchair or scooter who were scheduled to receive a new wheeled mobility/seating intervention (i.e., receipt of a new wheelchair or scooter) or a replacement device; 2) 18 years of age or older; 3) able to adequately communicate and have the cognitive levels that would allow them to answer questions (i.e., could respond to questions posed in the FMA by any means such as speech, signing, or with technology) because no attendant or proxy responses for the participants were permitted, and 4) individuals for whom English was a primary language. Out of the 43 participants recruited for this study, only two participants were unable to complete the second

part of the FMA. Thus, they were removed from the study and from all the subsequent data analyses. Participants were divided into two groups on the basis of the primary mobility devices participants were using at the time of the first FMA interview: Existing WMS users and Non-WMS users. The Existing WMS group participants used one of the following mobility devices: manual wheelchair, power wheelchair, or scooter. The Non-WMS users group included participants who used canes, crutches, walkers, orthoses, prostheses, or no mobility devices. The Existing WMS users group included 21 participants and the Non-WMS group included 20 participants.

3.3 INSTRUMENTATION

3.3.1 Functional Mobility Assessment (FMA)

The Functional Mobility Assessment (FMA) tool was based on a revision of the FEW instrument. The revision was done so that the new instrument, the FMA, would be applicable to assessing the needs of both existing WMS users and non-WMS users who do not have wheelchair or scooter experience. Being applicable to other mobility device users (e.g., canes, crutches, walkers) or people who do not yet use mobility devices, the FMA was created to overcome this limitation of the FEW. Thus, the objective of this study was to establish the test-retest reliability and clinically relevant stability of the FMA for both groups, so that it can be used to assess the functional effectiveness of seating-mobility interventions.

The FEW was reformatted and restructured by its developers to create the FMA. Modifications in wording were made to the items. For example, “The size, fit, postural support, and functional features of my current wheelchair/ scooter . . . ,” was replaced with “My current means of mobility . . . ,” so the FMA would be relevant to both experienced wheeled mobility device users (e.g., Existing WMS users, including manual, power wheelchair and scooter) as well as a Non-WMS users (e.g., consumers who are using canes, crutches, walkers, orthoses or prostheses).

The FMA consists of the following 10 items (see Appendix 1): (1) carrying out my daily routine, (2) comfort needs, (3) health needs, (4) operation, (5) reaching and carrying out tasks at different surface heights, (6) transfers from one surface to another, (7) personal care tasks, (8) indoor mobility (9) outdoor mobility (10) personal and public transportation. All items address the features of mobility devices, including wheelchairs, scooters, canes, crutches or walkers, which assist people with disabilities in functional mobility and allow them to perform functional tasks independently, safely and as efficiently as possible. All items are scored individually on a 7- point Likert scale in which *6 = completely agree, 5 = mostly agree, 4 = slightly agree, 3 = slightly disagree, 2 = mostly disagree, 1 = completely disagree and 0 = does not apply to me.*

3.4 PROCEDURES

This study was approved by the University of Pittsburgh Institutional Review Board prior to any data collection. Potential participants were recruited for the study after a researcher/clinician screened consumers of CAT services. These potential participants were initially asked by CAT clinicians during their face-to-face evaluations if they were interested in participating in this study. In addition, other clinicians in the CAT were made aware of the study and directed their consumers to contact the investigator if they were interested in participating in this study. Flyers were also posted at the CAT. Prior to enrollment in the study, all potential participants were screened to determine if they met the study inclusion criteria, and then informed consent was obtained from those individuals still interested in participating in the study.

Demographic and mobility specific information was then collected. Prior to administration of the FMA, participants were asked to rate their health and how they felt in performing their daily activities on the day of the study. These questions were scored on a vertical visual analogue scale with values of 0-100, with 0 representing the worst participants felt over the last three months, and 100 representing the best they felt over the last three months. The first assessment of the FMA questionnaire (i.e., the test) was completed on 20 participants from the Non-WMS group, who were currently using canes, crutches, walkers, prostheses or no devices at the CAT, and 21 participants receiving a replacement device of some type. All participants were asked to respond to the FMA questions from the perspective of their means of mobility used at the time of their assessment. After obtaining the initial MA assessment data, an appointment was made for

the second session (i.e., retest), to be conducted a minimum of seven days later, over telephone. For the second assessment (retest), each participant was contacted by telephone by a trained interviewer, and the FMA data were collected once again. Duration of time to complete administration of the first FMA (test) was approximately 30 to 45 minutes, and the second interview by telephone (retest) was completed in approximately 15 to 20 minutes. At the first administration of the FMA, participants were provided with a blank copy of the FMA to refer to during the retest assessment.

3.5 STATISTICAL APPROACH

Intra-Class Correlation (ICC) coefficients were computed to determine test-retest reliability between the two time points – test and retest. These calculations were repeated for all items, and for the total FMA score. We also computed the ICC for Existing WMS users and for Non-WMS users for individual items and for the total score. Acceptable results for the reliability coefficient were set at a value greater than or equal to 0.80, which is considered 'good' reliability. Weighted rank order (WRO) calculations were used to examine the ranking differences of responses between the test FMA and the retest FMA ratings across all existing WMS users and non-WMS users. To identify differences in ratings of individual items for test and retest between Existing WMS users and non-WMS users, we used the Mann Whitney U test with Bonferroni correction set *a priori* at $p \leq 0.005$ to compare these ordinal data. To examine health status impact ratings, we compared health status at test and retest administrations using a

paired t-test for these continuous, normally distributed data. All statistical analyses were computed using the Statistical Package for the Social Sciences (SPSS) 15.0 for computer.

Based on participant WRO rankings for each item of the FMA, a standard ranking system (1= highest priority to 10 = lowest priority) was used to assign a weighted value to each item across all responses. Values were then reversed so that higher rankings reflected greater numerical values. The frequency of item responses and weighted values assigned by the participants were then multiplied to yield a WRO for each item for the test and retest administrations of the FMA. Next, the WRO for all items were sorted to identify the items of highest priority and lowest priority so that comparisons could be made.

4.0 RESULTS

4.1 PARTICIPANTS

A total of 42 participants were recruited initially, and 41 completed the two sets of FMA questionnaire. One participant did not respond to complete the FMA retest on the phone. One participant was retested in a face-to-face interview because he came to the CAT, rather than completing the retest over the phone. Also, most participants were not available on day 7 after the initial FMA test. Administration of the retest of FMA, therefore, varied from one week to two weeks, due to the limited availability of participants by telephone.

4.2 DEMOGRAPHIC AND MOBILITY CHARACTERSTICS

TOTAL GROUP OF PARTICIPANTS: The total sample consisted of 41 people, of whom 24 were male (58.5%) and 17 were female (41.5%); this group included 30 Caucasians (73.2%) and 11 African Americans (26.8 %). The average age was 54±16 years (range: 25-87 years). The most common medical condition among participants was spinal cord injury (n = 9; 21.9%) followed by stroke (n = 6; 14.6%) and arthritis (n = 4; 9.7%). Of the total 41participants, 13

(31.7 %) used manual wheelchairs, 7 (17%) used power wheelchairs, 1 (2.4%) used a scooter, 8 (19.5%) used canes, 8 (19.5%) used walkers, 2 (4.8%) used crutches, 1 (2.4%) had lower limb prostheses and 1 (2.4%) did not use any mobility device. The average number of years of using a mobility device was 7.4 ±9.1 (range: 0-53). Table 1 presents a summary of the demographic characteristics of the study participants.

EXISTING WMS GROUP: Among those in the group Existing WMS users, the average age was 49.3 years. The total sample consisted of 21 people, of whom 12 were male (57.1%) and 9 were female (42.9%). The most common medical condition among these participants was spinal cord injury (n = 8; 38.1 %) followed by stroke (n = 3; 14.3%). Of the total 21 participants, 13 (61.9 %) used a manual wheelchair, 7 (33.3 %) used a power wheelchair, and 1 (4.8 %) used a scooter. The average number of years of using a mobility device was 9.1 ±5.9 (range: 1-25). See Table 1 for specific details.

NON-WMS GROUP: Among those in the group non-WMS users, the average age was 58.9 years. The total sample consisted of 20 people, of whom 12 were male (60%) and 8 were female (40%). The most common medical condition among participants was spinal stenosis (n = 3; 15 %), arthritis (n = 3; 15%) and stroke (n =3: 15%). Of the total 20 participants, 8 (40 %) used a cane, 8 (40 %) used a walker, 2 (10 %) used crutches, 1 (2.4%) used a lower limb prosthesis and 1 (2.4%) used no device. The average number of years of using a mobility device was 9.1 ±5.9 (range: 1-25). See Table 2 for specific details

Table 2. Demographic Characteristics of Study Participants

Demographic	All (n=41)	Existing WMS Users (n=21)	Non-WMS Users (n=20)
Age (mean; sd, min, max)	54±16 (25,87)	49.3±16 (28,81)	58.9±14 (31, 87)
Gender n (%)			
Male	24 (58.5)	12 (57.1)	12 (60)
Female	17 (41.5)	9 (42.9)	8 (40)
Race n (%)			
African American	11 (26.8)	5 (23.8)	6 (30)
Caucasian	30 (73.2)	16 (76.2)	14 (70)
Diagnoses n (%)			
Spinal Cord Injury	9 (21.9)	8 (38.1)	1 (5)
Stroke	6 (14.6)	3 (14.3)	3 (15)
Arthritis	4 (9.7)	1 (4.8)	3 (15)
Cerebral palsy	2 (4.8)	1 (4.8)	1 (5)
Spinal stenosis	3 (7.1)	--	3 (15)
Amputation	2 (4.8)	--	2 (10)
Multiple sclerosis	4 (9.7)	2 (9.5)	2 (10)
Muscular dystrophy	2 (4.8)	2 (9.5)	--
COPD	2 (4.8)	--	2 (10)
Polyneuropathy	2 (4.8)	--	2 (10)
Polio	1 (2.4)	1 (4.8)	--
Spina bifida	1 (2.4)	1 (4.8)	--
Myelopathy	1 (2.4)	--	1 (5)
Arthrogryposis	1 (2.4)	1 (4.8)	--
SLE	1 (2.4)	1 (4.8)	--
Type of current primary mobility device. n (%)			--
Manual wheelchair	13 (31.7)	13 (61.9)	--
Power wheelchair	7 (17)	7 (33.3)	--
Scooter	1 (2.4)	1 (4.8)	--
Cane	8 (19.5)	--	8 (40)
Crutch	2 (4.8)	--	2 (10)
Walker	8 (19.5)	--	8 (40)
Prosthesis	1 (2.4)	--	1 (5)
No device	1 (2.4)	--	1 (5)
Years of mobility device use - mean±sd(min, max)	7.4±9.1 (53,0)	9.1±5.9 (1, 25)	5.7±11 (0,53)
Age of mobility device -mean±sd, (min, max)	3.5 ±2.6 (10,0)	4.1±2.4 (0, 10)	2.8±2.7 (0,9)
Number of mobility devices mean, (min, max)	1.47(1, 2)	1.5 (1, 2)	1.4 (0,2)

4.3 HEALTH STATUS

Health status data (perception of health well-being) averaged 65.5 out of 100 at test (time 1) and 69.3 out of 100 at retest (time 2). Results from a paired t-test indicate no significant difference existed between participants' perception of well-being at test (time 1) and retest (time 2), ($t = -1.6$, $df = 40$ and $p=0.105$).

4.4 RELIABILITY

Test-retest reliability results indicated an ICC value of 0.87 for all FMA items for all participants (see Table 3). Our results were above the recommended value of ≥ 0.80. Items with the highest test-retest reliability were transportation (ICC = 0.96) followed by outdoor mobility and personal care (ICC=0.88 for both items). None of the items scored an ICC below 0.80 for all participants. As a result, we accept the Research Hypothesis #1: The test-retest reliability will be established at ≥ 0.80 using the intra-class correlation coefficient (ICC).

Table 3. Intra-class correlation coefficient (ICC) values for all participants including Existing WMS & non-WMS users

ITEMS	ICC values		
	All users ICC (CI)	**Existing WMS ICC (CI)**	**Non-WMS ICC (CI)**
Item 1:Carry out	.85 (.73 -.91)	.75 (.49 .89)	.93 (.84 -97)
Item 2:Comfort	.87 (.77 -.92)	.84 (.66 -.93)	.84 (.64 -.93)
Item 3:Health	.82 (70 -.90)	.84 (.64 -.93)	.75 (.47 -.89)
Item 4:Operate	.87 (.77 -.93)	.89 (.76 -.95)	.83 (.63 -.93)
Item 5:Reach	.83 (.71 -.91)	.85 (.66 -.93)	.76 (.49 -.89)
Item 6:Transfer	.81 (.68 -.89)	.74 (46-.88)	.87 (.71 -.94)
Item 7:Personal care	.88 (.79 - 93)	.83 (.63 -.92	.90 (.77-.96)
Item 8:Indoor mob	.85 (.74 - .92)	.81 (.60 -.92)	.86 (.69 -.94)
Item 9:Outdoor mob	.88 (.80 -.93)	.88 (73 -.95)	.82 (.61 -.92)
Item 10:Transportation	.96 (.94 -.98)	.95 (.73 -.95)	.98 (.61 -.92)
All Items	.87 (.85 -.89)	.85 (.81 -88)	.87 (.84 -.90)

For the Existing WMS users group, the overall ICC value was 0.85. Items with the strongest test-retest reliability were transportation (ICC = 0.95), followed by operation (ICC = 0.89), and outdoor mobility (ICC = 0.88). Items with moderate test-retest reliability were transfers (ICC = 0.74) and carrying out daily routines (ICC = 0.75). For the non-WMS users group, the total score ICC value was 0.87. Items with strongest test-retest reliability were transportation (ICC = 0.98), followed by carrying out daily routine (ICC = 0.93) and transfers (ICC = 0.87). The one item with moderate test-retest reliability was health needs (ICC = 0.75).

Histograms were used to represent the distribution of the total scores for the test and retest FMAs among all users (Figure 5), Existing WMS users (Figure 6), and non-WMS users (Figure 7). With a total maximum score of 60, the mean score across all users at the time of the test FMA was 35.7±13.8 and at retest was 36.2± 13.5. Among Existing WMS users the mean score at the time of the test FMA was 42.1±12 and at the retest was 41±13.8. Among Non-WMS users, the mean score at the time of the test FMA was 29.1±11.6 and at the retest was 31.2±12.2. The graphs in Figures 5-7 demonstrate that the data of the FMA scoring was normally distributed across all users, Existing WMS users and Non-WMS users, without any outlier or significant skewness values.

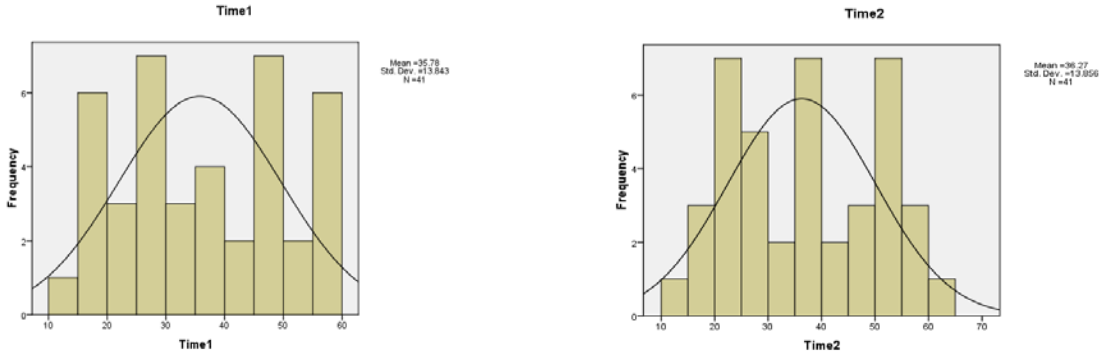

Figure 4 Total score distribution for Test and Retest across all users

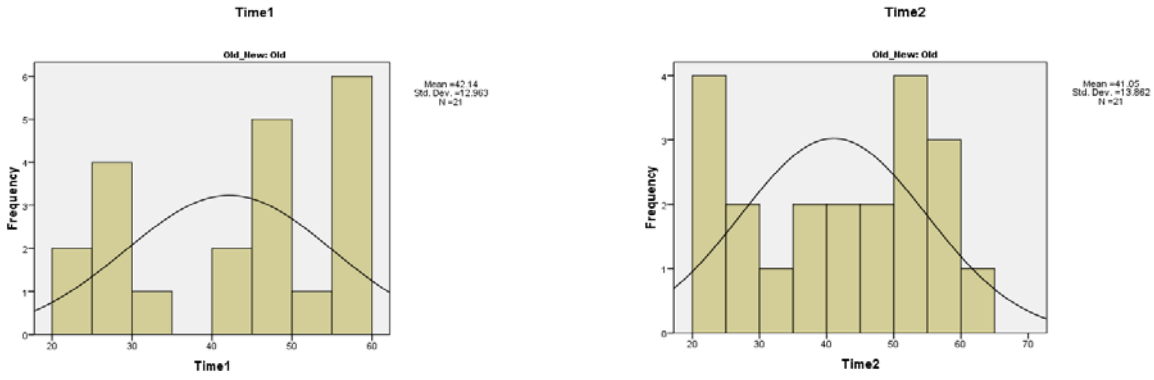

Figure 5 Total score distribution for Test and Retest among Existing WMS users

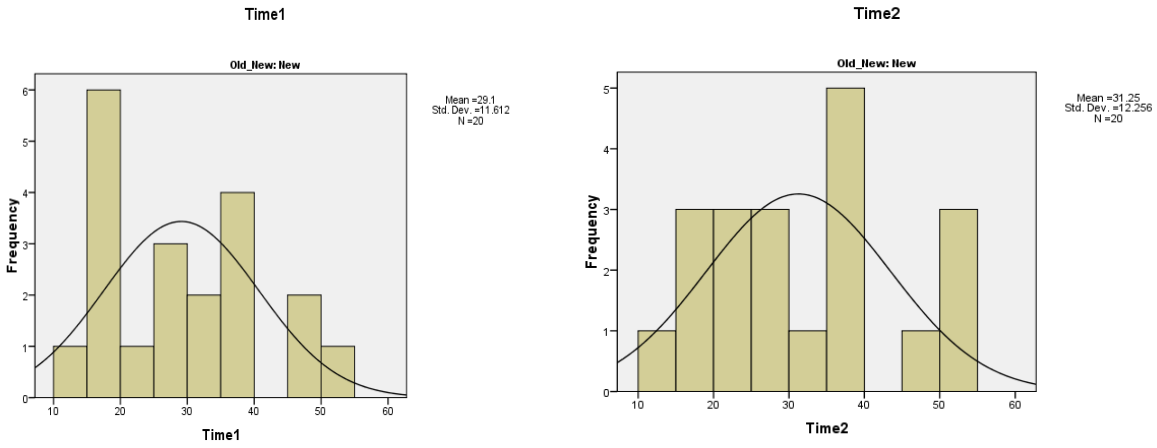

Figure 6: Total score distribution for Test and test-retest among Non-WMS users

A comparison of consumer responses accomplished through WRO sum and ranks for the 10 FMA items for both test and retest, including a breakdown by Existing WMS and Non-WMS user groups, is shown in Table 4. The WRO values for the overall sample ranged from 115 to 170. Among the 10 FMA items, indoor mobility received the highest WRO in the test and retest administrations of the FMA (test-170 and retest-170) followed by transfers (167 and 169), and carrying out daily routines (166 and 153). Outdoor mobility (121 and 122) and reach (115 and 123) were ranked the lowest at both test and retest. Tables 5 and 6 display the WRO sum and ranks of the 10 FMA items for Existing WMS users and Non-WMS user groups separately. Among those in the group Existing WMS, carrying out their daily routine was rated highest (98 and 87), followed by indoor mobility (95 and 96), and transfers (94 and 93). Among Non-WMS users, transfers (71 and 76) was ranked the highest and was equivalent to indoor mobility (71 and 74), followed by carrying out daily routines (68 and 66).

In a comparison of responses for total participants based on the WRO sums, both 'indoor mobility' and 'transfer' were ranked first and second, respectively, on the test and then retest results. These results indicate that these two areas are of the highest priority for participants of this study.

'Carrying out personal routine' ranked third on test and fifth on retest. 'Personal Care' ranked fourth on test and third on retest. Thus, these were very similar in their priority rankings for individuals with mobility disabilities.

'Operation' occupied eighth position for both test and retest. This result indicates that 'Operation' was consistently ranked in the 20% position, as one of the least priorities for study participants. To view the rankings of all of the FMA items, please refer to Table 4.

Table 4. Weighted Rank order of individual items by all participants during test and retest

RANK ORDER	TEST (TIME 1)	WEIGHTED RANK ORDER TOTAL	RANK ORDER	RETEST (TIME 2)	WEIGHTED RANK ORDER TOTAL
1	INDOOR MOBILIY	170	1	INDOOR MOBILITY	170
2	TRANSFER	167	2	TRANSFER	169
3	CARRY OUT	166	3	PERSONAL CARE	163
4	PERSONAL CARE	159	4	HEALTH NEEDS	155
5	TRANSPORTATION	147	5	CARRY OUT	153
6	HEALTH NEEDS	146	6	COMFORT NEEDS	145
7	COMFORT NEEDS	135	7	TRANSPORTATION	142
8	OPERATION	132	8	OPERATION	136
9	OUTDOOR MOBILITY	121	9	REACH	123
10	REACH	115	10	OUTDOOR MOBILITY	122

Table 5. Weighted Rank Order results of item by Existing WMS users group during test and retest administrations

RANK ORDER	TEST	WEIGHTED RANK ORDER TOTAL	RANK ORDER	RE-TEST	WEIGHTED RANK ORDER TOTAL
1	CARRY OUT	98	1	INDOOR MOBILITY	96
2	INDOOR MOBILITY	95	2	PERSONAL CARE	93
3	TRANSFER	94	3	TRANSFER	93
4	PERSONAL CARE	93	4	HEALTH NEEDS	92
5	HEALTH NEEDS	84	5	CARRY OUT	87
6	COMFORT NEEDS	76	6	COMFORT NEEDS	87
7	OPERATION	75	7	TRANSPORTATION	82
8	TRANSPORTATION	74	8	OPERATION	81
9	OUTDOOR MOBILITY	74	9	OUTDOOR MOBILITY	78
10	REACH	57	10	REACH	73

Table 6. Rank order of items by Non-WMS users group during test and retest

RANK ORDER	TEST	WEIGHTED RANK ORDER TOTAL	RANK ORDER	RE-TEST	WEIGHTED RANK ORDER TOTAL
1	TRANSFER	71	1	TRANSFER	76
2	INDOOR MOBILITY	71	2	INDOOR MOBILITY	74
3	CARRY OUT	68	3	PERSONAL CARE	70
4	PERSONAL CARE	65	4	CARRY OUT	66
5	TRANSPORTATION	64	5	HEALTH NEEDS	63
6	HEALTH NEEDS	55	6	TRANSPORTATION	60
7	COMFORT NEEDS	51	7	COMFORT NEEDS	58
8	OPERATION	46	8	REACH	50
9	REACH	43	9	OPERATION	49
10	OUTDOOR MOBILITY	39	10	OUTDOOR MOBILITY	36

The secondary aim of the study was to find the difference between test-retest responses of Existing WMS users and Non-WMS users. Because 10 Mann-Whitney U statistics were used for this analysis, a Bonferroni Correction was established *a priori* at $p < 0.005$. A comparison of FMA median scores and P values for Existing WMS users and Non-WMS users, respectively, is shown in tables 7 and 8. Median values for 'carrying out daily routine' were 5 and 3.5, (p=0.008) for Existing WMS users and Non-WMS users, respectively; median values for 'comfort' were 4 and 2.5 (p=0.003), respectively; 'health' scores were 5 and 2 (p=0.003), and for 'transportation' 4 and 4 (p=0.45).

The median and *p* values for the scores on the retest for Existing WMS users and Non-WMS users were as follows: for comfort, 5.0 and 3.0, respectively, (p=0.014); for health needs, 5 and 3 (p=0.4); for reach, 3 and 2 (p= 0.34); indoor mobility, 5 and 4 (p=0.31) and outdoor mobility, 4 and 2 (p=0.005). Transportation yielded the same median score for test and retest. As a result, the research hypothesis, the Existing WMS users will show a higher total score (greater satisfaction on the FMA), than the Non-WMS users who do not have any experience operating a wheelchair or scooter," is partially accepted for test and retest.

Table 7. Responses of Existing WMS and Non-WMS users at Time 1

ITEM	Existing WMS (MEDIAN)	NON-WMS (MEDIAN)	Mann-Whitney Test *P value < 0.005 with Bonferroni Correction
CARRY OUT	**5.00**	**3.50**	**.008**
COMFORT NEEDS	**4.00**	**2.50**	**.003***
HEALTH NEEDS	**5.00**	**2.00**	**.003***
OPERATION	**5.00**	**2.00**	**.001***
REACH	**3.00**	**2.00**	**.007**
TRANSFER	**5.00**	**4.00**	**.031**
PERSONAL	**5.00**	**3.00**	**.014**
INDOOR MOBILITY	**5.00**	**3.50**	**.007**
OUTDOOR MOBILITY	**4.00**	**2.00**	**<.001***
TRANSPORTATION	**4.00**	**4.00**	**.045**

Table 8. Responses of Existing WMS and Non-WMS users at retest (Time 2)

ITEM	EXISTING WMS USERS (MEDIAN)	NON-WMS USERS (MEDIAN)	Mann-Whitney Test *P value < 0.005 per Bonferroni Correction*
CARRY OUT	**5.00**	**3.00**	**.062**
COMFORT NEEDS	**5.00**	**3.00**	**.014**
HEALTH NEEDS	**5.00**	**3.00**	**.014**
OPERATION	**5.00**	**2.00**	**.056**
REACH	**3.00**	**2.00**	**.034**
TRANSFER	**5.00**	**4.00**	**.097**
PERSONAL	**5.00**	**3.50**	**.033**
INDOOR MOBILITY	**5.00**	**4.00**	**.031**
OUTDOOR MOBILITY	**4.00**	**2.00**	**.005**
TRANSPORTATION	**4.00**	**4.00**	**.302**

5.0 DISCUSSION

Based on the results of our study, the FMA has been found to be a reliable tool for measuring the perceived functional status and outcomes of both Existing WMS and non-WMS users of mobility devices. High Intraclass Correlation Coefficients (ICC $\geq$ 0.87) were achieved for the total sample scores.

Within the Existing WMS user groups, the ICC value for each item was greater than or equal to 0.80 (ICC $\geq$ 0.80), with the exception of carrying out daily routines (ICC = 0.75) and transfers (ICC = 0.74). However, the ICC scores for carrying out daily routines and transfers still demonstrate moderate reliability (Portney & Watkins, 2000). Items that demonstrate stronger reliability include comfort (ICC=0.84), operation (ICC=0.89) and outdoor mobility (ICC= 0.88). Because our ICC values were >0.80, we accepted the research hypothesis 1: The test-retest reliability will be established at $\geq$ 0.80 using the intra-class correlation coefficient (ICC).

The scores for Carrying out daily routines may be lower because the daily routines may differ significantly among study participants. The FMA was found to be an equally reliable tool for Non-WMS users (i.e., not a user of a wheeled mobility device). Results for Non-WMS users yielded an ICC value of 0.93 for carrying out daily routines, 0.90 for personal care, 0.87 for

transfers, and 0.86 for indoor mobility. Health and reach achieved ICC scores of 0.75 and 0.76 respectively, demonstrating moderate reliability among Non-WMS users. Currently, no other self- report outcome tools are designed to measure functional performance of both current Existing WMS users and Non-WMS users using canes, crutches or walkers and going to AT clinics for the first time for a new wheelchair or scooter assessment.

Comparison of the within-group participant's responses based on the Weighted Ranked Order (WRO) sums and ranking for individual items revealed that the users were consistent in ranking and in total scores on the FMA. Less variability was found in the WRO sums and ranks for the test and retest for the total group. In a comparison of total participants based on the WRO sums, both the 'indoor mobility' and 'transfer' were ranked first and second, respectively, on the test and then retest results. Among Existing WMS users, rankings for transfer, comfort, outdoor mobility, and reach were ranked the same in test and retest (ranked third, sixth, ninth and tenth respectively in test-retest). Among Non-WMS users, ranking for transfer, indoor mobility, comfort needs and outdoor mobility were ranked the same in test and retest (ranked first, second, seventh and tenth respectively in test-retest). The findings reveal that the WRO sums and consumer prioritizations of items on an individual basis during test-retests were consistent. Indoor mobility, transfers, outdoor mobility and reach yielded higher scores among Existing WMS users than the Non-WMS users for all items at test and retest, which supports the clinical view that Existing WMS users have a better understanding of the different features of seating mobility devices including manual wheelchairs, power wheelchairs and scooters.

Median values for the scores of individual items on the FMA indicate that the responses of the Existing WMS users and Non-WMS users differed. Individuals in the Existing WMS group scored higher for all items except Transportation, than the Non-WMS users in test-retest. The majority of median scores for all individual items were in the range of 3-5 among Existing WMS while the Non-WMS user's scores had a median value in the range of 2- 4. Results from Mann-Whitney U tests partially support our second research hypothesis that a difference will be found between the responses among the Existing WMS and the Non-WMS groups, as only four items scored significantly different (p value $\leq$ 0.005) at the test administration, but not at the retest. However, during the retest, items such as carrying out daily routines, operation, transfers and transportation showed no significant difference in response during the retest administration. This partial support of our hypothesis may be due to a small sample size, non-equivalent study groups, and regression toward the mean or maturation effects.

The purpose of this study was to revise the FEW to meet the needs not only of current wheeled mobility device users, but also to meet the needs of individuals who are not currently using a wheeled mobility device as the current version of the FEW was not designed to address the functional status and functional changes among new wheeled mobility device users. The FMA items yielded higher reliability coefficients compared to the latest version of the FEW (0.41 - 0.83), (Mills, Holm, & Schmeler, 2007).

The QUEST is considered to be a global assessment tool for AT, as it measures the concept of satisfaction related to the device used and the service delivery for those devices. The research of Demers et al. (2002) has indicated that QUEST has excellent test-retest reliability.

QUEST collects consumer responses on effectiveness of technology and AT service delivery by assessing items such as durability and comfort of technology and service delivery, repairs and professionalism of AT services. QUEST does not evaluate functional changes with respect to ADLs and IADLs in home or community settings. Comparatively, the FMA is a more inclusive tool which includes characteristics such as operation, durability, independency, safety and follow-up in addition to functional performance measurement. While the QUEST was designed to measure user satisfaction with various kinds of technology and services, the FMA is designed to measure both functional performance and satisfaction related with mobility devices only. The FMA tool was as reliable as the QUEST (0.82-0.91), (Demers et al., 2002), and the PIADS (0.87-0.92), (Jutai & Day, 2002).

The PIADS measures psychosocial effect of assistive technology on quality of life, which helps clinicians to identify the impact of prescribed AT (Day & Jutai 1996). The PIADS places more emphasis on competence, adaptability, and self–esteem, and, unlike the FMA, is not designed to measure functional outcomes related to mobility device use. Demers et al. (2002) found the PIADS to have robust reliability (r=0.92, 0.88 and 0.87) for the competence, adaptability and self esteem, respectively)

The WcS-DAT is a reliable and stable self-report tool for measuring discomfort while seated in a wheelchair. Thus, the WcS-DAT is not applicable to assess functional performance such as transfers, reaching to different surface heights, and indoor mobility while seated in a wheelchair,. Moreover, test-retest reliability was performed at an interval of one only hour, which increases the probability of carryover effects. Also, all the participants had intact

sensation, so results obtained using this tool cannot be generalized to the population whose sensation was not within normal limits (Crane et al., 2005).

The WhOM has demonstrated test-retest reliability ICC scores with a broader range of ICC values and a lower boundary ICC score than the FMA. The WhOM also contains questions regarding body structure, based on the WHO's ICF Model, which are not included in the FMA. Garden et al. (2009), found good test-retest reliability (based on an ICC value of 0.90) and inter-rater reliability (ICC of 0.89) when the tool was used with a population of individuals with spinal cord injuries who used wheelchairs. Auger et al. (2010) also reported good test-retest reliability (ICC= 0.77 - 1.00) using the WhOM during telephone administration among middle-aged and older populations using power mobility devices. Comparatively, the FMA is applicable to all kinds of wheelchair users irrespective of age.

The LSA- French version achieved good test-retest reliability (ICC=0.87) for older adults using a powered mobility device only. The LSA was systematically designed to measure mobility patterns among older adults only. Moreover, in Auger's study all the participants were power wheelchair users. Also LSA doesn't address other functional components including transfers, reach out, carrying out ADLs and IADLs. Thus, the LSA has not been tested on younger populations and nor tested to measure functional performance on manual wheelchair and non wheeled mobility users.

The test-retest reliability total score of the FMA across all users (ICC = 0.87) is consistent with the total score of the FEW (ICC 0.86). An itemized comparison between the

FEW and the FMA indicated that some of the items in the FMA yielded higher reliability. In one study (Mills et al., 2007), the FEW yielded an ICC of 0.52 for carrying out daily routines, 0.57 for 'reach' and 'carrying out tasks at different surface heights,' 0.41 for 'personal care tasks' (e.g., dressing, bowel/bladder care, eating, hygiene), and 0.46 for 'outdoor mobility.' On the FMA, for both Existing WMS users and Non-WMS users, the test-retest reliability of the item 'transportation' scored for total participants equaled 0.96; for Existing WMS users , 0.95; and for Non-WMS users, 0.98) showing better test-retest reliability than the FEW (ICC = 0.75 for personal and public transportation). This finding may result because 50 % of the FMA study participants were Non-WMS users, and most of them used their personal vehicles for transportation, which does not require modification to accommodate the disability of consumers using canes, crutches or walkers; also more individuals in the Existing WMS users group used manual wheelchairs for their primary mobility. Among Existing WMS users, most of the participants felt less positive about using their wheelchairs for reach and outdoor mobility, which was similar to results found in the FEW study (Mills et al., 2007). Both the FEW and the FMA shows little variance in WRO sums and ranks during test-retest trials.

Multiple factors could have influenced the test-retest reliability results leading to the FMA demonstrating better reliability than the FEW. For example, when the FMA was created from the FEW, an attempt was made to use more simple language that is easier to understand for both clinicians and clients. For example, the language of first item in the FEW, "*The stability, durability and dependability features of my wheelchairs/scooter contributes to my ability to carry out my daily routine as independently, safely, and efficiently as possible,"* was simplified

and shortened in the FMA to *"My current means of mobility allows me to carry out my daily routine as independently, safely and efficiently as possible."* (Refer to appendix B). The language of the FEW excludes new users, and clinicians have to ensure that they explain the meaning of question to clients. Clients may have had difficulty understanding the contextual relationship of the stability, durability, and dependability features of their wheelchairs within their daily routine. Also, the vague wording of several items on the FEW increased its. For example, the first line in the items from 2 to 10 in the FEW (see appendix B) has too many items to evaluat3: *"The size, fit, postural support and function features of my wheelchair/ scooter allows me . . ."* Wording these items in this way increased the complexity of the questionnaire, and again excluded the people who are new users of wheeled mobility devices, or are currently using canes, crutches, or walkers. Consumers may have had a hard time understanding the contextual meaning of postural and functional features. This wording was simplified in the FMA to *"My current means of mobility allows me . . . ,"* This reduced the clinician's burden when administering the tool and eliminated the additional time needed for explaining and clarifying the questions. Also, the participant burden was likely reduced as they would have needed less time to understand the language of FMA items and to rate each item.

In addition to the differences in wording of the items, variance in the test-retest reliability results between FEW and FMA might be due to demographic characteristics. For example, participants assessed with the FEW had diagnoses of neurological impairment including cerebral palsy (CP) and traumatic brain injury (TBI), which differed from those who completed the FMA. The FMA participants were more likely to report having orthopedic conditions. Also, with the FMA, Existing WMS users had similar demographic characteristics,

as this group included participants with neurological impairments including CP, cerebral vascular accidents (CVA or stroke), spinal cord injury (SCI), multiple sclerosis (MS) and muscular dystrophy (MD), while the Non-WMS users group included more participants with non-neurologic, general conditions, such as arthritis, amputation, or decreased cardiopulmonary capacity. Further, cognitive limitations resulting from underlying medical conditions might have influenced the response of those completing the FEW during test–retest. Thus, these demographic characteristics could have affected the test-retest reliability results when comparing the FEW and the FMA.

Another reason for the higher reliability of FMA compared to FEW could be in the way the questionnaires were administered. During the administration of the FEW, participants were asked to send the retest (Time 2) FEW questionnaires by mail after self-administering the questionnaire. With the FMA, a single study investigator collected the questionnaire data over the phone and provided assistance as needed. Possibly, this difference in administration of the questionnaire could introduce some bias in participant's ratings, similar to that reported in the study by Smith, Fielder, Hamilton, & Ottenbacher, (1996) of the Functional Independence Measure (FIM) retest. However, this method was identified to be effective for self-report instruments for identifying follow-up (retest) outcomes (Smith, Fielder, Hamilton, & Ottenbacher, 1996). Also, in a study by Auger et al. (2009), use of the telephone was found to be a reliable means of communication to assess self-report questionnaires. Specifically, when Auger et al. (2009) studied the psychometric properties of the French-Canadian version of the Life-Space Questionnaire (LSQ-F) for power mobility device users using the telephone, the applicability of the LSQ-F was satisfactory, considering an acceptable burden of assessment with

low refusal of the telephone interview format (8%; n = 4; total n=32). In the present study, out of the 42 subjects recruited, one participant did not respond to complete the FMA retest on the phone. Therefore, we believe the use of a phone interview for retest of the FMA was an appropriate method.

This current study also increased the applicability of the FMA for measuring functional performance with users of other mobility devices including canes, crutches, walkers or prostheses. Non-WMS users demonstrated higher reliability than Existing WMS users, although average total scores were higher in WMS users. This finding indicates that new users were not influenced by confounding factors such as the perception that scoring high will increase the probability of being prescribed a new wheelchair with power seat functions. This finding also disproves the probability of redundancy in ICC values among all participants as the nature of the responses of the Existing WMS users was different from Non-WMS users on the basis of median scores and Man Whitney U test ($P \leq 0.005$ – Note: Bonferroni correction) for individual items. The FMA had strong content validity because it: (a) was validated by clinicians; and (b) was a modification of the FEW, which was generated from consumer input, clinician input, and examination of related issues in the literature. The results of our study also support the intent of the FMA and FEW instruments for measuring functional performance through self report questionnaires.

5.1 LIMITATIONS AND FUTURE WORK

This study has several limitations: 1. Participants were a convenience sample, as a sample of WMS and Non-WMS users could not be selected randomly; 2. All participants were recruited from one assistive technology clinic; 3. The same person was involved in recruiting participants, administering the test and retest FMA, which may result in rater bias; 4. The participant's answers on the re-test (Time 2) could have been influenced by their completed test (Time 1) FMA; and 5. Participants could have performed well on the reliability testing of this questionnaire, as they knew they were a part of a research study – the Hawthorne Effect.

In the future, it would be beneficial to examine the inter-rater reliability of the FMA with raters administering the retest FMA being different from the rater of the test FMA. Further studies should also have larger sample sizes, be conducted at multiple sites, and be from a variety of settings – outpatient clinics, VA clinics, inpatient rehabilitation services, etc. A future plan is to create a central registry with which to conduct follow up FMA's on a regular basis using the telephone. Also, in the future, touch screen kiosks should be tried in a clinical setting in order to consumers to assess their own functional performance, thus saving the clinician's time during the clinical assessment. Kiosks or touch screen instruments can be applied during the test administration of the FMA. This will also help in data collection and measuring the functional outcomes at a broader level. For test-retest reliability, a comparable method of administration (e.g., self reported, phone, online, with a kiosk, or in person interview) is also recommended.

5.2 CONCLUSION

The FMA was found to have excellent test-retest reliability compared to its predecessor, the FEW. The FMA demonstrated equal or better reliability with other self-report outcome measure instruments used in assessing assistive technology. The findings of this study indicate that simplifying the language of this questionnaire increased the reliability of this outcome tool for collecting data about consumer satisfaction with and functional performance of Existing WMS and Non-WMS devices. This study also suggests that measuring self-report outcomes by means of the telephone was effective, which can be used in the future to reduce the workload of clinicians and the need for consumers to come to a clinic for an outcomes follow-up. The FMA was found to be a reliable tool to collect information on consumer's satisfaction with their current means of mobility. Information from this study may reduce the gap in consumer-relevant outcome data for consumers coming for wheelchair assessments. Further, it may help prevent the premature abandonment of assistive technology provided to persons with disabilities.

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APPENDIX A

[THE FUNCTIONAL MOBILITY ASSESSMENT QUESTIONNAIRE]

Functional Mobility Assessment (FMA)

DIRECTIONS:

Step 1. 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 current means of mobility (i.e., walking, cane, crutch, walker, manual wheelchair, power wheelchair or 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 write and specify the reason for your disagreement in the C*omments* section.

Step 2. Please determine your priorities, by rating the importance of the content in each of the 10 questions in the shaded box to the right of each question. Rate your highest priority as 10, and your lowest priority as 1.

What is your current means of mobility device? *(Check all that apply)*	Walking_____ Walker_____ Cane_____ Crutch_____ Manual Wheelchair_____ Power Wheelchair_____ Scooter_____

1. My current means of mobility allows me <u>to carry out</u> my daily routine 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)*	Completely Agree	Mostly Agree	Slightly Agree	*Slightly Disagree	*Mostly Disagree	*Completely Disagree	Does not apply	Rating priority
Comments:								

2. My current means of mobility meets my <u>comfort needs</u>: (e.g., heat/moisture, sitting tolerance, pain, stability)	Completely Agree	Mostly Agree	Slightly Agree	*Slightly Disagree	*Mostly Disagree	*Completely Disagree	Does not apply	
Comments:								

3. My current means of mobility meets my health needs: (e.g., pressure sores, breathing, edema control, medical equipment)	Completely Agree	Mostly Agree	Slightly Agree	*Slightly Disagree	*Mostly Disagree	*Completely Disagree	Does not apply	
Comments:								
4. My current means of mobility allows me to be as independent, safe and efficient as possible: (e.g., do what I want it to do when and where I want to do it)	Completely Agree	Mostly Agree	Slightly Agree	*Slightly Disagree	*Mostly Disagree	*Completely Disagree	Does not apply	
Comments:								
5. My current means of mobility allows 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:								
6. My current means of mobility allows me to transfer from one surface to another: *(e.g., bed, toilet, chair)*	Completely Agree	Mostly Agree	Slightly Agree	*Slightly Disagree	*Mostly Disagree	*Completely Disagree	Does not apply	
Comments:								

7. My current means of mobility allows me <u>to carry out personal care tasks</u>: *(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. My current means of mobility allows me <u>to get around indoors</u>: *(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. My current means of mobility allows me <u>to get around outdoors</u>: *(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. My current means of mobility allows me <u>to use personal or public transportation</u> 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:								

[THE FUNCTIONING EVERYDAY WITH A WHEELCHAIR]

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 C*omments* section.

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)*	Completely Agree	Mostly Agree	Slightly Agree	*Slightly Disagree	*Mostly Disagree	*Completely Disagree	Does not apply	Rating priority
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)*	Completely Agree	Mostly Agree	Slightly Agree	*Slightly Disagree	*Mostly Disagree	*Completely Disagree	Does not apply	
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)*	Completely Agree	Mostly Agree	Slightly Agree	*Slightly Disagree	*Mostly Disagree	*Completely Disagree	Does not apply	
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)*	Completely Agree	Mostly Agree	Slightly Agree	*Slightly Disagree	*Mostly Disagree	*Completely Disagree	Does not apply	
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,*	Completely Agree	Mostly Agree	Slightly Agree	*Slightly Disagree	*Mostly Disagree	*Completely Disagree	Does not apply	

shelves) (e.g., table, counters, floors, shelves)								
Comments:								
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	Completely Agree	Mostly Agree	Slightly Agree	*Slightly Disagree	*Mostly Disagree	*Completely Disagree	Does not apply	

wheelchair/scooter allow me to get around indoors as independently, safely, and efficiently as possible: *(e.g., home, work, mall, restaurants, ramps, obstacles)*								
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	

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)*