ASSESSMENT OF POWER WHEELCHAIR USER SATISFACTION USING SEAT ELEVATORS

by

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The purpose of this study was to assess the difference in satisfaction of using seat elevators (SE) on power wheelchairs among individuals with disabilities through retrospective analysis of two clinical quality assurance databases that included time 1 (T1) and time 2 (T2) Functional Mobility Assessment (FMA) scores. The FMA is a validated self-report questionnaire that measures a person's satisfaction in performing Mobility Related Activities of Daily Living (MRADL) across 10 items (Kumar, 2013). The databases collectively held 731 cases while 123 cases met the inclusion criteria of using a power wheelchair equipped with a SE at either T1, T2, or both. Three aspects of the FMA were assessed; #5 (reach), #6 (transfer), and total score. Cases were assigned to one of the three following groups; power wheelchair (PWC) users using a device with a SE at T1 but using a new device without a SE at T2 (SE – NSE, n = 14); PWC users using a device with a SE at T1 and using a device with a SE at T2 (SE – SE, n = 42); and PWC users using a device without a SE at T1 but using a device with a SE at T2 (NSE – SE, n = 67). The three aspects of the FMA were analyzed within the three groups of PWC users. For the SE-NSE group, there was a significant decrease for FMA item #5 (reach) ($p = .03$). There were no significant changes for FMA item #6 (transfer) ($p = .48$) and total score ($p = .57$). For the SE-SE group, there were significant improvements in FMA items #5 (reach) ($p < .01$), #6 (transfer) ($p < .01$), and total score ($p < .01$). For the NSE-SE group, there were significant improvements for FMA items #5 (reach) ($p < .01$), #6 (transfer) ($p < .01$), and total score ($p < .01$). In

summary, the study indicates a SE can increase satisfaction of PWC users. The lack of a statistically significant difference in FMA item #6 and FMA total for the SE – NSE group was likely due to a small sample in that subgroup.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

PREFACE

I would like to thank everyone involved in the preparation, writing, and editing of my thesis. Specifically, Mark Schmeler, Brad Dicianno, Annmarie Kelleher, Andi Saptono, and Richard Schein. I would also like to thank the individuals that assisted and facilitated data collection throughout the last few years. Specifically, Geoffrey Henderson and Corey Hickey. I would also like to thank Brad Dicianno and the Statistics Consulting Service for aiding me with performing the statistical analysis. Lastly, I would like to thank my friends and family that provided me with the patience and perseverance needed to complete this thesis.

1.0 INTRODUCTION

1.1 BACKGROUND

Types of wheeled mobility seating related devices include manual wheelchairs, power scooters, and power wheelchairs. The Rehabilitation Engineering Society of North America (RESNA) Wheelchair Service Provision Guide provides an insight to the proper wheelchair service process by identifying need, assessment of current technology and environment, equipment recommendation and selection, funding options, fitting and delivery, follow up and maintenance, and lastly, outcome measurement (Arledge et al., 2011). Medicare policy requires that for any mobility assistive equipment to be covered, it must improve or maintain a person's ability to perform Mobility Related Activities of Daily Living (MRADL) such as toileting, feeding, dressing, grooming, and bathing within the home (Center for Medicare and Medicaid Services, 2016). Several seat functions can be added to a power wheelchair such as tilt-in-space, backrest recline, and elevating leg rests to address medical issues (Dicianno, Arva, Lieberman, Schmeler, Souza, et al., 2009). The RESNA Position Paper on Seat Elevating Devices (Arva, Schmeler, Lange, Lipka, & Rosen, 2005) acknowledges that individuals with disabilities who utilize power wheelchairs move in a three dimensional world. This is sometimes overlooked as the majority of power wheelchairs only move forward, backward, left, and right. In addition, the base of the power wheelchair allows for the addition of a seat elevator for vertical movement. This is a common accessory on power wheelchairs which provides individuals the ability to perform

MRADL such as transferring and reaching (Arva et al., 2005). *The Wheelchair Evaluation: A Clinician's Guide* (Batavia, 2010) states that seat elevation optimizes transfer position, facilitates reaching high selves, and facilitates socialization by talking face to face. Biomechanically, the hip and knee joints experience a decrease range of motion when transferring from a higher to a lower seat height (Burdett, Habasevich, & Pisciotta, 1985). Reaching objects at a higher seat height impacts upper extremity joints significantly different compared to lower seat heights, specifically the cervical spine and glenohumeral joints (Sabari, Shea, & Chen, 2015). According to the National Kitchen and Bath Association (NKBA) (2016) the recommended maximum height for a stove is 34 inches and the location of the controls should not be in a position where individuals need to reach across the burners. Also according to NKBA (2016), Microwave oven controls have a recommended maximum height of 48 inches. These heights are only recommendations and may not take into account the specific needs of a wheelchair user reaching over a stove to prepare hot food. In conclusion, Medicare has determined that seat elevators are not a covered benefit as they are not medically necessary (Centers for Medicare and Medicaid Services Coverage Guidance by NHIC Corp., 2015). The purpose of this study is to investigate power wheelchair (PWC) user satisfaction in performing reach tasks, transfer tasks, and overall satisfaction in performing MRADL with and without SE.

1.2 RELATED RESEARCH

1.2.1 Functional Mobility Assessment (FMA)

The Functional Mobility Assessment (FMA) is a validated self-report questionnaire that measures a person's satisfaction in performing MRADL across 10 items. It serves as an outcome measure that can be administered and compares pre and post-delivery of a mobility device or intervention. The FMA is reported to have test-retest reliability with Intraclass Correlation Coefficient of 0.87 which is above the accepted value of ICC $\geq$ 0.80 (Kumar et al, 2013). Two items of the FMA specifically, report recorded test-retest reliability values for item #5, reach (ICC = 0.83) and item #6, transfer (ICC = 0.81) (Kumar et al., 2013). The FMA is a derivative of previously validated self-report and observation tools known as the Functioning Everyday with a Wheelchair (FEW), Functioning Everyday with a Wheelchair – Capacity (FEW-C), and Functioning Everyday with a Wheelchair – Performance (FEW-P) (Schmeler, 2005). The original FEW questionnaire has reported acceptable test-retest reliability of ICC = 0.92 for version 1 and ICC = 0.86 for version 2 (Mills, Holm, & Schmeler, 2007). Two additional studies show the FEW was cross-validated with consumer goals in the process of development (Mills et al., 2002a; Mills et al., 2002b).

The (FEW-C) was examined for inter-rater reliability (ICC = 0.97) (Schmeler, 2005). The validity of the 10 items of the FEW and the 10 items of the FMA are congruent with one another. The only difference is the FMA focuses on mobility in general while the FEW focuses on wheelchairs specifically. The FMA was developed from the FEW by rewording the statements to remove reference to wheelchair or scooter as many people with mobility impairments seen at initial clinical evaluation for a device or intervention were not using a

wheelchair or scooter therefore difficult to obtain a baseline score for comparison post-intervention (Kumar et al., 2013).

1.2.2 Seat Elevators on Power Wheelchairs

Seat functions such as tilt-in-space, recline, and elevating seats are commonly used by wheelchair users to perform MRADL (Arva et al., 2005; Dicianno et al., 2009). According to Ding et al. (2008) six individuals who use power wheelchairs equipped with seat elevators reported using the accessory four times per day on average. Seat elevators were used to complete tasks such as reaching higher levels, transfers, working at different levels, shopping, sitting at a bar, accessing light switches, toileting, socializing, eating, reading calendars on the refrigerator, and reaching elevator buttons.

Liu, Cooper, Kelleher, and Cooper (2014) reported on the use of power seat functions (tilt-in-space, recline, elevating legrests, and seat elevators) in the natural environment of five wheelchair users. The participants reported that power seat elevators were beneficial in reaching over shoulder height and standing up.

1.2.3 Transfers in Reference to Seat Height

Edlich, Heather, and Galumbeck (2003) performed a systematic review to investigate limitations in the ability to perform to sit-to-stand transfers and found presence of pain, reduced joint range of motion, joint stiffness, and muscle weakness as contributing factors. Lower moments of the

knee and hip joints at higher chair height were a result of the study. Other factors such as arm rest use and feet repositioning also contributed to a person's ability to stand. The review also indicated higher seat heights benefit healthcare personnel by eliminating the need to lift the individual while standing from a seated position.

Janssen, Bussmann, and Stam (2002) performed a review of 39 studies that fit the criteria of sit-to-stand transitions. The review found that a number of factors can influence sit to stand performance including seat height, armrests, and foot positioning. Specifically, the review indicates that a higher seat height results in lower force moments at the hip and knee level and that upper and lower extremity joints are affected by seat height during transfer.

Alexander, Gross, Medell, and Hofmeyer (2000) reported that biomechanically, standing from a lower seat height increased joint torque at the hip and knee joint. The study consisted of 16 participants who completed a 12 week strength-training program. The assessment included 7 chair rise tasks in which the effects of seat height adjusted to three different angles of flexed knee height were analyzed.

Burdett, Habasevich, and Pisciotta (1985) examined wheelchair transfers by measuring range of motion at the ankle, knee, and hip joints. The initial seating height of the participant observed was 0.43 meters and the second height observed was 0.64 meters. The study included 14 participants overall and was a mix between able and disabled users. The study found that significantly smaller hip and knee flexion were observed using a higher seat height. The study concluded that the use of a higher seat height while rising out of a chair is less stressful on joints. The study noted that similar results were found in both able bodied and persons with disabilities.

Crytzer, Cooper, Jerome, and Koontz (2015) examined factors that allow individuals to independently transfer from one surface to another and perform activities of daily living.

Participants for the study included 38 individuals who voluntarily participated. These volunteers consisted of experts in the field of assistive technology. As a result, user issues, factors, concerns, transfer process, transfer techniques, transfer preferences, built environment, and transfer training evaluation were determined to be the relevant goals. The relevant goals were used to determine research needs.

Toro, Koontz, and Cooper (2012) investigated the impact of transfer setup on the performance of independent wheelchair transfers. This study included 120 participants who performed transfers onto a height adjustable platform. The participants included were wheeled mobility users. The results showed highest and lowest heights of transferring were similar to the median seat to floor height (56 centimeters) of wheelchair users.

Gagnon, Nadeau, Desjardins, and Noreau (2007a) looked at kinematic factors in a case study involving one subject with a T6 spinal cord injury performing a sit to pivot transfer from two stationary platforms at a height of 50 centimeters and 60 centimeters. The findings showed that transferring to the higher surface resulted in greater elbow flexion and shoulder adduction. In a subsequent study of similar methods (Gagnon, Nadeau, Noreau, Eng, & Gravel, 2007b) ten participants with spinal cord injuries performed transfers to a 70 centimeter high seat height and a 40 centimeter lower eat height. Results indicated that time to complete transfers did not change from the case study however shoulder and elbow joint range of motion was more pronounced as height increases.

In conclusion, the literature shows that upper extremity and lower extremity joints are affected by seat height during transfers. Transferring from a higher to a lower height results in less strain to the upper and lower extremities as compared to transferring from a lower to a

higher height which can have significant impact on individuals with weakness or repetitive strain injuries.

1.2.4 Reaching in Reference to Seat Height

Sabari, Shea, and Chen (2015) studied the impact of wheelchair seat height on neck and shoulder range of motion and the ability of individuals to perform functional reach tasks. This observational study examined active range of motion for cervical extension and shoulder abduction as well as physical stature. The participants included 60 ambulatory adults seated symmetrically in a power wheelchair. Each participant was required to complete two tasks at normal seat height and maximum seat height. The tasks included viewing a tablet at a height above the head of the participant and hitting a switch with minimal movement using their index finger. The results indicate that wheelchair seat height impacts shoulder abduction and cervical extension active range of motion while performing reaching tasks. A larger active range of motion is needed to perform reaching tasks at a lower seat height.

1.2.5 Seat Elevator Funding

The Veterans Health Administrations Prosthetic Clinical Management Programs (U.S. Department of Veterans Affairs, 2004a) and the Clinical Practice Recommendations for Motorized Wheeled Mobility Devices (U.S. Department of Veterans Affairs, 2004b) outlines the recommendations for prescribing seat lift mechanisms. The medical criteria notes that “the use

of a seat lift mechanism is to make transferring from a seating position easier". The VA will cover the cost of a seat elevator as long as the Veteran meets the necessary requirements.

Medicare outlines the coverage of stationary seat lifts chairs for in the Medicare National Coverage Determinations Manual (Centers for Medicare and Medicaid Services, 2016). The coverage is limited to effectively assisting a patient in standing up or sitting down without other assistance. The Centers for Medicare and Medicaid Services Coverage Guidance provided by the National Health Insurance Company (NHIC) Corporation (2015) provides a Wheelchair Options/Accessories document (L33792) that states "power seat elevation features are non-covered because they are not primarily medical in nature". No further rationale is given for this policy. Additionally, funding from state Medicaid programs and private programs are available however most follow the Medicare policy. In conclusion, seat elevators can be covered by certain payers but denied by other payers.

2.0 ASSESSMENT OF SEAT ELEVATOR SATISFACTION

2.1 INTRODUCTION

In the United States, 38.3 million (12.6% of the U.S. population[1]) non-institutionalized individuals had a severe disability in 2010 and 12.3 million individuals (4.4% of U.S. population[1]) need assistance with one or more activities of daily living. As reported, 3.6 million individuals use a wheelchair and 11.6 million individuals use a cane, crutch, or walker (Brault, 2012). The Brault study, consisting of 241,682 individuals were asked if they could perform individual tasks, 5% reported that they had difficulty reaching for objects overhead.

These numbers focus on the United States population in past years and reflect the need of an intervention. Insurance plays a role in the lives of individuals with disabilities as 81.7% of individuals report making <$25,000 per year (Brault, 2012). This affects the individuals' ability to pay for certain assistive technology that is not covered under insurance. This reflects the 21% of individuals reporting that they were not enrolled in any health insurance coverage in 2010 (Brault, 2012). Medicare does not currently fund seat elevating devices as they do not consider them medically necessary (Centers for Medicare and Medicaid Services, 2016). The VA allows Veterans the use of seat elevators on their mobility device as long as certain functional criteria

[1] Based on the 2010 U.S. Census Population of 308,745,538

are met (U.S. Department of Veterans Affairs, 2004b). Certain states have programs that may offer assistance with seat elevator funding as well as private payment by private insurance or the user themselves (Groah, Ljungberg, Lichy, Oyster, & Boninger, 2014).

Outcome measures have become a necessity in all aspects of health care service delivery including wheeled mobility and seating (Arledge et al., 2011). The process begins by collecting baseline data related to a personal event or action (Hersen, 2004). The data is then collected at a second point in time and is considered an outcome measurement. Information from outcome measurement can be used to evaluate and improve the quality of care for individuals (Lohr, 1988). An outcome measure is ideally obtained by using a standardized tool such as the FMA. The FMA is a self-report consumer centered questionnaire to assess a person's satisfaction in performing MRADL. It can also be used as an outcome measure when administered post-intervention. The FMA consists of ten statements (carrying out daily routine, meeting comfort needs, meeting health needs, ability to operate, reaching and carrying out tasks at different surface heights, transferring, carrying out personal care tasks, getting around indoors, getting around outdoors, and using public or personal transportation) (Kumar et al., 2013) (Appendix A). These ten statements pertain to consumer satisfaction with overall mobility related to activities of daily living. Two statements from the FMA refer to the satisfaction with reaching and carrying out tasks at different surface heights and transferring from one surface to another. These two statements can be impacted by seat height and the functional ability of the individual to perform these tasks (Sabari et al., 2016; Burdett et al., 1985; Janssen, Bussman, & Stam, 2002; Alexander et al., 2000).

The use of a seat elevator is the main focus of this study. Three null hypotheses align with the three groups in the study and are listed as follows:

- Null Hypothesis 1: There will be no statistically significant difference in FMA item #5 (reach), item 6 (transfer), or total FMA scores for power wheelchair users who have a device equipped with a seat elevator at Time 1 compared to the same measures when the user has a new device unequipped with a seat elevator at Time 2.
- Null Hypothesis 2: There will be no statistically significant difference in FMA item #5 (reach), item 6 (transfer), or total FMA scores for power wheelchair users who have a device equipped with a seat elevator at Time 1 compared to the same measures when the user has a new device equipped with a seat elevator at Time 2.
- Null Hypothesis 3: There will be no statistically significant difference in FMA item #5 (reach), item 6 (transfer), or total FMA scores for power wheelchair users who have a device unequipped with a seat elevator at Time 1 compared to the same measures when the user has a new device equipped with a seat elevator at Time 2.

2.2 METHODS

2.2.1 Study Design

This study was a retrospective analysis of data collected under an approved quality assurance initiative. The study consisted of two separate databases that contained time 1 (pre) FMA scores and time 2 (post) FMA scores of 731 wheelchair users. Participants in the databases were divided into the following three groups:

- individuals with disabilities who were using a seat elevator initially at time 1 and lost the seat elevator at Time 2 (n = 14),

- individuals with disabilities who were using a seat elevator at Time 1 and maintained the seat elevator at Time 2 (n = 42),
- individuals with disabilities who were not using a seat elevator at Time 1 and obtained a seat elevator at Time 2 (n = 67).

At each time point (time 1 and time 2) the FMA scores were collected by a rehabilitation professional or student in a rehabilitation field. Time 1 FMA scores were collected at any time between 04/08/2008 – 08/18/2015. Time 1 FMA scores were recorded in seating clinics by rehabilitation professionals. Time 2 FMA questionnaires were performed at any time between 11/29/2010 – 02/22/2016. At any given data point, FMA time 2 scores were recorded no less than 21 days post-delivery. Time two FMA scores were collected by rehabilitation professionals by phone, letter, or face-to-face. The FMA data were extracted from both databases. When available, additional demographic variables were collected including gender, age, primary diagnosis, and primary insurance (Table 1).

2.2.2 Participants

Cases for inclusion met the following criteria:

- Seat elevator was recommended
- Time 1 FMA was completed
- Time 2 FMA was completed
- Cases had a power wheelchair at time 1 and time 2
- Age of 18 years or older.

The 123 cases were retrieved from two databases. The first database was housed at the Department of Rehabilitation Science and Technology (RST) at the University of Pittsburgh (n = 483) and included a collection of de-identifiable data from multiple seating clinics in which 41 cases met the inclusion criteria. The second database was from the Center for Assistive Technology at the University of Pittsburgh Medical Center (UPMC/CAT) (n = 248) in which 83 cases met the inclusion criteria.

2.2.3 Instruments

The only instrument included in this study was the Functional Mobility Assessment (FMA). The tool was administered at two time points and was performed by rehabilitation professionals such as students in the field of rehabilitation science, clinicians, or suppliers. Individuals who performed the FMA were experienced and had some training in use of the tool prior to administering it. The 10 statements of the FMA can have a response of 1-6 with 1 as completely disagree with the statement, 2 as mostly disagree with the statement, 3 as slightly disagree with the statement, 4 as slightly agree with the statement, 5 as mostly agree with the statement, and 6 as completely agree with the statement (Appendix B). Additional comments can be recorded under each statement however this was not collected or analyzed. All individuals who completed the FMA had to be cognitively able to answer by speaking themselves, pointing to the response, or facilitating their response to a proxy to relay the appropriate response.

2.2.4 Procedures

Retrospective and de-identifiable data were extracted from the RST and UPMC/CAT databases. Data within each database was collected beforehand and entered into each database respective to the seating clinic it was obtained. Each database was comprised of similar variables which kept consistency between the data. The data points extracted from the databases into the study for analysis were filtered out using the inclusion criteria. All cases were de-identified before any data was extracted resulting in only coded data. The de-identified data from both, the RST database and UPMC/CAT database was extracted and imported into a single excel document.

2.2.5 Data Analysis

Baseline demographics were used to determine if the three groups (SE-NSE, SE-SE, and NSE-SE) were homogeneous. For all tests, an alpha level of 0.05 was used. The three groups were compared with respect to baseline demographics such as gender, primary diagnosis, and primary insurance. All three variables were tested using a chi-square goodness of fit test between groups. If the test revealed a subject size under 5 then Fisher's Exact test was utilized. Analysis of Variance (ANOVA) was performed for age. A Wilcoxon Signed Ranks Test was performed for each group. The variables assessed were FMA #5 (reach), FMA #6 (transfer), and FMA total score within each group. All data were analyzed using IBM SPSS Statistics Version 23 Software (Statistical Package for the Social Sciences Statistics). A power analysis was conducted using G*Power software (Faul, 2014) to examine sample size for each FMA variable within each group. The type of power analysis used was a priori and the statistical test used was a Wilcoxon

signed-rank test (matched pairs). In addition, the effect size was calculated for the three groups and were interpreted using Cohen's d.

2.3 RESULTS

Overall, 123 cases were included in this analysis. Gender was not equally distributed between the three groups (Fisher's Exact Test, $p = .04$) (See Table 1). Primary diagnosis was not equally distributed between the three groups (Fisher's Exact Test, $p = .05$) (See Table 1). Primary insurance was equally distributed between the three groups (Fisher's Exact Test, $p = .73$) (See Table 1). The effect of age was not significant ($F(2,121) = 1.446$, $p = .24$). The data consisted of 89 males and 34 females (See Table 1). The average age of the population was 49.9 with minimum age of 18 and a maximum age of 88. Diagnostic information was missing on 50 of the cases. Of the diagnoses reported, the most prevalent primary diagnoses were multiple sclerosis (n=17), cerebral palsy (n=12), and muscular dystrophy (n=8) (See Table 1). Primary insurance information was missing on 42 of the cases. Of the reported primary insurance variable, Medicare, Medicaid Advantage, or Private Insurance HMO were most prevalent (See Table 1). The three seat elevator groups were not evenly distributed as SE-SE and NSE-SE made up 89% of the data (Table 2).

The following results relate to the SE-NSE group (See Table 3) (See Figure 1). Time 2 FMA #5 was significantly lower than time 1 FMA #5 ($Z=-2.23$, $p = .03$) (See Table 6). Time 2 FMA #6 was not significantly lower than time 1 FMA #6 ($Z=-0.71$, $p = .48$) (See Table 6). A Wilcoxon Signed-Ranks Test indicated that time 2 FMA total was not statistically significantly lower than time 1 FMA total ($Z=-0.56$, $p = .57$) (See Table 6).

The following results relate to the SE-SE group (See Table 4) (See Figure 2). Time 2 FMA #5 was significantly higher than time 1 FMA #5 (Z=-3.42, $p < .01$) (See Table 6). Time 2 FMA #6 was significantly higher than time 1 FMA #6 (Z=-3.17, $p < .01$) (See Table 6). Time 2 FMA total was significantly higher than time 1 FMA total (Z=-3.96, $p < .01$) (See Table 6).

The following results relate to the NSE-SE group (See Table 5) (See Figure 3). Time 2 FMA #5 was significantly higher than time 1 FMA #5 (Z=-5.37, $p < .01$) (See Table 6). Time 2 FMA #6 was significantly higher than time 1 FMA #6 (Z=-4.46, $p < .01$) (See Table 6). Time 2 FMA total was significantly higher than time 1 FMA total (Z=-5.63, $p < .01$) (See Table 6).

To achieve 95% power, the effect size ($R^2 = 0.01$ (d = 0.2)) revealed a sample size of N=258 for the SE-NSE group (See Table 7). The other two groups had an adequate sample size (See Table 7). Effect size was calculated in which a medium to large effect was present for the SE-SE and NSE-SE groups.

Table 1: Demographics

Age (N=122)		
Range in Years	18 - 88	
Mean ± SD in Years	49.9 ± 15.9	
Missing	1	
Gender (N=123)		
Male	N = 89	72%
Female	N = 34	28%
Primary Diagnosis (N=73)		
Multiple Sclerosis	N = 17	14%
Cerebral Palsy	N = 12	10%
Muscular Dystrophy	N = 8	7%
SCI (Paraplegia)	N = 6	5%
SCI (Tetraplegia/Quadriplegia)	N = 5	4%
Stroke/CVA	N = 4	3%
Spina Bifida	N = 4	3%
Osteoarthritis	N = 3	2%
Rheumatoid Arthritis	N = 3	2%
Other Neuromuscular or Congenital Disease (Not Listed Above)	N = 3	2%
Amputation	N = 2	2%
Amyotrophic Lateral Sclerosis/Primary Lateral Sclerosis	N = 1	1%
Traumatic Brain Injury (TBI)	N = 1	1%
Parkinson Disease	N = 1	1%
Spinal Stenosis	N = 1	1%
Osteogenesis Imperfecta	N = 1	1%
Cerebellar Degeneration	N = 1	1%
Missing	N = 50	41%
Primary Insurance (N=81)		
Medicare	N = 20	16%
Medicare Managed Care	N = 16	13%
Private Insurance - HMO	N = 16	13%
Private Insurance - Fee for Service	N = 14	11%
Medicaid Managed Care	N = 9	7%
Medicaid	N = 6	5%
Missing	N = 42	34%

Table 2: Group Distribution

Group (N=123)		
SE-NSE	N = 14	11%
SE-SE	N = 42	35%
NSE-SE	N = 67	54%

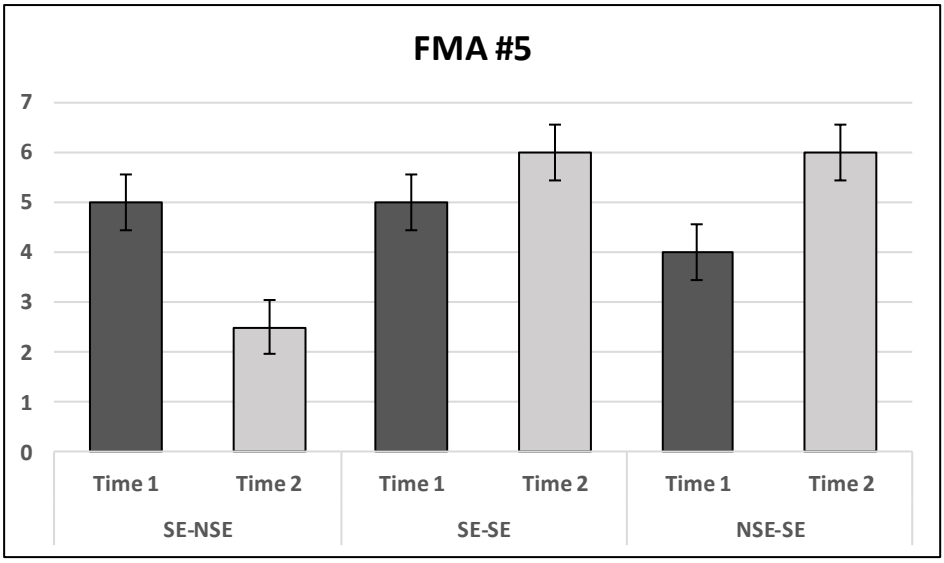

Figure 1: FMA Item #5 Score within Groups (Median)

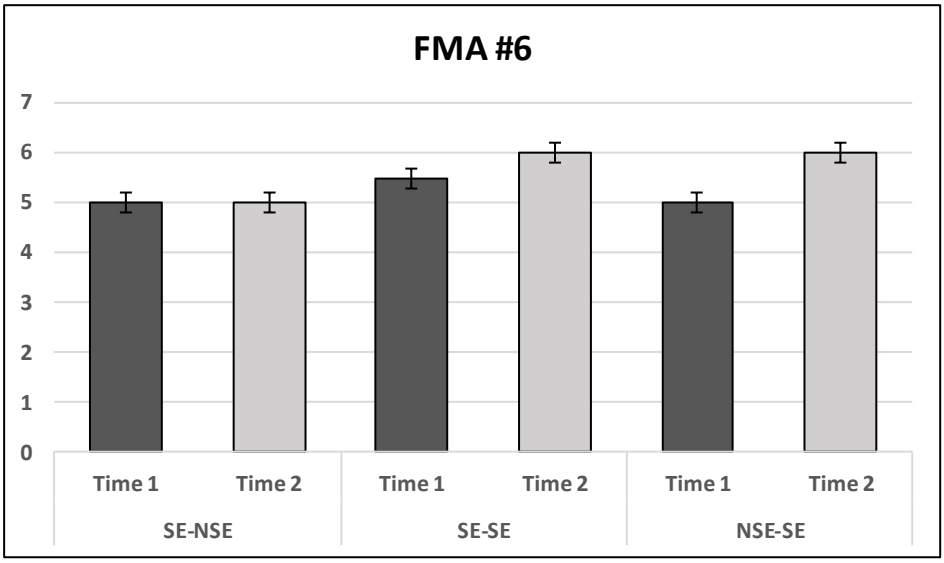

Figure 2: FMA Item #6 Score within Groups (Median)

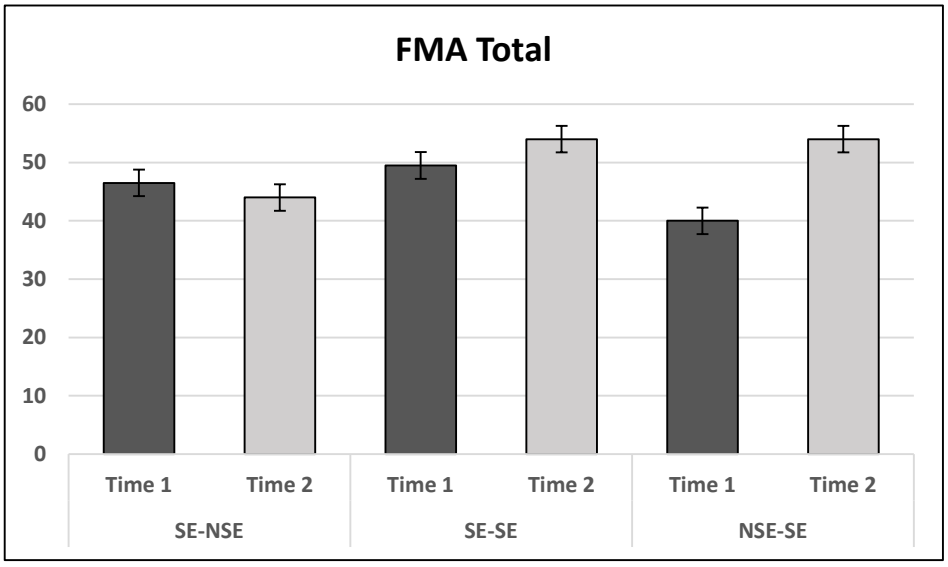

Figure 3: FMA Total Score within Groups (Median)

Table 3: Descriptive Statistics within Group 1

SE – NSE (N = 14)		
Age		
Mean ± SD in years	49.9 ± 16.2	
Gender		
Male	7	50%
Female	7	50%
Diagnosis		
Multiple Sclerosis	3	21%
SCI (Paraplegia)	2	15%
Cerebral Palsy	1	7%
SCI (Tetraplegia/Quadriplegia)	1	7%
Stroke/CVA	1	7%
Osteoarthritis	1	7%
Amputation	1	7%
Muscular Dystrophy	1	7%
Spina Bifida	1	7%
Parkinson Disease	1	7%
Missing	1	7%
Insurance		
Medicare Managed Care	7	50%
Medicare	4	29%
Private Insurance - Fee for Service	2	14%
Private Insurance - HMO	1	7%
Missing	0	0%

Table 4: Descriptive Statistics within Group 2

SE – SE (N = 42)		
Age		
Mean ± SD in years	53.2 ± 14.4	
Gender		
Male	28	67%
Female	14	33%
Diagnosis		
Multiple Sclerosis	7	17%
Cerebral Palsy	5	12%
Muscular Dystrophy	3	7%
Stroke/CVA	3	7%
SCI (Paraplegia)	2	5%
Other Neuromuscular or Congenital Disease (Not Listed Above)	2	5%
Traumatic Brain Injury (TBI)	1	2%
Osteoarthritis	1	2%
SCI (Tetraplegia/Quadriplegia)	1	2%
Cerebellar Degeneration	1	2%
Missing	16	38%
Insurance		
Private Insurance - HMO	10	24%
Private Insurance - Fee for Service	8	19%
Medicare	6	14%
Medicare Managed Care	4	10%
Medicaid	4	10%
Medicaid Managed Care	2	5%
Missing	8	19%

Table 5: Descriptive Statistics within Group 3

NSE-SE (N=67)		
Age		
Mean ± SD in years	47.9 ± 16.5	
Gender		
Male	54	81%
Female	13	19%
Diagnosis		
Multiple Sclerosis	7	10%
Cerebral Palsy	6	9%
Muscular Dystrophy	4	6%
SCI (Tetraplegia/Quadriplegia)	3	5%
Rheumatoid Arthritis	3	5%
Spina Bifida	3	5%
SCI (Paraplegia)	2	3%
Amyotrophic Lateral Sclerosis/Primary Lateral Sclerosis	1	2%
Osteoarthritis	1	2%
Spinal Stenosis	1	2%
Osteogenesis Imperfecta	1	2%
Other Neuromuscular or Congenital Disease (Not Listed Above)	1	2%
Missing	33	49%
Insurance		
Medicare	10	15%
Medicaid Managed Care	7	10%
Medicare Managed Care	5	8%
Private Insurance - HMO	5	8%
Private Insurance - Fee for Service	4	6%
Medicaid	2	3%
Missing	34	51%

Table 6: FMA Significance Levels within Groups

SE-NSE	Time 1 Score *Median (IQR)*	Time 2 Score *Median (IQR)*	
FMA #5 (reach)	5.00 (1.00 – 5.25)	2.50 (1.00 – 5.00)	$p = 0.03$
FMA #6 (transfer)	5.00 (2.00 – 5.00)	5.00 (2.75 – 6.00)	$p = 0.48$
FMA Total	46.50 (33.25 – 52.00)	44.00 (37.00 – 50.50)	$p = 0.57$
SE-SE	Time 1 Score *Median (IQR)*	Time 2 Score *Median (IQR)*	
FMA #5 (reach)	5.00 (2.75 – 6.00)	6.00 (5.00 – 6.00)	$p = 0.01$
FMA #6 (transfer)	5.50 (4.00 – 6.00)	6.00 (5.00 – 6.00)	$p = 0.01$
FMA Total	49.50 (37.00 – 55.25)	54.00 (50.75 – 59.00)	$p < 0.01$
NSE-SE	Time 1 Score *Median (IQR)*	Time 2 Score *Median (IQR)*	
FMA #5 (reach)	4.00 (2.00 – 5.00)	6.00 (5.00 – 6.00)	$p < 0.01$
FMA #6 (transfer)	5.00 (3.25 – 6.00)	6.00 (5.00 – 6.00)	$p < 0.01$
FMA Total	40.00 (28.00 – 50.00)	54.00 (48.00 – 58.00)	$p < 0.01$

**IQR = Inter Quartile Range*

Table 7: Power Analysis (95% power (α = .05))

	Effect Size (d)	Critical t	df	Sample Size (N)
SE-NSE				
FMA #5 (reach)	0.51	1.68	42.93	46
FMA #6 (transfer)	0.20	1.65	271.16	258
FMA Total	0.20	1.65	271.16	258
SE-SE				
FMA #5 (reach)	0.72	1.72	21.92	24
FMA #6 (transfer)	0.55	1.69	36.24	39
FMA Total	0.77	1.73	19.05	21
NSE-SE				
FMA #5 (reach)	1.09	1.80	10.46	12
FMA #6 (transfer)	0.72	1.72	21.92	24
FMA Total	1.11	1.82	9.50	11

2.4 DISCUSSION

2.4.1 Null Hypothesis 1 (SE – NSE)

The analysis failed to reject the first null hypothesis. FMA item #5 showed a significant difference ($p = .03$) while FMA item #6 and FMA total were not significantly different (Table 4). The data shows that individuals did not present a significantly different satisfaction score for transferring and total FMA when a seat elevator was lost at time two. This may likely be due to the small sample size of only 14 cases given the power analysis indicates a sample of 258 would be necessary for 95% power ($\alpha = .05$).

2.4.2 Null Hypothesis 2 (SE – SE)

The analysis rejected the null hypothesis as all three items from the FMA were significant (Table 4). All three variables showed a significant difference from time one to time two. The data suggests that a new device intervention had significantly higher FMA scores when a seat elevator was maintained. They were expected to stay the same. The cause to this phenomenon could be due to the device at time 1 wearing out overtime or as a result of a new device and not the seat elevator.

2.4.3 Null Hypothesis 3 (NSE – SE)

The analysis rejected the null hypothesis as all three items from the FMA were significant (Table 4). All three variables showed a significant difference from time one to time two. The data suggests that a seating intervention when a seat elevator was obtained at time two had significantly higher FMA scores as they did in the SE – SE group. The provision of a seat elevator as well as getting a new wheelchair may have contributed to the increase in FMA scores.

2.4.4 Study Limitations

Limitations were prevalent in this study. One limitation of self-report questionnaires is the possibility of individuals responding to the questions may want to please the tool administrator or concerns that scores will dictate the approval or denial of a payer. This phenomenon regarding self-report questionnaires could have influenced the individuals who responded to the FMA items. This phenomenon is known as social desirability, whereby it has been shown that responses may compromise the validity of self-report measures (Malham and Saucier, 2016). The solution to social desirability is comparing each task of the FMA to a comparable observable functional task. This would allow for the examination of associations between the user satisfactions with the task and the ability to perform the actual task (Schein et al., 2011). Other limitations include the low number of the SE-NSE group, the missing information within the variables, and the amount of time between FMA time 1 scores and FMA time 2 scores. Time one FMA scores were recorded between 8 April, 2008 and 18 August, 2015. Time two FMA scores were recorded between 29 November, 2010 and 22 February, 2016. In addition, the

follow-up FMA could have taken place over the phone, face-to-face, or through a letter in the mail. The SE-NSE group had a low number of individuals included (n=14) which did not satisfy a reasonable sample size to show a small effect. A power analysis was ran to achieve 95% power with an effect size of .02 for the SE-NSE group. The number of individuals within this group was significantly lower than the power analysis recommended number of 258. Gender was significantly different between the three groups (*p = .04).* The RST database was only male which contributed to the heterogeneity of gender which needs to be further investigated. The primary diagnosis variable was missing 50 cases could have influenced the relationship between the three groups. The rehabilitation professionals collecting the data may have not input the data into the respective database which contributed to the missing data. In addition, primary diagnosis was significantly different between groups (*p = .05).* In addition, primary insurance was missing 42 cases which could have been due to the same reason as primary diagnosis missing data.

New technology at time two could also influence the FMA score. The new technology could consist of tilt-in-space, recline, elevating leg rests, a more complex wheelchair, and/or alternative driving methods which all could have influenced FMA scores.

2.4.5 Future Work

Future work entails continuously and consistently gathering data to increase the number of consumers within each group. A larger sample within the overall database would allow for more discrete analysis especially for discrete groups such as SE – NSE. In addition, more organized data is an essential task for any future work. A significant amount of time was spent organizing the data which can create burdens to busy professionals. A better organized database would

allow for aggregation of data across multiple sites. A more descript uniform dataset would also ensure continuity and reduce missing data. A more organized database would pool all information in one place and the same variables would be collected for each subject (Kang, 2013). This would reduce missing data. In addition, obtaining objective data for each individual within this database would be useful. Two additional groups, in addition to the three groups included in this study, would aid in determining what factors contribute to SE satisfaction. The two additional groups would be 1.) No seat elevator – no seat elevator (NSE-NSE_1) as a result of an insurance denial and 2.) No seat elevator – no seat elevator (NSE-NSE_2) as a without submitting for a seat elevator to insurance. These two situations would give insight to why seat elevators on power wheelchairs get denied and the frequency of denial. Other future work would focus on clinical changes based on the data. The data shows that user satisfaction for reaching ability goes up significantly when the end-user receives a seat elevator on their new device when they did not have one on their old device. This indicates that end-users may benefit from clinicians including seat elevators within the letter of medical necessity (LMN) when the original reach score on the FMA is low. Additionally, other items on the FMA can be analyzed to see if seat elevators effect item #1, #2, #3, #4, #7, #8, #9, and #10. In addition, the FMA is available to be taken periodically throughout the duration of the new mobility device. This would allow the analysis of user satisfaction throughout the entire use of a device instead of at the end or at the beginning. Lastly, FMA scores can be studied within each time point such as evaluating all of the groups' time 1 scores with each other.

3.0 SUMMARY

In summary, this study focused primarily on consumer satisfaction with seat elevators equipped or not equipped on power wheelchairs. Gender and primary diagnosis were not accounted for as confounders within the analysis of primary FMA outcome variables. However, within groups, the analysis revealed that when seat elevators lost during intervention, FMA #5 (reach) scores were significantly lower but not for FMA #6 (transfers) or total FMA scores. In addition, within group scores for individuals maintaining a seat elevator and obtaining a seat elevator during intervention had significantly higher scores at time 2. The significant difference in FMA scores for individuals maintaining a seat could account for age and reliability of an old device to a new mobility device at time two. A significant difference in FMA scores could be accounted for within the group which obtained a seat elevator because of the seat elevator or the mobility device being new. To adjust for the new device, between group differences must be accounted for. Overall, the data indicated that a seat elevator equipped on a power wheelchair has a positive impact on user satisfaction.

APPENDIX A

FUNCTIONAL MOBILITY ASSESSMENT (PAGE 1)

FMA Date:__/__/____ ID# (optional):_____

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 using 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.**

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

	Completely Agree	Mostly Agree	Slightly Agree	*Slightly Disagree	*Mostly Disagree	*Completely Disagree	Does not apply
1. My current means of mobility allows me <u>to carry out my daily routine</u> 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. My current means of mobility meets my <u>comfort needs</u>: *(e.g., heat/moisture, sitting tolerance, pain, stability)*							
Comments:							
3. My current means of mobility meets my <u>health needs</u>: *(e.g., pressure sores, breathing, edema control, medical equipment)*							
Comments:							
4. My current means of mobility allows me <u>to operate</u> 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:							

Adapted from the FEW (2003) and FAW (2004)

FUNCITONAL MOBILITY ASSESSMENT (PAGE 2)

FMA Date: ___/___/_____ ID# (optional):_____

	Completely Agree	Mostly Agree	Slightly Agree	*Slightly Disagree	*Mostly Disagree	*Completely Disagree	Does not apply
5. My current means of mobility allows me <u>to reach and carry out tasks at different surface heights</u> as independently, safely and efficiently as possible: *(e.g., table, counters, floors, shelves)*							
Comments:							
6. My current means of mobility allows me <u>to transfer</u> from one surface to another: *(e.g., bed, toilet, chair)*							
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)*							
Comments:							
8. My current means of mobility allows me <u>to get around indoors</u>: *(e.g., home, work, mall, restaurants, ramps, obstacles)*							
Comments:							
9. My current means of mobility allows me <u>to get around outdoors</u>: *(e.g., uneven surfaces, dirt, grass, gravel, ramps, obstacles)*							
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)*							
Comments:							

Adapted from the FEW (2003) and FAW (2004)

APPENDIX B

Functional Mobility Assessment (FMA)

Please select one choice that best matches how much you agree with the statement:

Percentage	Description	Score
100%	COMPLETELY AGREE	6
80%	MOSTLY AGREE	5
60%	SLIGHTLY AGREE	4
40%	*SLIGHTLY DISAGREE	3
20%	*MOSTLY DISAGREE	2
0%	*COMPLETELY DISAGREE	1

 Adapted from the FEW (2003) and FAW (2004)

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