Comparing the Functional Mobility Assessment Outcomes for Wheeled Mobility Devices between VA Telehealth Assessments and In-Person Clinical Assessments

by

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As the access and abilities of technology vastly improves, the use of telehealth in the medical setting increases. While implementing these services, it is important to aim for the outcomes for patients to be comparable to the outcomes seen with in-person appointments. One area that telehealth can have an impact is on wheelchair seating and mobility assessments, as there are home factors that can influence the selection of a device. The population using wheeled mobility devices can also experience problems traveling to appointments, making telehealth a prime alternative. The purpose of this study is to compare the Functional Mobility Assessment (FMA) outcomes of a population of veterans receiving an evaluation using telehealth to a general population receiving their assessment in a clinic. Veterans were initially screened and administered the FMA Time 1 on their current device, and then evaluated in their home or place of residence using a VA videoconference system. Then, veterans received a phone call 21 days or more after receiving the new device to administer the FMA Time 2, and 27 veterans were reached during this follow-up. To compare the results to an in-person clinical setting, 27 participants were selected from a database matching for age, gender, and primary diagnosis. These participants also had Time 1 and Time 2 FMA scores, and the study compared each of the 10 FMA items between groups for each time point. The results showed that there were no statistically significant differences between the groups for 7 of 10 FMA items in Time 1 and 6 of 10 FMA items in Time

2. The veteran group showed statistically significant differences in daily routine, personal care, and indoor mobility for Time 1 and reach, transfers, personal care, and transportation for Time 2. The higher scores for certain items may be due to funding policy differences between the VA and non-VA groups. Overall, the results show that the telehealth group had no statistically significant differences in outcomes than the clinic group, and this provides encouragement for more studies to be done and assessments to be performed using a telehealth platform.

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Preface

I would like to thank my committee and those involved in the telehealth project, especially Mark Schmeler, Richard Schein, and Brad Dicianno. Thanks to the other Telehealth Clinical Technicians and clinicians that worked on the project; Kaila Grenier, Mauricio Arredondo, Joe Straatmann, Chad Evans, and Joseph Vasek. Everyone was a huge help in learning about the field of wheelchair seating and mobility. I would like to thank my friends and family for support throughout my scholarly career, and especially my parents, for their continued support and encouragement have led me to the opportunities I have today.

1.0 INTRODUCTION

1.1 BACKGROUND

In the United States, there are over 40 million people living with a disability, over 12% of the country's population. It is also reported that 6.9% of the country classified their disability type as "ambulatory", which was the highest category over visual, hearing, and cognitive (Erickson, 2019). In the US population aged 65 years and older, 40% reported at least one disability, and two-thirds of them have an issue due to mobility (He, 2014). When experiencing a lack of mobility, older adults face many risks. These include higher morbidity and mortality, a lower quality of life, and isolation from the world and social circles (Gill, 2006). There is also an association between low mobility and all types of social engagement, including using the phone and internet, and engagement was even lower when it was outside the home, such as visiting friends or recreation centers (Rosso, 2013).

Telehealth services are increasing in many areas of healthcare, and take on many names: telehealth, telerehabilitation, telemedicine, and e-health cover the broad categories, and specific names; telecardiology, teleneurology, telepathology, and more for each specialty. In many fields, teleservices are used for early assessments, patient management, and even prevention. They are used to serve parts of the community that do not normally have access to medical services. These areas often have little medical support, and they are often far away from specialized centers. This can result in long travel times for the client due to distance, geography, and transportation options (Ekeland, 2010).

In telehealth, it is important to consider the outcomes for the patient and balance them with the benefits and costs. While telehealth can save time, travel, and costs for the patient, it could be detrimental long-term if the care received is below what would be received at an in-person appointment. It is crucial to collect outcomes from the patient and the clinician, both with satisfaction using the telehealth service and the health and functional outcomes of the patient.

The purpose of this study was to look at the functional outcomes of a group of veterans who received a wheeled mobility device through a telehealth assessment compared to a similar group that received a device through the traditional in-person clinic assessment outside the veteran population. Both groups completed the Functional Mobility Assessment (FMA) satisfaction questionnaire before and after receiving and using their new device. This allowed for comparison of functional mobility outcomes pre and post intervention to determine if there is a statistically significant difference in outcomes between the methods of assessments.

1.2 RELATED RESEARCH

1.2.1 Wheeled Mobility

When choosing an appropriate device for mobility, there are many factors that affect the end user in terms of mobility and outcomes. The Rehabilitation Engineering and Assistive Technology Society of North America (RESNA) *Wheelchair Service Provision Guide* was created to show the essential steps when providing a wheelchair. It considers important factors including the current technology used, environment, support system activity, participation, body functions and structures, and the goals of the client (Arledge et al, 2011). When it comes to the goals of the client, there is a risk of abandonment if they are given a device to use where they had little input (Batavia 2001). In terms of body structures and function, setting up a manual wheelchair to a user's dimensions and comfort with propelling a chair will impact their function. A study by Boninger et. al (2000) found that the axle position of the wheelchair relative to the user's shoulder can affect injury to the upper limb, and proper positioning can improve the propulsion biomechanics and reduce the risk of injury. In a population of users in assisted living facilities, the users often use foot propulsion as a method of moving their chair around their room. This can be affected by the seat height and the footrests, and it is important to find out the goals of the user and propulsion method in order to accommodate their needs and improve their mobility (Suzuki, 2012).

There are also users who need much more support in their seating system. If the user is unable to support their trunk and upper body, a custom seating system needs to be considered (Lange 2018). If they are not able to relieve pressure by themselves, a dynamic seating component is considered to allow the user to tilt in space (Sprigle 2014). Furthermore, the RESNA Position Paper on the Application of Tilt, Recline, and Elevating Legrests for Wheelchairs (Dicianno, 2015) indicates that positioning features are important to consider when selecting a device to treat, alleviate, or prevent complications such as posture, edema, pressure, comfort, and spasticity. When these systems are implemented in a chair, information and training must be provided to the user to ensure the proper use and results.

1.2.2 Functional Mobility Assessment (FMA)

The Functional Mobility Assessment (FMA) is a self-reported outcome tool that measures the user's satisfaction with performing daily tasks and activities while considering all types of mobility. The FMA was created from a modified version of the Functioning Everyday with a Wheelchair (FEW) tool, which asked about satisfaction of performing tasks while using a wheelchair, but leaves out other mobility such as canes, crutches, prosthetics, or using no device (Mills, 2002). Since the FEW only concerned wheelchairs, it was found to be unreliable to use when asking users who are transitioning from a non-wheelchair mobility device to a wheelchair (Kumar, 2013). From testing in the study performed by Kumar et al, the FMA was found to have a high intra-class correlation coefficient (ICC = 0.87), whereas the FEW had an ICC = 0.86.

Items of the FMA satisfaction questionnaire ask about most of the factors that are considered in the RESNA Wheelchair Provision Guide, in a very short questionnaire. The questions start with "My current means of mobility" to be inclusive of all devices (or no device), and asks the following 10 items:

Table 1. FMA Items and Abbreviations

My current means of mobility…	Abbreviation
Allows me to carry out my daily routine as independently, safely, and efficiently as possible	Daily Routine
Meets my comfort needs	Comfort
Meets my health needs	Health
Allows me to operate it as independently, safely, and efficiently as possible	Operate
Allows me to reach and carry out tasks at different surface heights as independently, safely, and efficiently as possible	Reach
Allows me to transfer from one surface to another	Transfers
Allows me to carry out personal care task	Personal Care
Allows me to get around indoors	Indoor Mobility
Allows me to get around outdoors	Outdoor Mobility
Allows me to use personal or public transportation independently, safely, and efficiently as possible	Transportation

These items are answered on a scale of 1 to 6, from completely disagree to completely agree. The FMA is asked over time as well, which allows the observation of change in function over a period of time, including when a new device is received.

The FMA has improved on the older version, the FEW, by simplifying the wording of the questions, and changing them to ask about a user's current means of mobility, which includes all types of mobility. It has received an excellent test-retest and is known as a reliable tool to determine a user's satisfaction with a mobility device over multiple time points (Kumar, 2013). Studies have also shown that outcome tools like the Wheelchair Outcome Measure can be practical, reliable, and have good test-retest reliability when collected over the phone (Auger, 2010).

1.2.3 Telehealth Benefits

A systematic review of telehealth and satisfaction (Krowski, 2017) found that the biggest factors contributing to the use were improved outcomes, preferred modality, ease of use, lowered cost, and decreased travel time. One of the largest benefits to conducting a telehealth assessment for wheeled mobility in a client's home is that the home assessment can take place at the same time. During a normal wheelchair assessment in clinic, the client sees a specialist, usually a physical therapist, occupational therapist, assistive technology professional, and/or a physician. Then they are recommended a device to try out. The procedure after initial assessment is to have the supplier visit the client's home with the device to evaluate accessibility such as home entry, floors, and door width, and then they order the equipment for delivery and a final fitting. With telehealth, the home evaluation can be completed by the Telehealth Clinical Technician (TCT's), measurements can be taken, the device can even be test-driven in the house, and ordered all in one appointment. This allows a one-stop visit where the clinician, TCT's, the client, and their family can appropriately see and demonstrate the way the device will be used in that setting, and many issues can be immediately tested.

Another benefit is the saved time for both the veteran and the provider. In settings such as the Veteran's Administration Medical Center, the seating clinician would travel to a veteran's home if the veteran was unable to make it to the clinic. This takes extra time before and after the appointment, and they would book just one appointment that morning or afternoon. Using the telehealth system, the appointment took up a normal amount of the clinician's time (60 to 90 minutes). There could be two telehealth appointments scheduled per day: one in the morning and one in the afternoon (Grenier, 2018). During the time the TCT's travel between the two telehealth sites, the clinician can continue to see clients at their regular in-person clinic.

Telehealth has shown to reduce costs to the patient and the medical system as well. Studies have shown that using telehealth methods to perform assessments and monitor patients has decreased the number of hospital stays and emergency room visits (Noel, 2004). A systematic review of 36 studies found that telehealth was less costly in 61%, equally as costly in 9%, and costlier in 31%. Meanwhile, the outcomes were improved or similar to traditional care in 91% of the studies (Wade, 2010). They commented that telehealth was most effective for home care, on-call specialists, and rural service delivery, while not as effective for service in hospitals and primary care.

Telehealth services can serve communities that lack access to specialized medical fields. With rural parts of the country, there is a lack of specialized care facilities and physicians, and if that care is needed, they must travel to larger cities. Travel from rural communities can take hours, especially dependent on the weather, traffic, and geography, and missed appointments are burdensome to both the patient and the system. Implementing telehealth in these communities allows access to these services in the home or at local medical centers, where a combination of nurse care and telehealth communication with a specialist can be used (Nelson, 2017). According to the Pennsylvania State Legislature, there are 48 rural counties in PA (less than 284 persons per square mile), which equates to 27% of the state's population. These counties also contain a higher population of people over 65 years old, and implementing these telehealth systems to the region will increase the care (Rural/ Urban PA, 2010).

1.2.4 User Satisfaction with Telehealth

Even with all the benefits that telehealth modalities offer, a large factor in whether or not the system should be used is the user satisfaction. Telehealth increases the range of services available while they decrease the burden of cost and travel on the user.

To measure the satisfaction of users of telehealth, surveys are used to gather data on different parts of telehealth. In a previous study performed using telehealth between an expert clinician and four remote wheelchair clinics set up at least 125 miles away, Schein, Schmeler, and Saptono (2010) found that the patients accepted the use of telehealth and reported significantly higher scores (past the scales mid-point) per the Telerehabilitation Questionnaire (TRQ). The TRQ was also measured during the home telehealth evaluations that were performed for Grenier's study. The veterans had a high satisfaction of all aspects of the telehealth process and would use it again over clinical appointments (Grenier, 2018). While this could be from a satisfaction based on the convenience of telehealth, the high satisfaction scores have been shown in several studies. The providers also marked significantly high scores with the telehealth process; their lowest scoring item was due to the quality and clarity of the platform. While the veterans were highly satisfied with the quality and clarity, this particular item would be more important for the clinician. The veteran only needs to see the clinician's face and hear the clinician's voice, while the clinician must see the client clearly while they are being evaluated, especially when it comes to fitting the veteran. While there was a significant difference between the veteran and provider TRQ, they were almost all within one point on the TRQ, where the difference could be from mostly satisfied to completely satisfied (Grenier 2018).

1.2.5 Telehealth Issues

One of the main costs of using telehealth is in fact the monetary expense for using TCT's out in the field. Compared to an in-person clinical setting, there is the added costs of the TCT's wage, a van, gas, parking, extra tools, the device (tablet), cellphone, mobile data device, and the mobile data plan. While this cost can be high for doing mobility assessments, the impact can be minimized by using the telehealth staff for other appointments. There is also the benefit of the clinician being able to stay in the clinic for other appointments versus driving.

Telehealth can also face some issues with the ability of the client to use the technology. Some telehealth modalities require some technology experience from the user to access the video calls. This experience can vary, and often times an older population has less experience with using the platform. In the paper by Grenier (2018), the issues faced during this study are detailed further, including the personal connection and strength of connection.

1.2.6 Telehealth Outcomes

Using traditional outcome measures to determine if a significant difference between telehealth groups and a clinical setting has been tested in several studies. A study evaluated the Functional Independence Measure (FIM) scores between telerehabilitation and standard care over six months for those with a spinal cord injury. They found no significant difference between the two intervention types and any clinical complications, and improvements on the FIM scores in the telerehabilitation group in the areas of grooming, dressing and transfers (Dallolio, 2008).

Another study (Schein et al., 2010) closely related to the current study was performed using the Functioning Everyday with a Wheelchair (FEW) outcome measure, and relating an in clinic setting with telehealth performed at several offsite locations for wheelchair and seating evaluations. There were no significant differences in FEW scores during the pretest, and no significant differences in FEW scores for the post-test except for transportation, where telehealth had a slightly lower score. They also looked at the clinically significant difference of 1.85, the only two items to not reach the significance was in-person transfer and telerehabilitation transportation (Schein et al., 2010).

1.2.7 VA Telehealth Services

The Department of Veterans Affairs' (VA) runs the largest healthcare system in the United States, with over 9 million veterans enrolled, and they are seen at 172 medical centers and over 1,000 outpatient clinics (U.S. Department of Veterans Affairs, 2016). With a high population of veterans that live in rural areas (45% of telehealth recipients in the VA), the VA develops, tests, and implements new telehealth services to ensure all veterans are receiving a high quality of care. There are three modalities of telehealth that are used by the VA:

- Clinical Video Telehealth (CVT) – real-time video conferencing to assess and treat a patient remotely
- Home Telehealth (HT) – using in-home technology to monitor patients and manage their conditions
- Store and Forward Telehealth (SFT) – information is stored and then sent to or retrieved by a provider at a later time

In 2016, the VA had over 700,000 veterans using a form of telehealth, which 45% of were living in rural communities that were determined to have low access to VA healthcare. There are also 900 locations using the telehealth services and are offered in 50 specialties. The veterans are screened and are allowed to continue regular care if requested, but many are continuing use of telehealth. The veterans are also satisfied with the system; veterans are 88%-94% satisfied with the telehealth technologies, and when following patients using these services, they are witnessing a 59% decrease in the VA bed days of care (U.S. Department of Veterans Affairs, 2016).

1.2.8 VA Wheeled Mobility Telehealth Process

To conduct wheelchair seating and mobility appointments using the VA Telehealth platform and CVT, a team of Telehealth Clinical Technicians (TCTs) were recruited. A TCT had to meet several characteristics; knowledge of wheelchair seating and mobility, ability to operate the technology used and diagnose any issues that may arise, a driver's license to travel to the appointments, and other TCT requirements. The team had multiple wheeled mobility devices; a Quickie 2 wheelchair, a scooter, and a group 3 power wheelchair as devices for clients to try, as they cover the three main areas of wheeled mobility. For the telehealth system, an electronic tablet was connected to the internet via a mobile hotspot, with two carriers available in case one had a poor signal. Other equipment included a tool kit to make adjustments, measurement tools, a portable ramp for loading the van and entering a veteran's home if a step was present, a light to brighten the video, and information on the products. To determine if a telehealth visit would be used for a wheelchair assessment, the original consult and veteran's medical record was reviewed to determine location, diagnosis, and transportation. If they met the criteria, a TCT contacted the veteran by phone to evaluate home accessibility, internet connection information, willingness to receive the appointment via telehealth, collect the pre-visit assessment containing the Uniform Dataset (UDS) and the Functional Mobility Assessment Time 1 (FMA T1), and then an appointment was scheduled. The TCT's would then travel to the veteran's home with the telehealth equipment and wheeled mobility devices, connect to the VA Wheelchair Clinic, and the TCT's conducted the evaluation according to the directions from the Teleprovider. The Teleprovider completed the documentation and submits the order, and the veteran would receive the device in clinic or at the home, where the TCT's would conduct the final fitting via telehealth. Twenty-one days or more after the device was received by the veteran, the TCT called the veteran to conduct the Functional Mobility Assessment Time 2 (FMA T2). A flowchart of this process can be found in the Appendix A (Grenier, 2018).

2.0 METHODS

2.1 INTRODUCTION

The research project that this study is based on was a project that looked to reduce the problems in accessing wheeled mobility devices in a veteran population by creating a telehealth method of wheelchair assessments in the rural Pittsburgh area, and conducting the assessments on those veterans while collecting data. The assessments were based out of the VA Pittsburgh Aspinwall seating clinic and used a team of TCT's to travel to the veteran's homes. There were several metrics that were used to measure outcomes of the assessments, including the Functional Mobility Assessment and associated Uniform Dataset (FMA/UDS), the Telerehabilitation Questionnaire (TRQ), and the Quebec User Evaluation of Satisfaction with Technology (QUEST). These are commonly used tools when measuring the satisfaction and outcomes of wheelchair seating and mobility interventions and services.

The FMA/UDS outcomes management system and registry is a strategy developed between the University of Pittsburgh and US Rehab that comprises a nationwide network of mobility equipment providers (Schmeler et al., 2019). US Rehab providers collect baseline FMA/UDS and at set times following provision of a mobility device to monitor progress, accrue large data, perform Quality Assurance, and conduct research on the effectiveness of device interventions and service delivery models.

This study specifically evaluated the FMA scores of veterans who received new device through the telehealth program at the VA clinic pre-appointment and post-delivery of the new device. Since the VA does not typically collect FMA/UDS as part of routine wheelchair service delivery, VA telehealth data was compared to matched cases in the FMA/UDS registry. While there are differences between the VA and non-VA groups, the study helps to see if receiving an assessment using telehealth has a significant difference from an in-person assessment. Showing similar scores in both settings is important before larger projects and studies are conducted on telehealth in the seating and mobility sector. To show this, there are two hypotheses tested: there is no difference at Time 1 to show the groups are at similar starting mobility, and Time 2 to show both groups report the same satisfaction with their new device. These tests were run on each of the 10 FMA items to determine if specific needs were not being met. The hypotheses are as follows:

- Null Hypothesis 1: There will be no statistically significant difference in the FMA T1 scores between veterans who are receiving a device from the VA Telehealth and clients who are receiving their device from the clinic.
- Null Hypothesis 2: There will be no statistically significant difference in the FMA T2 scores between veterans who are receiving a device from the VA Telehealth and clients who are receiving their device from the clinic.

2.2 STUDY DESIGN

The study was a retrospective analysis of data collected from two independent databases. The first was a deidentified database from the VA Telehealth project, where 27 individuals passed the inclusion criteria (having both Time 1 and Time 2 FMA scores). The second database is from providers across the United States, and 27 individuals were chosen from this source based on matching age, gender, and primary diagnosis. The two independent groups were assigned as the Telehealth (TH) group and the Clinic (CL) group. The matching was performed on these variables to remove them as potential confounding variables. While matching on current device at Time 1 and Time 2 would help to remove the possibility that the device chosen was not directly influencing the FMA scores, this would severely restrict the sample size given a starting point of 27 veterans.

The matching was performed first by searching the FMA/UDS registry for all matching cases on primary diagnosis. Then, a list of birth year for both the veteran group and clinic group was formed for that diagnosis, and all perfect matches were paired. If there was no exact match for birth year, the range would extend on year earlier and later until a match was formed. In most cases, an exact year was matched.

For each group, the FMA scores were collected by a person trained on administering the FMA. The Clinic group had Time 1 (T1) scores collected in clinic, and the Time 2 (T2) scores in clinic, over the phone, or by letter. With the Telehealth group, T1 scores were collected over the phone or in-person, while T2 scores were collected during a follow-up phone call. Both groups had the T2 scores collected no less then 21 days post-delivery in order for the user to have spent time using the device and getting acclimated to use.

Both the FMA scores and the other important demographics were placed into an Excel sheet where the participants could be compared on different variables. The data was also sorted in IBM SPSS Statistics 25, where descriptive and inferential statisticswere performed.

2.3 PARTICIPANTS

The participants were used from two databases: from the VA Telehealth study data and from a national de-identified FMA/UDS dataset. To be selected from the VA Telehealth study, users must have met the following criteria:

- FMA T1 was complete
- FMA T2 was complete
- Veteran was evaluated completely using telehealth

To be selected from the FMA/UDS dataset, cases must have met the following criteria:

- FMA T1 was complete
- FMA T2 was complete
- Matched with a veteran based on age, gender, and primary diagnosis
- Client was seen by an Assistive Technology Professional for evaluation

For this study, there were 27 matched pairs formed (n = 54). There were 43 veterans seen during the telehealth project, but there were 16 without Time 2 FMA scores due to not using the new device, passing away, or not answering/returning follow-up calls, leaving 27 veterans. Twenty-seven clients from the national FMA/UDS registry (n = 2029) were selected based on inclusion criteria, and matched to the VA group based on gender, primary diagnosis, and age. For some of the cases pulled from the FMA/UDS registry, some items were answered "Does Not Apply" thus lowered the sample size for certain items. This can further lower the power in detecting if a change was there between the two groups. A table of the number of responses can be found in Appendix B.

2.4 INSTRUMENTATION

The instrument used in this study is the Functional Mobility Assessment (FMA), and the tool was administered at two time points: Time 1 (T1) and Time 2 (T2). Time 1 was related to their current means of mobility, and Time 2 was administered at least 21 days after receiving their new mobility device. In the telehealth group, the FMA was conducted by students in the Rehabilitation Science and Technology program who were trained in administering the tool, and were conducted over the phone before the appointment for Time 1 and by phone at least 21 days after for Time 2. For the clinic data set, the questions were performed by providers who received training. The FMA consists of a 10 item questionnaire regarding satisfaction in performing mobility related activities of daily living that is answered as follows:

1 = Completely Disagree

2 = Mostly Disagree

3 = Somewhat Disagree

4 = Somewhat Agree

5 = Mostly Agree

6 = Completely Agree

The maximum score that can be reported on the tool is 60. The lowest score can be a 10, but there is an option for each statement on the tool that is 'Does Not Apply', which then lowers the total possible score. For example, if the client reports 'Does Not Apply' for one question, the maximum score would be out of 54. During this study, the FMA comparisons were broken down by each of the 10 items; therefore, a change can be observed based on certain items versus just the total score.

2.5 PROCEDURES

The data was de-identified from VA Telehealth an FMA/UDS datasets and both contained the UDS and FMA Time 1 and Time 2. The matching cases that met the inclusion criteria were added to the Excel document. This spreadsheet contained the demographics for each subject and their FMA Time 1 and Time 2 scores. The FMA data included each score out of 6, and then the sum out of 60. It was kept separated by each item on the FMA, and Excel worksheets were made for Time 1, Time 2, and change in score per person. These worksheets were used to calculate the mean and standard deviation of the telehealth group and the clinic group for each item, and then the data was exported to IBM SPSS Statistics 25 to be analyzed.

2.6 DATA ANALYSIS

The data analysis was done using IBM SPSS Statistics 25. All alpha levels during this study were set to $\alpha = 0.05$ for all tests. The mean age of the groups was tested using an independent samples t-test, as age was normally distributed for both groups. The demographics of primary device at Time 1 and Time 2 were compared between groups using a Chi Squared Goodness of Fit Test. In cases where the sample size was too small for the chi square test, Fisher's exact test was performed.

For analyzing the FMA scores between groups, the tests were split up to compare each FMA item between Telehealth and Clinic. This was done for both Time 1 and Time 2, yielding 20 tests. Since the FMA uses ordinal (ranked) data, the Mann-Whitney U test was chosen as it is the nonparametric equivalent of an independent t-test. The effect size and power were calculated post-hoc using G*Power 3.1.9.2 for each item using the mean, standard deviation, and sample sizes from the data.

3.0 RESULTS

3.1 DEMOGRAPHICS

There were 54 total participants in this analysis. For some FMA items, the group size was less than 27 due to participants answering 'Does Not Apply', and the group size can be seen in Appendix B. Gender and primary diagnosis were a perfect match between groups. The ages reported for the two groups were TH = 81.63 ± 8.58, and for CL = 79.93 ± 9.14. The mean of the ages was found to be not significant (t = .706, p = .483). For the current primary device, the types of device were no device, transport chair, cane/crutches/walker, POV/scooter, K0001/K0002, K0003/K0004, K0005, K0009/not coded, group 1 power wheelchair, group 2 power wheelchair, group 3 power wheelchair, and group 4 power wheelchair. There was no significant difference between these devices (p = .074). See Table 2 for all demographic information.

Table 2. Demographics

Demographic	Telehealth (TH N = 27	Clinic (CL) N = 27	Z	*p**
Age (Mean ± SD)	81.63 ± 8.58	79.93 ± 9.14	.706 (t)	.483
Gender (n, %)				
Male	27 (100%)	27 (100%)		
Female	0 (0%)	0 (0%)		
Primary Diagnosis (n, %)				
Amputation	2 (7.4%)	2 (7.4%)		
Cardiopulmonary	3 (11.1%)	3 (11.1%)		
Osteoarthritis	5 (18.5%)	5 (18.5%)		
Other Neuromuscular	8 (29.6%)	8 (29.6%)		
Parkinson Disease	1 (3.7%)	1 (3.7%)		
SCI (tetra/quad)	1 (3.7%)	1 (3.7%)		
Stroke/CVA	7 (25.9%)	7 (25.9%)		
Current Primary Device				.074
No Device	1 (3.7%)	2 (7.4%)		
Transport Chair	1 (3.7%)	0 (0.0%)		
Cane/Crutches/Walk	12 (44.4%)	10 (37.0%)		
POV/Scooter	0 (0.0%)	1 (3.7%)		
K0001/K0002	0 (0.0%)	2 (7.4%)		
K0003/K0004	8 (29.6%)	1 (3.7%)		
K0009/Not Coded	0 (0.0%)	1 (3.7%)		
Group 1 Power	0 (0.0%)	1 (3.7%)		
Group 2 Power	1 (3.7%)	6 (22.2%)		
Group 3 Power	4 (14.8%)	3 (11.1%)		
Device at Time 2				.001
Transport Chair	1 (3.7%)	0 (0.0%)		
K0003/K0004	0 (0.0%)	1 (3.7%)		
K0005 Ultralight	10 (37.0%)	1 (3.7%)		
Tilt-in-Space	2 (7.4%)	0 (0.0%)		
Group 1 Power	1 (3.7%)	0 (0.0%)		
Group 2 Power	0 (0.0%)	12 (0.0%)		
Group 3 Power	12 (44.4%)	13 (48.1%)		
Group 4 Power	1 (3.7%)	0 (0.0%)		

*p**< 0.05

3.2 FMA TIME 1

Looking at the tests for Time 1 (Table 2), there was no significant difference between FMA scores on seven of the items: Comfort (Z = -1.877, p = .061), Health (Z = -1.366, p = .172), Operate (Z = -1.576, p = .115), Reach (Z = -.047, p = .962), Transfers (Z = -.799, p = .424), Outdoor (Z = -.733, p = .464), and Transportation (Z = -.087, p = .931). The telehealth group scored significantly higher in Daily Routine (Z = -2.029, p = .042), Personal Care (Z = -2.528, p =.011), and Indoor (Z = -2.688, p = .007).

Table 3. Time 1 Telehealth and Clinic Mann-Whitney U Test

FMA Item	Telehealth FMA N = 27	Clinic FMA N = 27^	Z	p*
Daily Routine	3.56 (1.91)	2.44 (1.76)	-2.029	.042
Comfort	3.26 (1.72)	2.46 (1.96)	-1.877	.061
Health	3.33 (1.80)	2.69 (1.87)	-1.366	.172
Operate	3.67 (1.82)	2.81 (1.92)	-1.576	.115
Reach	2.89 (1.85)	2.92 (1.89)	-.047	.962
Transfers	3.93 (1.62)	3.46 (1.79)	-.799	.424
Personal Care	4.11 (1.67)	2.88 (1.64)	-2.528	.011
Indoor	4.44 (1.40)	3.11 (1.78)	-2.688	.007
Outdoor	2.00 (1.54)	2.44 (1.85)	-.733	.464
Transportation	3.30 (1.98)	3.21 (1.69)	-.087	.931

p*< 0.05

^See Appendix B for Group Size

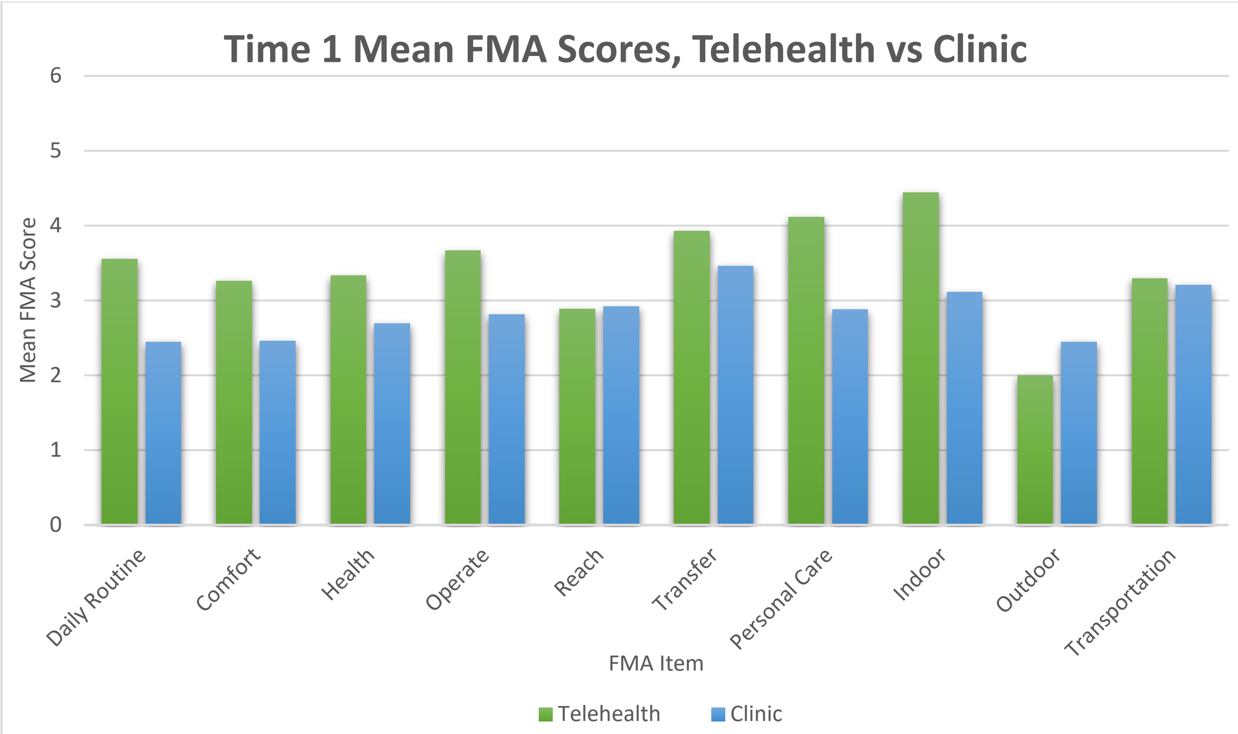


Figure 1. Time 1 Mean FMA Scores

3.3 FMA TIME 2

For the Time 2 comparison (Table 3), there was no significant difference between the FMA scores on 6 items: Daily Routine (Z = -.931, *p* = .352), Comfort (Z = -1.310, *p* = .190), Health (Z = -1.495, *p* = .135), Operate (Z = -1.416, *p* = .157), Indoor (Z = -.215, *p* = .830), and Outdoor (Z = -.795, *p* = .427). The telehealth group scored significantly higher on Reach (Z = -2.195, *p* = .028), Transfers (Z = -3.381, *p* = .001), Personal Care (Z = -2.242, *p* = .025), and Transportation (Z = -2.048, *p* = .041).

Table 4. Time 2 Telehealth and Clinic Mann-Whitney U Test

FMA Item	Telehealth FMA N = 27	Clinic FMA N = 27^	Z	*p**
Daily Routine	5.59 (0.69)	4.89 (1.85)	-.931	.352
Comfort	5.52 (1.09)	4.93 (1.82)	-1.310	.190
Health	5.81 (0.62)	5.15 (1.79)	-1.495	.135
Operate	5.70 (0.67)	5.00 (1.75)	-1.416	.157
Reach	5.56 (0.97)	4.70 (1.81)	-2.195	.028
Transfers	5.93 (0.27)	4.93 (1.66)	-3.381	.001
Personal Care	5.74 (0.86)	4.89 (1.93)	-2.242	.025
Indoor	5.78 (0.42)	5.44 (1.37)	-.215	.830
Outdoor	5.52 (0.85)	4.81 (1.90)	-.795	.427
Transportation	5.56 (0.97)	4.31 (2.15)	-2.048	.041

$p^* < 0.05$

^See Appendix B for Group Size

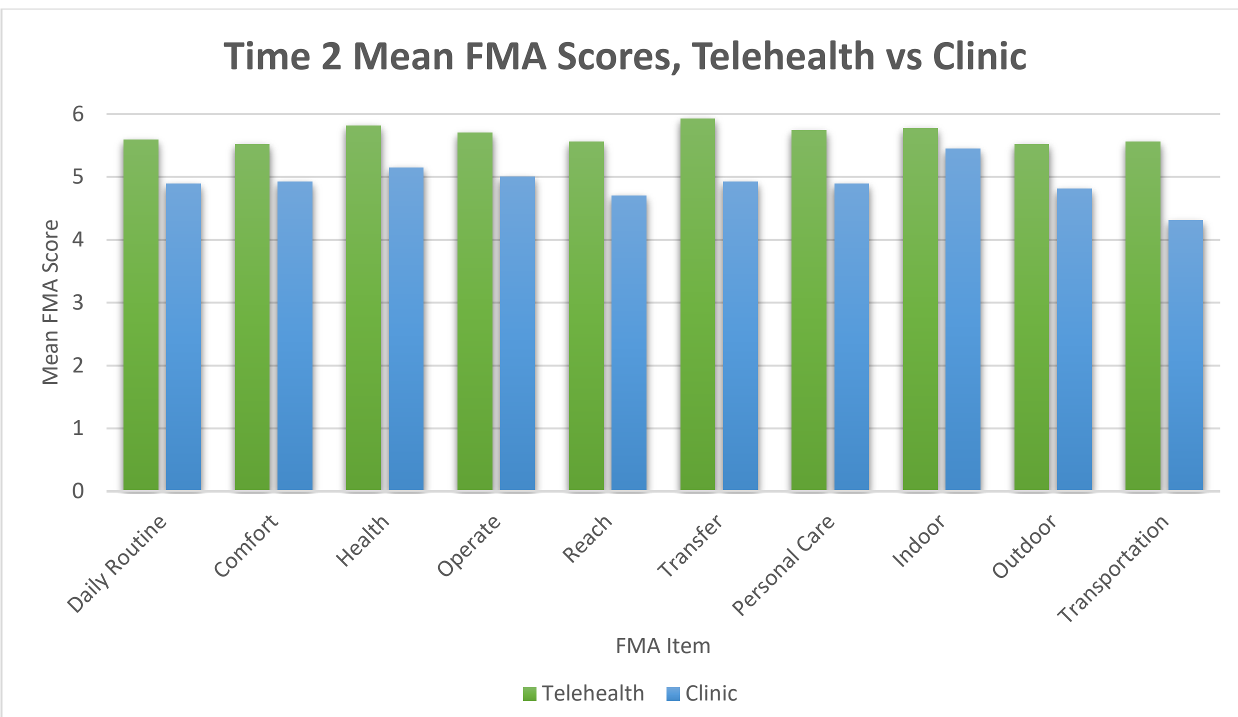


Figure 2. Time 2 Mean FMA Scores

4.0 DISCUSSION

4.1 NULL HYPOTHESIS 1

The null hypothesis for Time 1 FMA was accepted for seven of the ten FMA items, and was rejected for the following items: daily routine, personal care, and indoor mobility. It was expected that the scores would be similar across all areas, as Time 1 scores were before the implementation of telerehabilitation. This shows that for most of the FMA items, there is little to no difference between the VA group and the people receiving devices in the clinic. The few scores that showed a statistically significant difference could be due to the difference in the providers or funding, as 48% of veterans from the VA group received their original device from the VA. In all three cases, the VA group had the higher mean, showing a higher satisfaction with their device. The Indoor item also had a large effect size, with the standard deviation greater than 0.8 (Appendix E). The other items had a medium effect size, except for transportation, which had a small effect size.

4.2 NULL HYPOTHESIS 2

The null hypothesis for the Time 2 FMA was accepted for six of the ten items, and it was rejected for the following items: reach, transfers, personal care, and transportation. With 6 of the 10 items being similar, it shows that the Telehealth method had no real change from the clinic method of assessment. In the four cases that showed a statistically significant difference, the VA group had significantly higher satisfaction with their devices. Since they received the device from the VA, their scores such as reach and transfer could be higher due to the VA providing seat elevators; seven of the veterans received a seat elevator at Time 2 compared to only two subjects in the clinic group. Studies have also shown that seat elevators do have an impact on these FMA times (Schiappa, 2016). Transfers also had a high effect size, over 0.8 standard deviations (Appendix E). All other items had a medium effect size. The VA will also make sure a veteran can get a lift added to their vehicle if necessary, which increases their satisfaction with transportation (four of the veterans received a vehicle lift between Time 1 and Time 2, while there was no change in transportation for the clinic group).

4.3 CHANGE IN FMA SCORES

In some cases, the change in FMA score was larger in the Clinic group vs the Telehealth group. These included routine, personal care, and indoor mobility. This would primarily be due to the Telehealth group having significantly higher scores in these areas during Time 1; they had much less room to increase. The Telehealth group had a larger change in height, outdoor mobility, and transportation, which were also three areas they had significantly higher Time 2 scores when compared to the clinic group.

Overall, fifteen out of the twenty items reached an increase of 1.85 or above. This number (1.85) was used in a study on telehealth assessments using the Functioning Everyday with a Wheelchair scale to represent a clinically significant change (Schein et al, 2010); there is no such number for the FMA, but the FMA is a modified version of the FEW, so some comparison can be made. All but personal care and indoor mobility were clinically significant for the Telehealth group, and these two items were significantly higher than the Clinic group during Time 1, so there was less room for change over time. For the clinic setting, reach, transfers, and transportation did not reach 1.85. This could again be due to the lack of funding for seat elevators and vehicle lifts, both of which often come as out of pocket costs to the client. Therefore, they would not see improvements in these areas compared to the veterans.

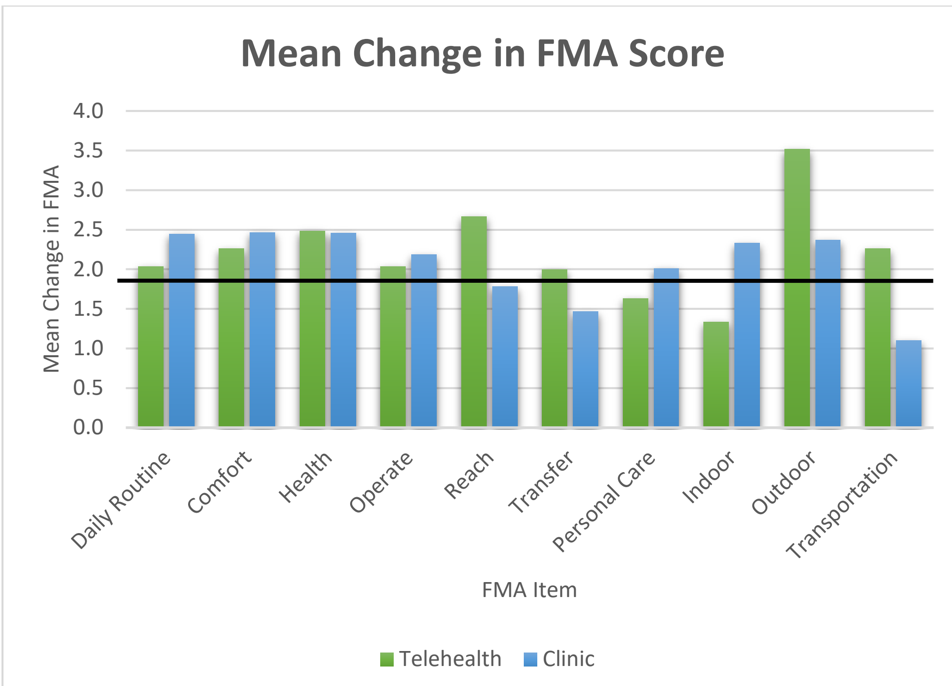


Figure 3. Mean Change in FMA Scores

4.4 STUDY LIMITATIONS

One of the limitations to the study is that the telehealth data was from the Pittsburgh VA Hospital (Aspinwall Campus), while the clinic data comes from the national FMA/UDS registry outside of the VA System. There are differences in the settings, mainly with the funding of the devices, the options for the client, and the quality of care. The VA system does not have a database of the demographics and FMA scores from their users over time, so a comparison could not be made in the same health system. From the sample, the veterans had a higher satisfaction with their current means of mobility, and also finished with higher changes in score relating to their outdoor mobility and their reach. With the VA as a funding source, outdoor mobility is also considered when selecting a device. Through Medicare and some other insurance policies (used in the clinic setting), they are mostly concerned with inside the home, and Medicare's coverage specifically states, "for use in home" (Medicare, Wheelchair Insurance Coverage). During our telehealth appointments, some were focused on finding the veteran an option for a device to use outside the home as well as inside (one group 4 power wheelchair was provided for the telehealth group).

The sample for this study may also have an effect on the study. Since the veteran group was all males, they were matched with males from the clinic group. An all-male sample is not representative of the population, which could lead to a bias based on gender. This was due to the convenience sampling of the study, where no females were eligible. There was also a low sample size which reduces the power of the study, and influences whether it can detect an effect if there is one (Appendix C). This can lead to a higher chance of Type II error, where the hypothesis is confirmed when an alternative is true.

The higher level of evaluation received may also be a limit to the study. The FMA/UDS Registry includes evaluations performed from a range of professionals, from Assistive Technology Professionals (ATP's), clinicians, and suppliers. While all cases had an ATP present, the telehealth group had one ATP/clinician on the video call, and two or more TCT's who were trained student in the field. This would cause more viewpoints during an evaluation and given that the telehealth group was assessed in the home while the other group could be in clinic, in home, or another location, the device chosen for the user could be better based on the home and use case.

There was a statistically significant difference between the type of device received at Time 2 that may have been a confounding factor in the study. While the difference in device could cause a difference in the FMA scores, matching on Time 2 device on top of the other matched factors would yield a smaller sample size. During an evaluation, a device is chosen on many factors, and even when matching on age, gender, and diagnosis, the appropriate device for each subject could be different.

Another limitation with the study can be the presence of the ceiling effect. With the FMA Time 2 scores being recorded between one to three months after receiving the device, the participants had answers that were very high, which makes it difficult to detect a significant difference between groups even if there is one. There FMA is designed to show satisfaction of the device, and during this study investigators compared the end of the life cycle and the very beginning of the new device. While they were all satisfied with the device, the purpose of this study was to demonstrate that there were no statistically significant differences between the groups.

Finally, there might be a limitation due to using convenience sampling to find the veterans to use telehealth. There were selection criteria, but the veteran was offered to try the telehealth assessment in their home. Some veterans were close enough that they normally could make it to clinic, but several would never receive the device without a telehealth assessment due to travel limitations. They may report higher satisfaction with the device because they received a new device, when the increase in score may not be with the mobility. This might be a problem with telehealth services, as people may be satisfied that they are receiving care they normally would not have access to. However, the FMA is targeted around the devices and mobility, and their comments for items match what is to be expected based on their score.

4.5 FUTURE WORK

To further conduct research on this topic, it would be beneficial to continue receiving FMA scores from the telerehabilitation group long term. With the clinic data, there are often FMA scores that are asked over multiple points of the life of the device (typically 5 years) which can show a greater change in satisfaction. Having multiple time points for the FMA scores could show a change in the satisfaction over months or years, and then a difference between telehealth and traditional clinic settings could be shown, as a comparison could be made between new devices and the FMA scores a few years after receiving the device. The VA could also implement the FMA/UDS, which would allow comparisons within similar funding/provider systems, and would increase the sample size for future studies.

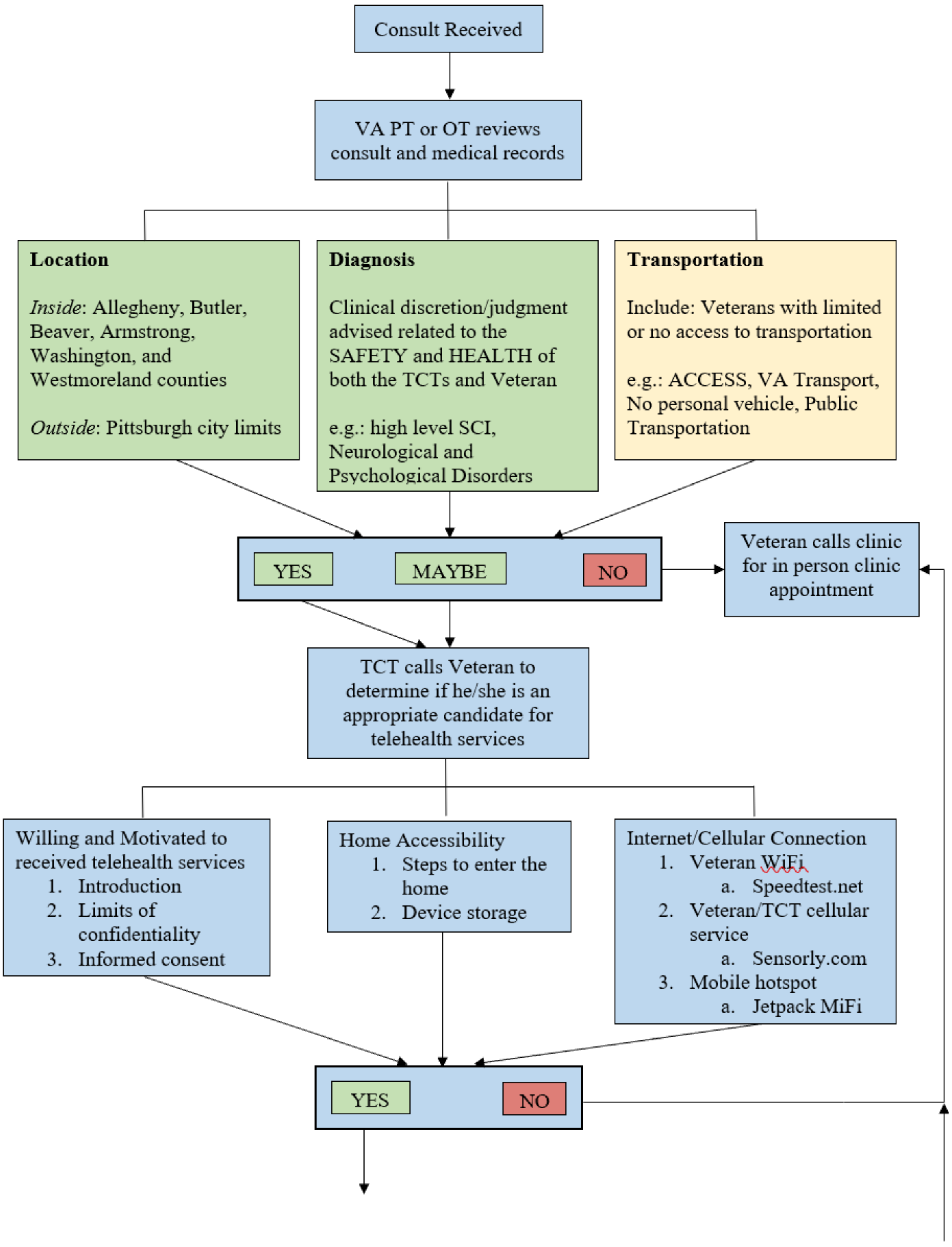
Changing the setting of the study could also provide useful results. The study could be carried out in various clinics across the United States and expand the population of users with devices received through telerehabilitation. Their continued follow-up appointments and new devices could be received through telehealth appointments, and a better idea of the telehealth affect on the satisfaction with the devices could be proven.

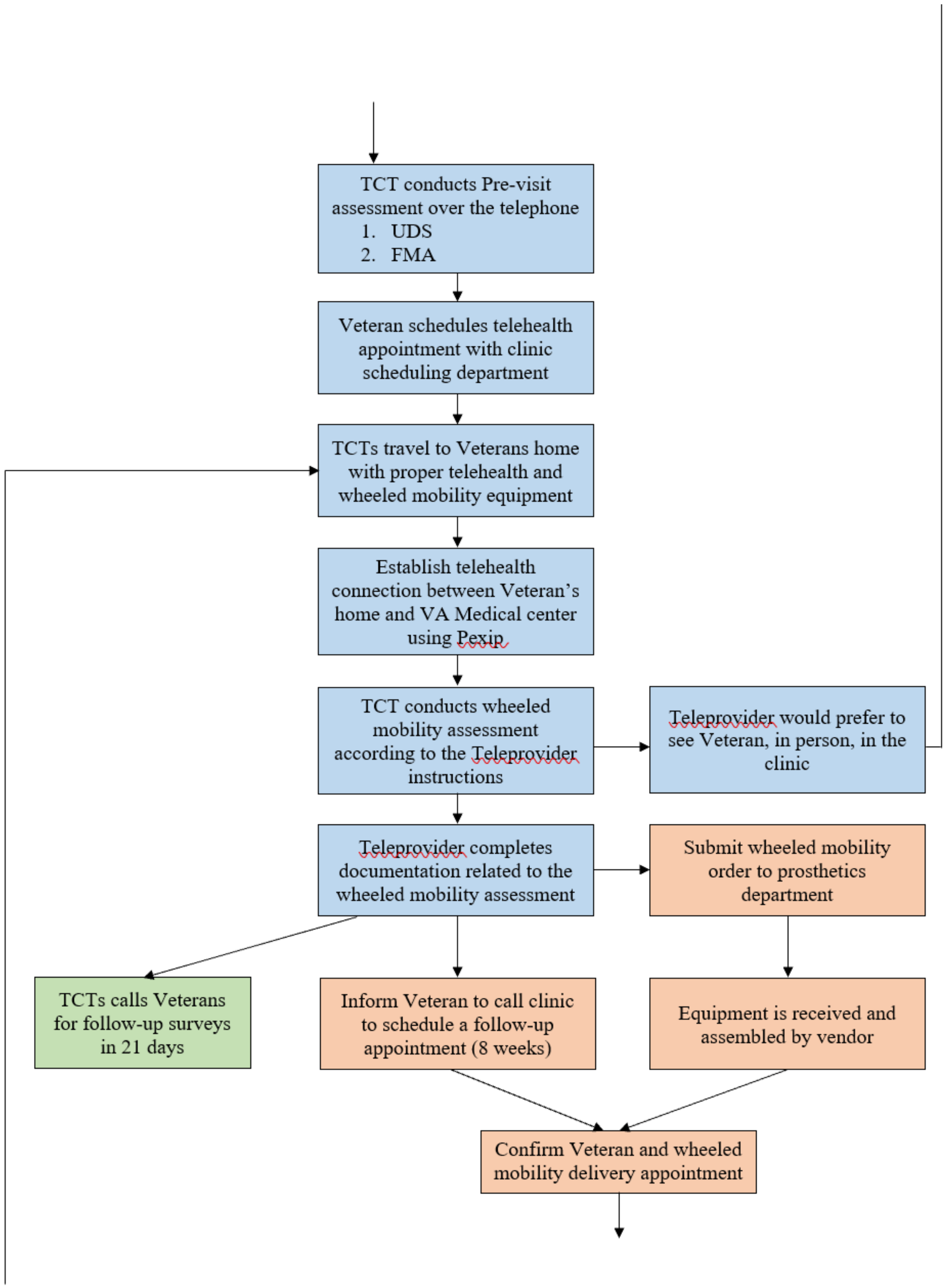
As technology expands and increases in quality, telehealth can branch out into many different fields. There can be uses for this platform in different areas of assistive technology; computer access, mobility, home accessibility, home automation, sports and recreation, and more veterans can be assessed and treated through telehealth platforms.

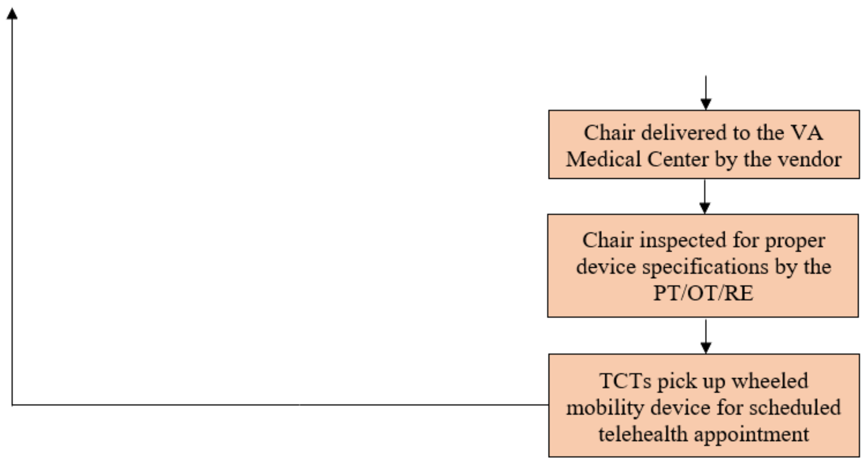
4.6 CONCLUSION

Using telerehabilitation is becoming popular in many fields of healthcare and is used to increase the access to care and the information available for users. Wheelchair seating and mobility is an area of healthcare that affects many different parts of a person's daily routine, and improper mobility is a barrier to accessing health services. Using telehealth as a way to assess clients for an appropriate device can increase the population receiving devices, and can also be a method of performing the evaluation, home assessment, and device trial in one meeting. Both the users and clinicians were satisfied with using the telerehabilitation platform, and this study shows that the people receiving their device through telerehabilitation showed no statistically significant differences with their mobility compared to a group receiving their device in a clinic. The study also found that the telerehabilitation group was experiencing the same clinically significant change in FMA score between Time 1 and Time 2 that the clinical population saw. Telerehabilitation for mobility assessments is an option for those who can not make the trip into the clinic that will match the process of receiving a device in a clinic, and it can have monetary savings for both the clinic and the user.

Appendix A Telehealth Process Flowchart




TCT conducts Pre-visit assessment over the telephone
1. UDS
2. FMA
Veteran schedules telehealth appointment with clinic scheduling department
TCTs travel to Veterans home with proper telehealth and wheeled mobility equipment
Establish telehealth connection between Veteran's home and VA Medical center using Pexip
TCT conducts wheeled mobility assessment according to the Teleprovider instructions
Teleprovider would prefer to see Veteran, in person, in the clinic
Teleprovider completes documentation related to the wheeled mobility assessment
Submit wheeled mobility order to prosthetics department
TCTs calls Veterans for follow-up surveys in 21 days
Inform Veteran to call clinic to schedule a follow-up appointment (8 weeks)
Equipment is received and assembled by vendor
Confirm Veteran and wheeled mobility delivery appointment


Chair delivered to the VA Medical Center by the vendor
Chair inspected for proper device specifications by the PT/OT/RE
TCTs pick up wheeled mobility device for scheduled telehealth appointment

Appendix B Group Size

Table 5. Time 1 Group Size

FMA Item	Telehealth N	Clinic N
Daily Routine	27	27
Comfort	27	26
Health	27	26
Operate	27	27
Reach	27	25
Transfers	27	26
Personal Care	27	25
Indoor	27	27
Outdoor	27	27
Transportation	27	24

Table 6. Time 2 Group Size

FMA Item	Telehealth N	Clinic N
Daily Routine	27	27
Comfort	27	27
Health	27	27
Operate	27	27
Reach	27	27
Transfers	27	27
Personal Care	27	27
Indoor	27	27
Outdoor	27	27
Transportation	27	26

Appendix C Effect Size and Power

Table 7. Time 1 Effect Size and Power

FMA Item	Effect Size	Power
Daily Routine	0.61	0.57
Comfort	0.43	0.33
Health	0.35	0.23
Operate	0.46	0.37
Reach	0.02	0.05
Transfers	0.27	0.16
Personal Care	0.74	0.73
Indoor	0.83	0.83
Outdoor	0.25	0.14
Transportation	0.05	0.05

Table 8. Time 2 Effect Size and Power

FMA Item	Effect Size	Power
Daily Routine	0.50	0.42
Comfort	0.39	0.28
Health	0.49	0.41
Operate	0.53	0.46
Reach	0.59	0.55
Transfers	0.84	0.84
Personal Care	0.57	0.52
Indoor	0.34	0.22
Outdoor	0.48	0.40
Transportation	0.75	0.74

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