EVIDENCE-BASED TRAINING MANUAL FOR THE SAFE USE OF POWERED WHEELCHAIRS

A Thesis submitted to the faculty at Stanbridge University in partial fulfilment of the requirements for the degree of Master of Science in Occupational Therapy

by

Ashley Morales, Marjorie Pineda, Megan Serrato, and Savanna Toledo

Thesis advisor: Annette Hatala, OTD, OTR

October 2023

Certification of Approval

I certify that I have read the *Evidenced-Based Training Manual for the Safe Use of Powered Wheelchairs* by Ashley Morales, Marjorie Pineda, Megan Serrato, and Savanna Toledo, and in my opinion this work meets the criteria for approving a thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Occupational Therapy at Stanbridge University.

Annette Hatala, OTD, OTR

Instructor of Occupational Therapy

ACCEPTED 

Myka Persson, OTD, OTR/L

Program Director, Master of Science in Occupational Therapy

Acknowledgments

This endeavor would not have been possible without our advisor. We express our deepest appreciation to Annette Hatala who generously provided her valuable knowledge, daily communication, and guidance to execute the development of this manual.

We could not have undertaken this journey without the assistance of our university librarian Frederick Poling and Professor Michael Mahoney, PhD for their countless hours of editing, research assistance, feedback, and moral support.

Finally, we would like to extend our sincere thanks to our university Professor Adam Sanchez. We appreciate his contributions to extending our knowledge about powered wheelchairs and sharing his own personal experiences which inspired and impacted our enjoyment of this project.

Abstract

The focus of our thesis project is the safe use of powered wheelchairs (PWCs) for marginal ambulatory individuals. A marginal ambulatory individual is someone who encounters limitations when walking long distances due to a health condition or injury. Safety concerns associated with powered mobility devices can limit community mobility. Tips, falls, and collisions are a major concern, with incident rates remaining consistently high over the years. Our project aims to answer, "what type of evidence-based materials can assist in developing an effective powered wheelchair safety manual?" We conducted an in-depth literature review and consulted with an occupational therapy practitioner (OTP) with more than twenty years of experience working with PWCs to help us better understand how the environment, collision and accidents, and device maintenance affect PWC users' community mobility. The manual was created with the Person-Environment-Occupation (PEO) framework in mind. Our findings showed some of the most challenging driving skills are turning, backing up, and maneuvering through uneven surfaces. We developed an evidence-based training manual for the safe use of powered wheelchairs supported by literature and commonly identified safety concerns. Our evidence-based training manual can be used by a future thesis group to create educational training videos for practitioners to distribute to their clients as a resource.

Table of Contents

Evidence-Based Training Manual for the Safe Use of Powered Wheelchairs

Community mobility is the ability to move around within the community using various modes of transportation, including public and private means such as driving, walking, or other transportation systems (American Occupational Therapy Association [AOTA], 2020). For the purpose of our project, community mobility involves participation in community activities by navigating through accessible spaces, including those that can be accessed by a wheelchair. Our project focused on individuals who are marginal ambulators and require the assistance of a powered wheelchair (PWC) to functionally move about in their daily lives. Marginal ambulators are individuals who encounter limitations when walking for long distances due to a health condition or injury (Cook & Polgar, 2015). For this population to safely move around within their communities, proper training supported by evidence-based research on PWCs must be utilized. Therefore, our central research question is: "What types of evidenced-based materials can assist in developing an effective powered wheelchair safety manual?"

The purpose of the evidence-based PWC manual we developed is to teach clients and caregivers how to properly perform specific skills using a joystick operated PWC. Clients and caregivers would benefit from PWC training so that their assistive devices could effectively serve as an extension of the body and facilitate community mobility for occupational engagement. Information from peer-reviewed journal articles, occupational therapy practitioner's (OTP) clinical expertise, and theoretical insights about effective client care assisted in the development of our evidence-based manual. OTPs can play a significant role in developing PWC safety manuals through their use of a client-centered approach, their expertise on assistive devices, and their assessment of performance skills,

contexts/environments, and occupations that are meaningful for the client. The materials could further be developed into educational videos based on the manual. Assistive device use can increase independence, community engagement, performance of activities of daily living (ADL) and instrumental activities of daily living (IADL), and overall quality of life. The development of our manual further supports AOTA's "Vision 2025" statement which highlights the field of occupational therapy's role in creating effective solutions to assist in facilitating participation in everyday life to maximize health, well-being, and quality of life of all populations (AOTA, 2017).

Statement of Problem

Although PWCs are packaged with a user manual, the information provided is limited and conservative. The user manuals suggest that consumers avoid certain situations, such as driving over uneven surfaces, making sharp turns, and making sure there are no obstacles behind them before reversing. However, many of these barriers were and continue to be unpredictable factors in the client's environment.

Literature Review

The ability to freely move about in one's community can significantly impact an individual's self-esteem, quality of life, and sense of independence. Community mobility allows people to participate in occupational engagements such as ADLs and IADLs (AOTA, 2020). According to the "Occupational Therapy Practice Framework - 4th edition," functional mobility is an ADL that allows for "moving from one position or place to another" (AOTA, 2020, p. 30). Individuals may sometimes experience difficulty with participation in daily activities, which requires them to use assistive devices to facilitate occupational engagement. Before clients utilize a functional mobility device,

such as a PWC, they should be properly trained and educated on how to safely operate the device prior to everyday use. An efficient way to distribute such training is through the use of an evidence-based training manual focused on safety and driving skills. OTPs can incorporate their knowledge and the Person-Environment-Occupation (PEO) framework to develop educational resources within the manual (Cole & Tufano, 2020).

Our literature review examined the benefits of producing an evidence-based training manual for clients and caregivers, specifically PWC users. The World Health Organization (2023) described an appropriate wheelchair as one that meets the needs of the user and their environmental surroundings, provides proper support, is accessible, maintained, and is safe for the user and community members. Taking these characteristics into consideration, the themes that we further examined were the environmental barriers, injuries resulting from accidents/collisions, and maintenance. Common gaps found within the literature were the exclusion of marginal ambulatory PWC users and insufficient clinical guidelines for PWC training.

Theme #1: Environmental Barriers

When assessing PWC safety, it is important to look at indoor and outdoor environmental factors. Indoor barriers may include problematic accessibility, inadequate building layout, limited moving space, and a congested atmosphere (Ashadi et al., 2022). In their research on PWC use in outdoor areas, Carlsson and Lundälv (2019) identified some of the most common causes of device turnover, including ground-level differences, uneven surfaces, and excessive speed while turning or entering the surrounding terrain. Meanwhile, sudden stops or unpredicted movement/motion are the main causes of falling off of devices. The differences within the ground level/curbs account for 34% of single

accidents, while entering the terrain accounts for approximately 9%, colliding with a fixed object accounts for 11%, and surface conditions account for approximately 10%. When wheelchair users travel within their community they may encounter uneven surfaces, such as roads and sidewalks, the presence of stairs and steep slopes, the absence of curb cuts and pedestrian crosswalks, and varying weather conditions that could impede their ability to maneuver in their environment (Saha et al., 2022). Wheelchair users must have appropriate physical and psychological capabilities in order to anticipate a sudden change in environmental terrain forcing them to take an alternate route of travel. Limited alternative routes may cause the wheelchair user to navigate through undesirable terrains, such as dirt and pebbled or cracked surfaces. When these incidents occur, the PWC user may experience an unpleasant and uncomfortable community outing (McCullough et al., 2022).

Some sidewalks may display challenges that impede PWC users from safely and independently traveling to their destinations. A few examples of sidewalk barriers are "uneven, cracked, and sunken surfaces of some block-paved sidewalks, presence of trees lining the street and standing sign boards, and certain road facilities" (Choi et al., 2021, p. 108). Due to sidewalk barriers, PWC users may attempt to drive on the roads causing an added risk of vehicle and motorcycle collisions that could result in severe injuries (Choi et al., 2021). Additionally, hazardous and uneven terrains can damage the integrity of the PWC, such as worn out or punctured tires (McCullough et al., 2022).

Theme #2: Injuries from accidents/collisions

Improper training of PWC devices can lead to accidents and collisions, causing further injury to clients and may even result in death. Such incidents can lead to the

device tipping or falling over, which may then cause severe head or bodily injury. Carlsson and Lundälv (2019) stated that when it comes to PWC collisions, cars have been found to be involved 60% of the time, often at main intersections or while backing out of areas. It was a common occurrence for PWC users to make contact with the ground during accidents and collisions. Studies have found that approximately 87% of single accidents involved the PWC driver impacting the ground, 71% involved PWC user turnover, and 16% included the driver falling out of their devices (Carlsson & Lundälv, 2019). Despite tips and falls having remained among the top safety concerns for PWC users over time, it does not appear that enough is being done to address this issue. This is demonstrated by the consistent rate of incidence of 60-80% in 2003 to 71% in 2019 (Carlsson & Lundälv, 2019; Xiang et al., 2006). As stated earlier, these incidents are dangerous because they can lead to head and/or bodily injury upon contact with the ground. Studies determined that the head (32%), upper limb/arms (26%), lower limbs/legs (19%), hip (9%), and torso (8%) are the most commonly injured body regions during a single accident (Carlsson & Lundälv, 2019).

Interviews with PWC users and caregivers identified backing up, turning/ maneuvering through confined spaces, uneven surfaces, and avoiding obstacles as some of the most challenging driving skills (Torkia et al., 2015). It is important to address and educate clients on these complex skills as soon as they receive their devices, to reduce the likelihood of developing poor, unsafe habits/routines related to maneuvering their powered devices. Due to the limited PWC training they received upon the arrival of their devices, clients have reported experiencing similar difficulties as both novice and

experienced drivers putting them at a greater risk of injury from accidents and collisions (Torkia et al., 2015).

Theme #3: Maintenance

PWCs are the most commonly used assistive devices that enable community mobility (Worobey et al., 2022). However, like all devices, its mechanical parts become damaged due to everyday wear and tear. Commonly reported repairs among PWC users were worn out/punctured tires, broken powered seating function, suspension elements, and controller box including the joystick. When a PWC breaks down, it impedes the client's ability to change positions, manage pressure, complete ADLs, and participate in the community. According to Worobey et al. (2022), 45-88% of wheelchair users will experience a breakdown. This could result in possible injuries, becoming stranded in unsafe areas, or missed obligations. Clients who experienced a breakdown are 1.9% times more likely to re-hospitalize, 1.7% times more susceptible to developing a pressure injury, and are more likely to report experiencing pain. Therefore, the underlying fear of breakdown during community engagement was a commonly reported barrier to independence. Less than 50% of participants received training on wheelchair maintenance, 21% attended wheelchair follow-up appointments and were unsatisfied with the services, and 60% of those who attended experienced long wait times for repairs/replacements. This was accompanied by limited mobility while waiting for the repairs to be completed (Worobey et al., 2022).

PWC breakdowns are not only physically and mentally detrimental to the user but can be a financial burden. Out-of-pocket repairs can range between $6 to $4,000 which can inhibit the user from completing all the necessary repairs (Worobey et al., 2022).

While their PWC is being repaired, they are provided with a backup wheelchair that is typically in poor condition and no longer satisfies the needs of the user. Worobey et al. reported most insurance companies will not replace a wheelchair unless the cost of repairs exceeds 50% of the cost of purchasing a new PWC. The repair and maintenance only cover the primary wheelchair and not the backup wheelchair. In the case of someone receiving maintenance on their primary PWC, they may not have an operational backup wheelchair for emergency use. An unfortunate consequence of increased community participation across various environmental terrains results in a higher demand for extensive repairs. Community participation increases quality of life; however, this results in a higher risk of wheelchair breakdown and damage. Lastly, racial and ethnic disparities affect the delivery of wheelchair provisions, discrimination in healthcare, and decreased healthcare literacy for minorities have been reported (Worobey et al., 2022).

Knowledge Gaps

A gap we found in this area of literature was the lack of studies regarding marginal ambulatory users. Marginal ambulatory PWC users can ambulate for short distances, but become easily fatigued; therefore, requiring the assistance of a powered mobility device. Since they can walk short distances, insurance may not be as likely to cover the device as it would for fully wheelchair bound individuals. This may increase the likelihood that marginal ambulatory individuals will have to pay out-of-pocket for their devices. This is because insurance may consider it to be more of a convenience item, which is not covered (Health and Human Services Agency, 2015). Insurances, like Medicare, may also deny coverage of this device because they only cover equipment which they consider appropriate within the home (Payment for Part B Medical and Other

Health Services, 2023, para 202). Therefore, they will not receive standard provisions such as appropriate training, fitting, and maintenance that an individual who is wheelchair dependent would receive. The lack of knowledge and support could potentially increase the risk of collisions/accidents, financial burden, and optimal functional performance during community participation. There is insufficient research supporting marginal ambulatory user's access to educational and training resources.

An additional knowledge gap we recognized in the literature was the insufficient delivery of existing clinical guidelines on a global scale. McSweeney and Gowran (2019) stated that World Health Organization's 8-step wheelchair service delivery is a helpful resource, but the guidelines are not being effectively administered. D'Innocenzo et al. (2021) revealed that many countries are in need of quality clinical guidelines but are commonly weak or non-existent. As a consequence, organizations using specific services or setting forth product standards are optional. Additionally, the World Health Organization created an outlined approach of wheelchair safety, but still lacks evidence that this may address concerns for efficiency (D'Innocenzo et al., 2021). If OTPs adhered to the administration of universal guidelines, the clients would likely receive a higher standard of care.

Clinical Significance of Occupational Therapy Implications

As community mobility specialists, OTPs can play a crucial role in educating clients and caregivers on appropriate PWC provisions. Delivering proper training in skills such as turning, reversing, and navigating through uneven surfaces, can decrease the rate of accidents and collisions among PWC users. Being aware of environmental barriers and hazards found within the community will help the client to problem solve and safely

navigate their devices without hindering their participation in the community. With this knowledge, PWC users can choose routes and community transportation that best suit their needs. Rough terrains can cause wear and tear to wheelchair parts, resulting in the user needing to replace and repair the damaged components (Choi et al., 2021). Damage to a PWC can be a burden on the client and caregiver; therefore, it would be beneficial for OTPs to provide follow-up appointments to assess the integrity of the device. Not only would this be convenient for the client, but cost-effective as well.

Addressing community mobility plays a significant role in occupational engagement and the carrying out of many IADLs. OTPs can implement an evidence-based approach to develop client-centered evidence-based training materials such as manuals or videos. These resources can address some of the most challenging skills needed to maneuver their powered devices in a safe manner and promote participation in meaningful activities that provide a sense of purpose and independence. A detailed manual gives clients the confidence to transfer knowledge gained in training to real-life situations.

Theoretical Framework

The PEO model is a client-centered approach that focuses on the dynamic relationships between the "person," "environment," and "occupation" to facilitate optimal performance in meaningful occupations (Cole & Tufano, 2020). An OTP has the skills needed to assess all factors which impact their clients' ability to perform desired tasks. When implementing the PEO frame of reference to our thesis project, the person aspect included the individual(s) whom the manual was being developed for– both the client and their caregivers. Our goal was to be able to identify the factors contributing to client

participation in community mobility by finding the optimal fit between personal, environmental, and occupational dimensions of everyday life.

The client's environment consists of physical, social, cultural, and institutional elements (Cole & Tufano, 2020). Examples of physical environments may include public areas an individual travels through. When using a PWC, the client could encounter many unexpected barriers. These barriers can range from curbs to uneven surfaces, confined spaces, different terrains, and more. It is important to recognize these types of factors because they influence the client's engagement within their environment. Without proper training, clients and caregivers may find it difficult to overcome these barriers. Hence, proper training on some of these barriers may prevent dangerous situations such as PWC turnover as well as accidents and collisions. The "Occupational Therapy Practice Framework - 4th edition" stated that support and relationships are also considered a part of the client's environmental factors (AOTA, 2020). For this reason, it is important to include any family or caregivers in assistive device training as they play a crucial role in safety awareness. The caregiver's involvement in such training can be helpful with additional cueing for safety. For example, the caregiver may provide cues regarding the client's position in the PWC and inform them if there is a safety hazard. The PEO model supports the efforts in continuing to seek different approaches to improving the client's experience.

Finally, occupations are defined as anything an individual wants or needs to do in their everyday life, such as ADLs and IADLs, social participation, health management, and more (AOTA, 2020). Our PWC manual gives clients the ability to perform skills

needed for social and community participation. It allows them to be able to independently perform their ADLs and IADLs and empowers the users to feel accomplished.

Methodology

We focused on creating an evidence-based PWC manual for marginal ambulatory clients, individuals who may encounter limitations when walking long distances, and their caregivers. A second thesis group may choose to use our manual to develop a series of instructional videos and send out surveys to OTPs for feedback, while a third group can test the validity of both the manual and educational videos.

There were several steps that needed to be performed before our group could start developing the actual manual. The first step involved conducting an in-depth literature review. This helped us to identify the importance of evidence-based manuals and allowed us to gain insight into PWC user and caregiver perspectives on assistive devices. This process also allowed us to gain a better understanding of current PWC training methods, evaluate their implementation, and determine their effectiveness. Lastly, this review helped us identify specific skills PWC users find most difficult to perform. Our manual made sure to address those skills in order to help decrease injuries from accidents/collisions among PWC users due to insufficient PWC training over time.

In order to find peer-reviewed articles, we utilized Google Scholar, ProQuest Nursing and Allied Health Source, and EBSCO databases: CINAHL Complete, MEDLINE Complete, Academic Search Complete, PsycINFO, and ERIC. Once on these databases, we used key terms and phrases to narrow down our results. The major keywords included: “powered wheelchair,” “occupational participation,” “powered wheelchair safety,” “accidents and collisions,” “powered wheelchair skills,” “caregiver

education," "client experiences and/or perspectives," "maintenance and repairs," and "community mobility."

Based on our research of existing literature, we discovered a trend of common difficulties that clients face when executing certain skills like turning, backing up, and navigating through uneven surfaces (Torkia et al., 2015). Therefore, our manual focused on these three specific skills. We practiced these skills within a natural community environment to gain first-hand experience of the potential challenges PWC users may encounter. This trial-and-error process helped us develop a manual that was safe for clients and caregivers to rely on when navigating their surroundings. Once we experienced this, we were able to write detailed instructions on how to safely perform these three skills with a joystick PWC. Our group also consulted and collaborated with an OTP who has in-depth knowledge and experience with powered mobility devices to ensure that our manual was as accurate and effective as possible.

Our group incorporated the PEO framework while developing the manual for specific PWC skills. The PEO framework takes into consideration how the person, environmental factors, and occupation interact and influence one another (Cole & Tufano, 2020). When implementing this framework to promote therapeutic change, the OTP would develop a close collaborative relationship with the client. This would assist OTPs in identifying the occupation that will be targeted by their therapeutic intervention, as well as possible personal and environmental factors that may either hinder or promote the achievement of those goals. For our thesis project, the clients and caregivers that this manual was developed for served as the person. The barriers and support systems served

as the environmental influence, and community mobility and participation in tasks such as ADLs and IADLs were the occupations.

For the purpose of our project, we utilized the Merits Health EZ-GO Deluxe PWC. This PWC is joystick-operated and has many features that help meet many demands of marginal ambulatory users. Some of these features include a tight 23" turning radius, a top speed of 4 mph, rear-wheel drive, and a battery charge distance of 12 miles (Merits Health, n.d.). This device is also convenient due to its durable steel frame, compact size, and easy assembly/ disassembly. It is important to note that this device is available for purchase without insurance or prescription. Our group had access to this specific PWC when developing our manual which helped us understand the functionality of common joystick powered wheelchairs. We took into consideration the EZ-GO Deluxe PWC's reliability and affordability for marginal ambulatory individuals to participate in their daily occupations.

There were inclusion/exclusion criteria related to the articles used for our literature review. The inclusion criteria for the literature review included scholarly articles about user/caregiver perspectives, current joystick PWC manuals, and articles solely focused on adult PWC users who were eighteen years or older and caregivers. Articles we surveyed also had to be available in the English language and come from reputable sources to be included. Exclusion criteria included other thesis papers, articles that were written in a language other than English, articles about PWC controlled by something other than a joystick, and articles related to pediatric PWC users.

Limitations

A major limitation of our project was its application to only marginal ambulatory individuals. Individuals who are wheelchair-bound or require a PWC operated by something other than a joystick may find that the contents of our manual are not suitable to their needs. Other limitations include our manual only being developed in English and for adult PWC users without significant motor and/or cognitive impairments. The manual will reference one specific type of joystick PWC, the EZ-GO Deluxe PWC, which may serve as a limitation. Lastly, we encountered limited research regarding the safety of PWC users which further supports the need for developing an evidence-based research manual.

Ethical and Legal Considerations

Our thesis project did not involve research with human subjects. We surveyed the literature and incorporated OTP expertise to create an evidence-based research manual rather than tested/measurable data. We took appropriate safety measures by consulting with an OTP experienced in wheelchair mobility throughout the development of our manual. Due to the time frame of our project, we were not able to test the validity of our manual. We acknowledge that the manual is written from the perspective of ambulatory individuals. The manual is intended to be used for marginal ambulatory users who are using a fully functioning joystick-powered wheelchair. The manual follows a sound design that does not intend to offend or do harm to clients and caregivers and is developed with adequate levels of expertise with the support of evidence-based literature.

The manual includes photos we took of the PWC and were displayed throughout the manual to further benefit the understanding of the consumer. These photos were not

taken from the original EZ-GO Deluxe provider manual/website, internet, or stock photos. All photos were produced specifically for the manual; therefore, we are the copyright holders of these photos. We used images to support the instructions, highlight important information, and add visual interest to the manual. The photos featured the EZ-GO Deluxe PWC, which was purchased by our thesis advisor. The images do not contain brand logos, faces, or associations with specific populations to avoid biases.

Results

Our research question was "what types of evidenced-based materials can assist in developing an effective powered wheelchair safety manual?" We predicted that information from peer-reviewed journal articles, OTP clinical expertise, and client values and perspectives would be most helpful in the development of an evidence-based manual. In conducting our literature review, we were able to locate peer-reviewed journal articles that shared PWC user and caregiver perspectives of common challenges faced when navigating their device through their community. Common issues reported by the PWC user population included difficulty turning in confined spaces, backing up, and maneuvering over uneven surfaces (Torkia et al., 2015). This was a common issue among PWC users regardless of the amount of experience with their device. These findings helped us in determining which skills we wanted our manual to focus on. Additionally, literature revealed environmental barriers and device maintenance as major contributors to positive user experience with their devices (Worobey et al., 2022).

Collaboration with an OTP with in-depth knowledge regarding these devices was helpful in making sure that instructions for performing these skills were as clear, accurate, and safe as possible. In the end, we were able to produce a short evidence-based

manual that focused on overcoming common environmental barriers, teaching three PWC skills, and considerations for device maintenance. The three main skills our manual focused on included turning in confined spaces, backing up, and maneuvering over uneven surfaces in a safe manner.

Discussion

Research studies involving marginal ambulatory individuals are very limited. When considering powered mobility training, marginal ambulatory individuals are often excluded. By developing a manual for them, we are implementing the "Vision 2025" statement which emphasizes the inclusion and participation of all populations in everyday life (AOTA, 2017). Marginal ambulatory individuals require assistive devices to be able to attend doctor appointments, spend time with their families, and explore their communities.

Our evidence-based training manual is a comprehensive guideline for marginal ambulatory clients and their caregivers. The restrictive instructions of current powered mobility manuals can evoke fear and a lack of confidence in users. This can influence them to avoid community mobility altogether due to fear of injury. OTPs can assess how environmental barriers, injuries from accidents and collisions, and maintenance affect the user's participation in IADLs and come up with effective solutions to maximize their participation in everyday life (AOTA, 2017). To ensure consumer understanding, we included labeled images and detailed instructions written at the average reading level of American adults. Operating the PWC ourselves provided us with first-hand experience and knowledge allowing us to provide more informed guidance on safety and functionality. In conclusion, the evidence-based training manual for the safe use of PWCs

will serve as an effective training tool to support marginal ambulatory users and their families in facilitating meaningful occupational engagement in their communities.

Conclusion

We conducted extensive research regarding factors that influence community participation among PWC users. We concluded that environmental barriers, injuries from accidents and collisions, and maintenance were the most prevalent concerns among this population. When these factors occur in conjunction with each other, it discourages the individual from venturing outside their home and participating in meaningful occupations. Through proper training, OTPs can incorporate the PEO frame of reference to effectively educate clients and caregivers about using assistive devices and maintenance. Doing so allows clients to gain a sense of independence and improve their overall quality of life. A PEO-based instruction manual ensures clients can optimally perform in all of their preferred community activities without limitations. We encountered gaps within the literature such as the exclusivity of marginal ambulatory PWC users and insufficient implementation of clinical guidelines regarding PWC training. Surveying the literature has allowed us to identify the risks and barriers that have hindered the users' ability to live a fulfilling life. We suggest that future researchers further test the validity of our manual, which can be used for future videos. These educational materials can serve as an effective solution which helps facilitate participation of all individuals in everyday life (AOTA, 2017). Clients and caregivers will know how to overcome barriers rather than let them hinder their participation in meaningful activities.

References

American Occupational Therapy Association. (2017). Vision 2025. *American Journal of Occupational Therapy*, *71*(3), 7103420010p1. https://doi.org/10.5014/ajot.2017.713002

American Occupational Therapy Association. (2020). Occupational therapy practice framework: Domain and process (4th ed.). *American Journal of Occupational Therapy*, *74*(Suppl. 2), 7412410010p1-7412410010p87. https://doi.org/10.5014/ajot.2020.74S2001

Ashadi, K., Purnomo, M., Haryudo, S. I., Wibowo, S., Wiriawan, O., Setijono, H., Soegiyanto, S., Sugiharto, S., Rustiadi, T., Handayani, O. W., & Shah, S. A. (2022). Wheelchair user's barriers in physical activity: Rural vs. urban area. *International Journal of Human Movement and Sports Sciences, 10*(3), 534–539. https://doi.org/10.13189/saj.2022.100321

Carlsson, A., & Lundälv, J. (2019). Acute injuries resulting from accidents involving powered mobility devices (PMDs)—Development and outcomes of PMD-related accidents in Sweden. *Traffic Injury Prevention, 20*(5), 484-491. https://doi.org/10.1080/15389588.2019.1606910

Choi, S. W., Woo, J. H., Hyun, S. Y., Jang, J. H., & Choi, W. S. (2021). Factors associated with injury severity among users of powered mobility devices. *Clinical and Experimental Emergency Medicine*, *8*(2), 103–110. https://doi.org/10.15441/ceem.20.078

Cole, M. B., & Tufano R. (2020). *Applied theories in occupational therapy: A practical approach* (2nd ed.). SLACK Incorporated.

Cook, A. M., & Polgar, J. M. (2015). *Assistive technologies: Principles and practice* (4th ed.). Elsevier Health Sciences.

D'Innocenzo, M. E., Pearlman, J. L., Garcia-Mendez, Y., Vasquez-Gabela, S., Zigler, C., Rosen, P., Dewi, E. H., Praptoraharjo, I., & Mhatre, A. (2021). Exploratory investigation of the outcomes of wheelchair provision through two service models in Indonesia. *PLOS ONE, 16*(6)*,* Article e0228428. https://doi.org/10.1371/journal.pone.0228428

Health and Human Services Agency. (2015). *Criteria for coverage of wheelchairs and applicable seating and positioning components.* (APL 15-018). California Department of Health Care Services. https://www.dhcs.ca.gov/formsandpubs/Documents/MMCDAPLsandPolicyLetters/APL2015/APL15-018.pdf

McCullough, S., Eisma, J., Park, J. Y., Salazar, M., & Rose, S. F. (2022). Inequity by inequity: Community driven investigation of wheelchair user discomfort by infrastructure failures. *BuildSys '22: Proceedings of the 9th ACM international conference on systems for energy-efficient buildings, cities, and transportation,* (274-277). https://doi.org/10.1145/3563357.3564081

McSweeney, E., & Gowran, R. J. (2019). Wheelchair service provision education and training in low and lower middle income countries: A scoping review. *Disability & Rehabilitation: Assistive Technology*, *14*(1), 33–45. https://doi.org/10.1080/17483107.2017.1392621

Merits Health. (n.d.). *EZ-GO deluxe wheelchair user manual.* https://www.mobilityscootersdirect.com/pdf/p-321-ez-go-deluxe-wheel-chair-user-manual.pdf

Payment for Part B Medical and Other Health Services, 42 C.F.R. § 414 (2023). https://www.ecfr.gov/current/title-42/chapter-IV/subchapter-B/part-414/subpart-D/section-414.202

Saha, S., Selingo, L., Olejniczak, E. O., Noyce, H. N., Raychoudhury, V., Smith, R. O., & Gani, M. O. (2022, July 13-15). *MyPath: Accessible routing for wheelchair users* [Paper presentation]. Rehabilitation Engineering and Assistive Technology Society of North America (RESNA) Annual Conference, Washington, DC, United States. https://www.resna.org/sites/default/files/conference/2022/PublicTransportation/80_Saha.html

Torkia, C., Reid, D., Korner-Bitensky, N., Kairy, D., Rushton, P. W., Demers, L., & Archambault, P. S. (2015). Power wheelchair driving challenges in the community: A users' perspective. *Disability & Rehabilitation: Assistive Technology*, *10*(3), 211–215. https://doi.org/10.3109/17483107.2014.898159

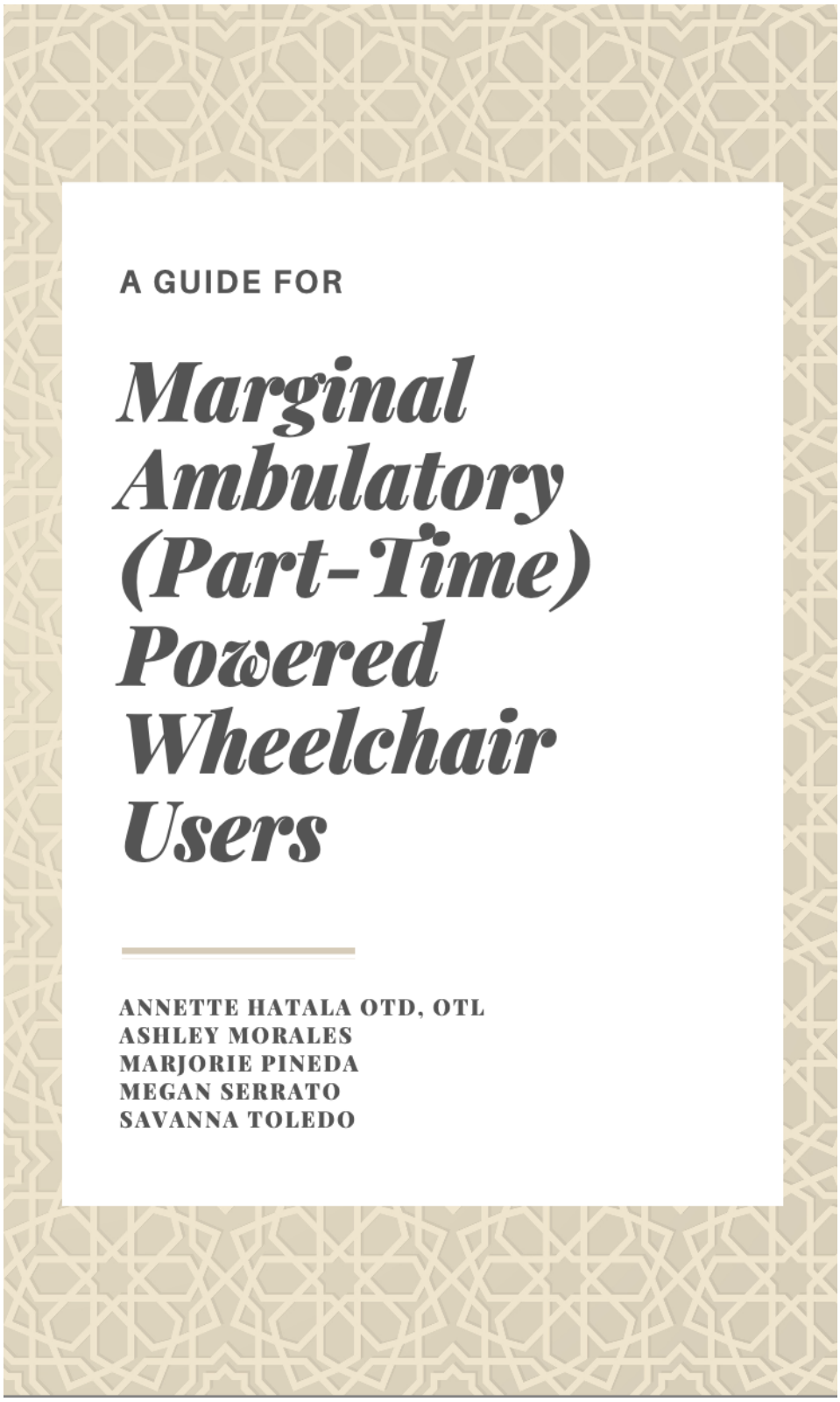
World Health Organization. (2023). *Wheelchair provision guidelines*. https://www.who.int/publications/i/item/9789240074521

Worobey, L. A., Heinemann, A. W., Anderson, K. D., Fyffe, D., Dyson-Hudson, T. A., Berner, T., & Boninger, M. L. (2022). Factors influencing incidence of wheelchair repairs and consequences among individuals with spinal cord injury. *Archives of Physical Medicine and Rehabilitation*, *103*(4), 779–789. https://doi.org/10.1016/j.apmr.2021.01.094

Xiang, H., Chany, A. M., & Smith, G. A. (2006). Wheelchair related injuries treated in US emergency departments. *Injury Prevention: Journal of the International Society for Child and Adolescent Injury Prevention*, *12*(1), 8–11. https://doi.org/10.1136/ip.2005.010033

Appendix

Evidence-Based Training Manual



DISCLAIMER

PLEASE CONSULT YOUR LOCAL OCCUPATIONAL THERAPIST AND PRIMARY CARE PROVIDER BEFORE USING THIS MANUAL. WE ARE NOT RESPONSIBLE FOR INJURY OR DEATH WHICH MAY RESULT FROM UTILIZING OUR MANUAL.

TABLE OF CONTENTS

Introduction

This manual will focus on the safe use of powered wheelchairs (PWCs) for marginal ambulatory individuals. A marginal ambulatory individual is someone who may encounter limitations when functionally ambulating to long distances due to a health condition or injury. PWCs can be highly effective tools for facilitating and promoting community mobility and occupational participation. However proper training on how to safely operate them is important to serving these larger ends for successful occupational engagement. This manual will cover topics such as the environment, accidents/collision, and maintenance information needed for safe driving and upkeep of PWCs. It will also teach clients and caregivers how to perform complex skills such as backing up, turning in confined spaces, and driving over uneven surfaces.

This is a photo of the EZ-GO Deluxe powered wheelchair.

Environment

Environmental barriers can affect the ability to maneuver a powered wheelchair smoothly.

- Certain surfaces may make for a bumpy or unpleasant ride.

Examples of environmental barriers which users may encounter include holes/cracks in sidewalks, different terrains, spacing, etc. (see Figure 1 and Figure 2).

Users must know how to effectively approach different situations in a safe manner.

Environmental Barriers

Figure 1. This image depicts the curb ramp and gutter of a sidewalk. The PWC might shift towards the gutter unless speed is adjusted and joystick is appropriately used.

Figure 2. This image shows holes, cracks, and an uneven surface along a parking lot. Users must be aware of their PWC tilting on these types of uneven surfaces.

Types of Accidents/ Collisions

Backing Up

Step 1: Remove hand from joystick and make sure you are at a complete stop
Step 2: Assess area for safety
- Are you in a safe area?
- Is the area clear and free of oncoming traffic, walls, or other physical barriers?
- Make sure to check both sides and behind your device!

Step 3: Adjust speed to no more than 3 of 5 (see Figure 3).
- May vary slightly depending on terrain

Step 4: Check both over your shoulders and the ground behind you (both sides) once more.
Step 5: Use your dominant hand to slowly pull the joystick towards the back of the wheelchair once you have determined the area is safe.
- Caution: Joystick is sensitive!
- Slight twisting motions or pulling too quickly may cause jolty movement

Step 6: Continue maneuvering joystick and checking over both shoulders until at desired locations
Step 7: Once at desired location, let go of joystick
Step 8: Double check that you are in a safe location away from moving cars and/or objects

*Caregivers may provide auditory cues for safety throughout the entire process.

Turning in Confined Spaces

Step 1: Make sure you are at a complete stop by letting go of the joystick
Step 2: Assess the area around you
- Ask yourself if there is enough space to turn.

Step 3: Position the wheelchair in an area where there are several inches around the edge of the wheelchair chair on all sides (based on personal judgement)
Step 4: Adjust speed to 1 or 2 (see Figure 3).
Step 5: Identify target location.
Step 6: Make sure area is clear of people and other physical obstacles
Step 7: Use your thumb and pointer finger to manipulate the joystick in a circular manner & point it towards your target location. (see Figure 4).
Step 8: Once the wheelchair is pointed towards the desired location, release the joystick to come to a complete stop.
Step 9: Readjust speed (no more than 3 mph) to proceed straight towards target location

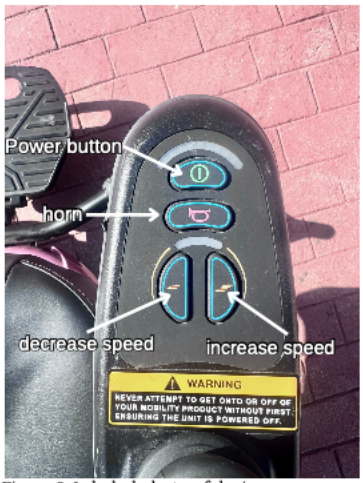


Figure 3. Labeled photo of device.

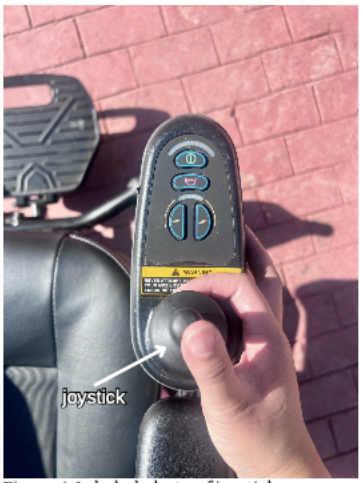


Figure 4. Labeled photo of joystick.

Uneven Surfaces

- Be cautious of the following uneven surfaces:
  - Potholes or large cracks on sidewalks and roads
  - Pebbled pathways
  - Tiled flooring
    - Tiled flooring presents some grooves with a smooth surface. It is recommended to decrease speed to 1 or 2 mph, especially in public spaces (i.e., restaurants, patios, etc.)
  - Cement paths that transition onto grass (i.e., wet grass creating muddy textures)
    - Mud is slippery and will reduce traction on the wheels making it tough to move. Speeding through the mud may cause you to lose control. Too slow may cause you to be stuck.
  - Sidewalk curb ramp
    - It is recommended to increase speed by one or two to prevent shifting towards the gutter (see Figure 5).

Figure 5. Labeled photo of a sidewalk.

Maintenance

Battery

- Maintain battery life by charging the device at least once a week or as indicated in the device manual.
- A full charge will take up to 8-14 hours.
- Check the battery before leaving the home to avoid becoming stranded or requiring the powered wheelchair to be manually pushed by a caregiver.

Tires

- Consider your environment. Some terrains will cause more wear and tear than others. It is important to frequently check the condition of the tires.
- Good tires will decrease skidding and improve traction for safety.
- Check and clean tires when transitioning between different terrains (e.g. pavement to grass) to avoid safety hazards.

Routine Maintenance

- Annual inspections to test each component of the device
- Replace tires, brakes, wheels, and footrests when necessary.
- Replace seat cushions or armrests if they become worn or torn.
- Keep the device clean of mud, dust, and water.
- Keep an eye out for any power ports that may gather some form of build-up.

Warranty

- Consider warranty options to reduce the potential cost of future repairs and replacements.