WHAT'S THE IDEAL SCOOTER? STAKEHOLDERS’ PERSPECTIVES ON
ENHANCING THE USABILITY AND SAFETY OF MOTORIZED MOBILITY
SCOOTERS

by

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The following individuals certify that they have read, and recommend to the Faculty of Graduate and Postdoctoral Studies for acceptance, a thesis/dissertation entitled:

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Abstract

The use of motorized mobility scooters (MMSs) helps improve the quality of life of people living with disabilities by facilitating independence and community engagement. However, alongside these benefits, some challenges have been found to accompany their use. While issues that stem from the environment, the user, and the technology have been identified in literature as leading contributory factors to challenges with MMS use, technological problems have received much less attention. As the design of any technology plays a vital role in facilitating or impeding its own use, this study sought to understand diverse stakeholders’ perspectives on how technological factors influence MMS usability and safety, and how these can be enhanced.

A qualitative descriptive method of inquiry was used in the study. A conceptual framework developed from the HAAT Model and the Compensatory frame of reference informed the data collection and analyses. Semi-structured in-depth interviews were conducted with a purposive maximum variation sample of 12 MMS users and 17 service providers who had experience with MMS-related services. The interviews were audio recorded and transcribed verbatim and content analysis was performed on the data.

Analyses of the data resulted in three main themes. The first theme “Finding the right fit” explored the technology-related considerations and compromises made along the MMS procurement process; the second theme “Negotiating everyday challenges” explored the day-to-day challenges of MMS use that are associated with technological issues; and the third theme “Identifying solutions and barriers” explored ideas on enhancing MMS usability and existing or potential barriers.
By investigating the technological issues that arise with MMS use in real world situations from the perspectives of diverse stakeholders, this study presents a unique point of view that has not been explored in literature. Findings from this study provide insights into how technological factors impact the usability and safety of MMSs for different user populations, during the performance of different activities, and its use in different environments. Stakeholders’ recommendations on enhancing MMS usability and safety can also help inform future innovation regarding MMS design.
Lay Summary

Motorized mobility scooters (MMSs) have been shown to help enhance mobility and promote independence among people who live with disabilities, however, some challenges are associated with their use. While problems related to MMS design have been identified as a key challenge area, it has remained the least explored so far. Thus, the purpose of this thesis was to investigate the perspectives of MMS users, clinicians, and vendors who deliver MMS-related services, on the usability (i.e., effectiveness, efficiency and provided satisfaction) of MMS technology. The findings of this study bring forth new knowledge and contribute to an in-depth understanding of aspects of MMS technology that do not work so well and their resulting implications; how MMS design can be enhanced to improve user experience; and the existing or potential barriers to implementing the required modifications to MMS design.
Preface

This project was reviewed and approved by the University of British Columbia Behavioral Research Ethics Board, certificate number: H17-01155. This work is part of a larger multisite study conducted in UBC’s Rehab Research Lab by Dr. William C. Miller and Dr. Ben Mortenson; and in McGill University by Dr. Phillippe Archambault and Dr. Dahlia Kairy.

I identified the research questions in this thesis and was responsible for the study design, data collection, data analyses, and synthesis.
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<td>AT</td>
<td>Assistive Technology</td>
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<td>CFOR</td>
<td>Compensatory frame of reference</td>
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<td>C-HAAT</td>
<td>Compensatory - Human Activity Assistive Technology</td>
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<td>FOR</td>
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<td>HAAT</td>
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<td>MMS</td>
<td>Motorized Mobility Scooter</td>
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<tr>
<td>NSW</td>
<td>North South Wales</td>
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<td>UK</td>
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Glossary

**Class 2 invalid carriages** - A term used in the UK to refer to MMSs that can be driven on sidewalks.

**Class 3 invalid carriages** - A term used in the UK to refer to MMSs that can be driven on both roads and sidewalks.

**Coding** – A process of breaking down raw qualitative research data into some form in which they can be manipulated, organized and examined more easily.

**Conceptual framework** – A set of interrelated concepts that symbolically represent and convey a mental image of a phenomenon.

**Confirmability** - A measure of rigour in qualitative research that demonstrates how the research findings are supported by the data.

**Credibility** – A measure of rigour in qualitative research that demonstrates consistency between research participants’ expressions and the researcher’s interpretations of data.

**Definitive concept** – It “refers to precisely what is common to a class of objects by the aid of a clear definition in terms of attributes or fixed bench marks”. It “provides prescriptions of what to see.” (page 7 of reference 84)

**Dependability** – A measure of rigour in qualitative research that demonstrates whether a study would yield similar findings, along with logical differences, if it were carried out in a similar
context in the future.

**Effectiveness** – “The accuracy and completeness with which specified users can achieve specified goals in particular environments. (ISO 9241 cited in page 37 of reference 54)

**Efficiency** – “The resources expended in relation to the accuracy and completeness with which users achieve goals”. (ISO 9241 cited in page 37 of reference 54)

**Emic** – An epistemological stance where knowledge is gathered from within a social group.

**Epistemology** – A branch of philosophy that describes the theory of knowledge and explores what is known and the rationalizations of justified belief.

**Etic** – An epistemological stance where knowledge is uncovered from outside a social group in an effort to maintain objectivity and avoid bias.

**Member checking** – A technique for exploring credibility of qualitative research findings by returning data or results to participants to check for its accuracy and resonance with their experiences.

**Motorized mobility scooter** – A tiller-controlled motorized assistive mobility device with 3 or 4 wheels.

**Motorized mobility scooter design or technology** – Physical characteristics (e.g., size, weight, components and accessories) and performance characteristics (e.g., speed, power, stability, and maneuverability) of MMSs.

**Motorized mobility scooter user** – A person with mobility challenges who uses an MMS.
**Ontology** – A branch of philosophy that describes the nature of being, and of reality and truth.

**Paradigm** – A basic set of beliefs that shape the worldview of the researcher. These include the ontological, epistemological and methodological underpinnings of research.

**Peer debriefing** – Involves seeking input (substantive or methodological) from knowledgeable colleagues as consultants, soliciting their reactions as listeners and using them as sounding boards for researcher’s ideas.

**Pragmatism** – A paradigm that does not take a dogmatic position concerning different methods but adopts a pluralist attitude by using methods and method combinations that work in relation the research purpose and current empirical situation.

**Reflexivity** - The conscious revelation of the underlying beliefs and values held by researchers in selecting and justifying their methodological approach.

**Regulations** – Rules, directives, or laws made and maintained by an authority towards MMS use.

**Relativism** – The ontological belief that there are multiple realities and that various truths can co-exist.

**Rigour** - The intellectual precision, robustness, appropriateness, sufficiency, and cohesiveness of concepts, methodologies, epistemology, ontology, and methods deployed in the research process and output.
Satisfaction – “The comfort and acceptability of the work system to its users and other people affected by its use” (ISO 9241 cited in page 37 of reference 54).

Sensitizing concept – It “gives the user a general sense of reference and guidance in approaching empirical instances”. It “merely suggests directions along which to look.” (page 7 of reference 84)

Standards - Voluntary guidelines established as a model for the design of MMS.

Stakeholders - Users, individuals, organizations and authorities that are directly or indirectly involved in or affected by matters pertaining to MMS use.

Transferability – A measure of rigour in qualitative research that describes the degree to which study results can be applied to populations outside of the study sample.

Trustworthiness – The predominant measure of rigour in qualitative research that is characterized by credibility, confirmability, dependability, and transferability.

Usability – “The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction, in a specified context of use” (ISO 9241 cited in page 37 of reference 54).
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To my awesome husband Dami, and our families, I would like to say thanks for being there for me. I would also like to thank Pastor Dinesh and members of the South Vancouver Community Church for being a family away from home.
Dedication

I dedicate this work to my Abba. You inspired me to go for this master’s program and came through for me in so many ways from the beginning to the very end. Thanks for loving me and standing firm by me. I could not have done this without You. I really cannot thank You enough!
Chapter 1: Introduction

1.1 Background

Motorized mobility scooters (MMSs) help to improve users’ quality of life by facilitating independence, thus, decreasing reliance on caregivers, and enhancing community engagement by minimizing the physical effort and time required to travel longer distances (1-3). They are often preferred to other motorized alternatives because they are relatively more affordable (e.g., average cost of a MMS is US $2,407 versus US $5,237 for a power wheelchair) and there tends to be less stigma of disability associated with their use (4,5,6).

Alongside the benefits of MMS use, some challenges have been found to exist. In a study by Kirby and Ackroyd-Stolarz (7), the occurrence of tips, falls and collisions were reportedly higher with MMS use (52.8%) than with power (24.6%) and manual (22.6%) wheelchair use combined. Also, accidents associated with the use of MMSs have been reported to result in severe injuries and sometimes death (7-13). Thus, over the years, these adverse reports have led to growing concerns about how to ensure the safe use of MMSs and have raised questions about their usability (14-17).

In literature, the leading causes of MMS safety and usability challenges include a lack of driving competence, environmental factors, and technological problems (7-19). However, while the resolution of issues pertaining to the environment and the MMS user have received much attention, less emphasis has been placed on investigating mitigation strategies to address technological problems.
1.2 Currently emphasized strategies to address MMS issues and their limits

1.2.1 Regulations

In countries where MMS use is widespread various regulatory strategies have been implemented to ensure its safe use (8, 14-15, 20). The most common include the establishment of regulations on MMS use, creation of MMS guidelines, and implementation of environmental accessibility standards (8, 15). In most countries, MMS users are recognised as pedestrians and do not require a driving licence or need to go through a driving test, but other regulatory strategies employed vary widely across countries and across locations within each country (8, 15, 20-33).

1.2.1.1 UK regulations

The UK has arguably the most comprehensive guidelines and legal requirements on the use and design of MMSs. These regulations are set by the UK’s Department for Transport (21) and provide guidance on not only how MMSs can be used outdoors, but on the design features that MMSs must possess to be permissible for certain kinds of outdoor use (21-22).

MMSs that can only be driven on sidewalks are called class 2 invalid carriages (22). Users of class 2 invalid carriages are subject to the same laws as pedestrians and are not required to have their devices registered (22). Class 2 invalid carriages also have set design specifications which include having a maximum capable speed of 6.4kph, a maximum unoccupied weight of 248 lbs.

In contrast, MMSs that can be used on roads and sidewalks, are called class 3 invalid carriages (21). Class 3 invalid carriages must be registered annually regardless of whether they were purchased new or second-hand (21). The specifications they must posses include a maximum
capable speed of 12.9kph, a maximum width of 0.85 metres, a maximum unladen weight of 330 lbs, a speed regulating device, a speed indicator, reflectors, an audible warning instrument (horn), a rear-view mirror, and indicator lights (front and rear) (21).

For both Class 2 and 3 invalid carriages, reliable brakes that can be held at a gradient of at least 1 in 5, are mandatory requirements (21-22).

1.2.1.2 Australia regulations

Australia’s regulations and guidelines on MMS use and design are not as consolidated as the UK’s regulatory system. According to Australian federal regulations, MMS users are recognised as pedestrians only if they do not exceed a maximum speed of 10kph (23). However, it is unclear whether this regulation is meant to discourage higher speeds on sidewalks by being a speed restriction; to distinguish between MMSs that can be used on sidewalks from those that can only be used on roads; or is meant to be a legal design requirement for the maximum capable speed of the MMS.

Slightly different from the federal regulation of MMS users not exceeding a maximum speed of 10kph, states like Queensland, South Australia, North South Wales (NSW) and Victoria, require the MMS to have a maximum capable speed of 10kph (24-27). Some details about regulatory requirements also differ across these states. For instance, the specification for maximum unladen MMS weight is 150kg in Queensland (24), but is 110kg in South Australia, NSW, and Victoria (25-27). In Queensland, MMS users must get a certificate of proof of disability from a health practitioner to use an MMS. Also, MMSs designated for outdoor use must be registered, however, this registration is free and includes a 3rd-party insurance (24). In contrast, MMS users
in South Australia, NSW and Victoria are neither required to register their devices nor provide proof of their disability status (25-27).

1.2.1.3 New Zealand regulations

In New Zealand, MMS use is regulated at the federal level (28), but in comparison to the UK, their regulations are not as stringent. For MMS users to be considered pedestrians, their MMS must meet New Zealand Road Rule’s definition of a mobility device which is “a vehicle with a maximum power output not exceeding 1,500 Watts, designed and constructed for use by persons who require mobility assistance” (28-29). This definition, however, also raises questions about how MMSs that do not meet the power output criteria can or should be used.

Recommendations on MMS design dimensions are provided by Standards New Zealand, but their adoption is not mandatory (28, 30). Under the guidelines set by New Zealand Transport Agency (NZTA) for MMS use, registration is not required and there are no set speed limits for driving (28-30). However, MMS users are obligated to drive in a “considerate manner” which entails being mindful of the safety of other pedestrians; and are obligated to report crashes to the police within 24 hours if someone sustains an injury (30).

1.2.1.4 USA regulations

In the USA, MMSs are classified as electric personal assistive mobility devices and are regulated at state or municipality levels (31). Across states, there is a lack of specific guidelines for MMS use and design but the Americans with Disabilities Act (ADA) (32) enforces accessibility laws (for indoor and outdoor environments) to promote the accommodation of assistive devices used
by populations with disabilities. It requires that any entity or organization that serves the public (i.e., covered entity) should grant people with disabilities and their assistive mobility devices access into all places where the public is allowed to go. (32) Although the ADA (32) gives people with disabilities the right to choose whatever assistive mobility devices they need, covered entities (i.e., states, local governments, business entities, and non-profit organizations that serve the public) still maintain some autonomy in making decisions about if a particular type of device can be accommodated based on legitimate safety requirements described in the ADA (32). Covered entities can also request for credible assurance of disability but either a state-issued proof of disability or verbal confirmation by the user, must be accepted (32).

1.2.1.5 Canada regulations

Across Canada, MMS users are considered as pedestrians (14-15). However, regulations on MMS use vary widely and are non-existent in most cases; which is attributed to the fact that municipalities have jurisdiction over how sidewalks are used and not the federal or provincial government (14). Because MMSs are not considered as vehicles, the federal government is not responsible for setting safety standards or guidelines on MMS design, thus, none currently exist. Also, accessibility requirements for MMSs are not explicitly stated in the Canadian Standard Association (CSA) guidelines (33-34). The CSA (33) guidelines state the following: “Where possible, a larger clear floor area should be provided to accommodate these devices” (33 p.6). This fuzzy requirement leaves the provision of accessible environments for MMS users to mere discretion. Also, the proliferation in diversity of MMS design (15) makes specific estimations of area allowances for accessibility challenging to establish.
1.2.1.6 The limits of current regulations

Although the overall impact of the current regulations and guidelines on MMS use has not been found to be reported in literature, some of the guidance they provide helps to promote the safe use of MMSs. In some cases, they also ensure that MMSs are equipped with appropriate features that make them safe for use in certain environments (e.g., roads or sidewalks). However, most of these regulations or guidelines still do not address aspects of MMS design such as comfort, ease of operation, or reliability, which may directly influence the MMS user and consequently the usability and safety of the MMS.

1.2.2 Training

Training has been widely recommended in literature as an intervention to help promote MMS safety and usability (6, 8, 16-20, 35-39). Although it has been suggested as a mandatory prerequisite to determine the fitness of potential users to drive MMSs (8, 16), it has been favored more as a means to enhance driving competence, which MMS users can choose to seek at their own discretion. (20, 40, 41).

Training is usually provided by clinicians, expert MMS users (e.g., in community training programs), and vendors, but the level of training offered varies widely (8, 20,40, 42). Training offered by vendors have often been described by MMS users as being more of a test-run of the device than education on driving skills and usually involves getting instructions on how to operate the MMS controls and driving around the vendor’s store (40, 42). In contrast, MMS users who receive their MMSs via government or health initiatives appear to get more comprehensive training as clinicians or other qualified personnel are usually involved in the
device procurement process (20, 40). Although clinicians have been reported to provide a higher level of training than vendors do, the depth of training offered has been reported to vary across them, as there is a lack of standard MMS training guidelines (6, 37, 39).

Community based training via organizations such as transport agencies, police authorities, or advocacy groups for people with disabilities, are provided by clinicians and other qualified personnel, but may also include experienced MMS users (6, 20, 40). This training typically involves training on driving skills and education about road rules (20, 40).

1.2.2.1 Limits of training

In literature, there are dissenting views about the impact of MMS training on reducing accident occurrence, but more evidence leans towards the fact that it helps to enhance driving skill and competence (6, 11-12, 35-39). While training may be beneficial in enhancing the safe use of MMS, its ability to address issues that are inherent to the MMS device remains limited and such issues have the propensity to influence the efficiency of training.

1.3 The need to explore issues regarding MMS technology

From the review of literature, technological issues were found to be the least explored barrier to MMS use. However, this is not an indication of its unimportance or lack of existence.

1.3.1 Existing evidence about MMS technological issues

In a study by Kirby and Ackroyd-Stolarz (7) on wheelchair safety in the US, engineering problems related to mechanical frame (including wheels and tires), electrical connections, brakes and motors were found to be the highest reported contributing factors to incidents involving the
use of MMS and other wheeled mobility devices. Also, the results of laboratory experiments performed by the US Federal Drug Agency (FDA) revealed that radiofrequency interference from cell phones had the tendency to cause MMS brakes to malfunction (7).

Cassell and Clapperton (9) in a study on MMS related injuries and deaths in Australia, argued that the occurrence of MMS-related accidents, to an extent, reflected the inefficiency of the country’s consumer product safety systems. The study highlighted the need to improve certain features of MMS technology such as the braking control, the stability of the device, and its visibility during outdoor use.

By consulting with MMS users, retailers, and other stakeholders, a UK market research study on MMSs revealed that performance claims made by MMS manufacturers were often unreliable (40). Features that were found to fall short of usage expectations were battery life, range, speed, climbing ability, the resilience of the device to environmental factors (such as terrain), and their ability to accommodate for individual user characteristics (primarily weight). Also, some MMS users reported that technological problems related to braking and speed control and the long stopping distance of MMSs were contributing factors to some of the accidents they experienced. The most commonly reported safety incidents were tips and falls, but interestingly, only a few reported that they were using a 3-wheeled MMS when this occurred, which contradicts the common assumption that 3-wheeled MMSs tend to tip more than 4-wheeled ones.

Rutenberg et al (43) in exploring the challenges of MMSs use in the Canadian environment, investigated the concerns of diverse stakeholders about MMS technology. Government stakeholders at a municipality in British Columbia indicated that keeping track of new or evolving mobility technology was an issue. Concerns of local public transit operators were about
the transportability of MMS due to issues with its dimensions and the lack of appropriate attachment points. Dealers advocated for the need to standardize MMS size because size was usually a concern for clients. They also highlighted the need to add safety features to the MMS that will enhance its use at night and in bad weather conditions.

Souza et al (44) evaluated twelve 3-wheeled MMSs of three commercially sold brands. Different models of each brand were tested for how well they measure up to the American National Standards Institute/Rehabilitation Engineering and AT Society of North America (ANSI/RESNA) standards and to determine their performance in adverse environmental conditions. They reported that most of the MMSs failed to meet manufacturers’ performance claims and the recommended ANSI/RESNA standards. They also projected that this may be true of other MMSs found in the market and that using such devices may put users at risk of experiencing accidents.

Using computer simulations, Li and Chirwa (45) evaluated the crashworthiness of a MMS that was described as one of the best class 3 invalid carriages in the UK market. They reported that the nature of deformations that occurred on the MMS during some of the simulated crashes could be dangerous to users, thus, indicating that the MMS was not as safe as advertised.

In a qualitative study by Fomiatti et al (41), features of the MMS that users were dissatisfied with included the lack of adjustable tillers, seat, and armrest. Some users also mentioned feeling discomfort from prolonged use of acceleration controls (especially thumb pushing methods). Users also reported that the battery indicators and batteries were unreliable, and this limited their participation in certain activities because of the fear of getting stranded.
To determine the usability of MMS controls, the Research Institute for Consumer Affairs (Rica) (46) sought for feedback on 7 MMS brands from MMS users and non-users whose ages were between 60 and 75 years. Non-users who experienced crashes claimed it was due to the counter-intuitiveness of the controls. They also felt that smaller MMSs were quite “nippy” (i.e., speed modulation was quick and sudden) and it was challenging to predict their speed without the use of a speedometer. Gradual speed regulation was generally found to be difficult due to the sensitivity of the controls. Also, issues pertaining to colors of the controls (e.g., buttons or battery indicators), control labels, size of controls, proximity of controls to fingers and hands, and sounds following the controls (i.e., volume and type of sound) were generally reported. There was also a consensus about certain MMS brands being easier to use than others.

1.3.2 Significance of investigating MMS technology-related issues in Canada

In Canada, MMS users are the most prevalent motorized mobility user group (5) and based on projections about future demographic trends, a further increase in this population is expected. In 2011, it was estimated that 108,550 people with mobility challenges related to conditions that existed since birth, injury, disease, illness, and aging, were MMS users (5). Of this population, 57% were aged 65+ years, 39% were aged 45-64 years, and 4% were aged 15-44 years (5).

Over the next 5 decades, as baby boomers move into the age group of 65 years and above, older adult populations are expected to triple from about 5.4 million to 15 million (47). This rise in older adult populations is likely to increase the prevalence of mobility impairments that come with ageing and consequently, the demand for MMSs. Also, as mobility challenges are the third leading cause of disability in Canada, and the average age of onset of disability is 43 years across
the 3.8 million people living with disabilities (48), an even larger increase in demand for MMSs is expected.

Considering the projected increase in MMS use and the fact that regulations, which could otherwise serve as a safety buffer, are mostly non-existent in Canada, investigating the usability and safety of MMSs is particularly important in the Canadian context.

1.3.3 Current gaps in knowledge

The reviewed studies highlight some technological issues that stem from the use of MMSs, however, the scope of knowledge they provide is limited. For instance, while studies that empirically evaluated MMS technology suggest that design problems may be caused by production flaws rather than deterioration from ongoing use, they offer no contextual insights into the issues that MMS users encounter in real-world situations. In contrast, studies that explored the experiences of MMS users provided more of an atomistic than a holistic understanding of MMS issues, as they were either focused on specific contexts of MMS use, groups of MMS users, or aspects of MMS design. Thus, there is a gap in knowledge about the technological challenges faced by different user groups, with different aspects of MMS, and in different contexts of MMS use.

In view of the identified gaps in knowledge and their significance, the purpose of this study was to investigate the influence of technological factors on MMS use as well as how the usability and safety of MMS technology for different user populations, activities, and contexts can be improved.
1.4 Conceptual framework

A guiding framework was developed to help ensure that all aspects of MMS technology were explored without decontextualizing the findings. This guiding framework—the Compensatory-Human Activity Assistive Technology (C-HAAT) Model—was drawn from the Human Activity Assistive Technology (HAAT) Model (49) and the Compensatory frame of reference (CFOR) (50).

1.4.1 The HAAT Model

The HAAT Model is an AT-specific conceptual model that was developed by Cook and Hussey (49) to guide the selection and evaluation of AT. This model was derived from the Human Performance Model (HPM) (51) which proposes that human performance is defined by how the individual, the activity and the environment interact. In contrast to the HPM, however, the HAAT Model focuses on the performance of the AT system which consists of the Human (i.e., the user), AT (the assistive device itself), Activity (i.e., purpose or tasks AT is used for) and Context (i.e., environment where AT is used); rather than on human performance (52, 53).

As shown in Figure 1, each component of the HAAT Model consists of distinct elements (i.e., sub-components) that explore them in greater depth (49). A detailed description of the components of the HAAT Model and their respective elements as it applies to mobility AT can be found in Appendix A.

According to Lenker and Paquet (53), the HAAT Model, in comparison to other AT-specific models, offers a superior descriptive framework that facilitates the extensive exploration of diverse aspects of the AT and its interaction with the user, activity and relating contexts (53).
The HAAT Model

Giesbrecht (52), in an extensive review of the HAAT Model, described its components as being easy to understand and applicable for use in both research (e.g., as a theoretical framework), and practice (e.g., in AT provision). As a theoretical framework, the HAAT Model has been applied in quantitative, qualitative, and mixed methods research that involve the evaluation of AT (52). It has been adopted by educators, researchers, and clinicians as a theoretical framework to enhance an understanding of the impact of AT on users’ lives, and to facilitate the identification of users’ needs and goals (49, 52, 53).

The HAAT Model was deemed the ideal AT-specific conceptual model to draw upon for this study because it offers a broad and clear descriptive framework for exploring all aspects of AT and the contexts of its interactions without being predictive of their relationships. Although the HAAT Model does not directly predict the actual impact of AT, it explores some indicators of
impact such as satisfaction, effectiveness, and efficiency, which are fundamental concepts of usability (49, 53, 54).

1.4.2 The CFOR

In rehabilitation practice, a frame of reference (FOR) generally refers to defined principles, body of knowledge, and research findings that constitute the conceptual basis of a specific aspect of practice (50, 55-56). The CFOR is a theoretical paradigm in occupational therapy practice which focuses on applying interventions that can help maximize the independence of individuals with disabilities without remediating their actual illness or disability (50, 55-56). In essence, the intervention is modified to suit the individual’s needs (56).

Under the CFOR, AT is a common intervention provided (56). The International Standards Organization (ISO) describes AT as “any product specially produced or generally available, for preventing, monitoring, relieving, neutralizing, or compensating for impairments, activity limitations, and participation restrictions” (ISO 2010, cited by Friederich (56)). Based on the premise that MMSs are ATs which are meant to compensate for the disabilities of their users, the CFOR was adopted as a conceptual lens to investigate the compensatory role that MMSs play in diverse contexts and how they can be modified to enhance their compensatory performance.

1.4.3 The guiding framework (C-HAAT Model)

The guiding framework (i.e., C-HAAT Model) (Figure 2) was created to help maintain the focus of the study on exploring the influence of MMS technology on its own usability and safety rather than on how MMS usability and safety are influenced by external factors. The C-HAAT Model was conceptualized by exploring the components of the HAAT Model via a CFOR that was AT-
focused. In the C-HAAT Model, the CFOR acts as a conceptual lens to understand the compensatory role that the AT (which in this case is the MMS) plays in relation to elements of the Human, Activity, and Context components of the HAAT Model. So, for example, instead of looking into how the environment impedes the use of MMSs, an emphasis is placed on features of the MMS that do not work well in the environment and how they can be enhanced. Thus, unlike the HAAT Model that only provides a broad descriptive framework, the C-HAAT Model provided more directed guidance which helped to ensure that the exact relationship of interest was extensively explored.

The C-HAAT Model informed the selection of the study design; data collection in terms of developing questions for the interview guide; and data analyses in terms of identifying patterns and themes that were relevant to the research question. Most importantly, the C-HAAT Model was created to keep the data analyses primarily focused on identifying issues with MMS technology rather than on environmental or user-related factors which are often difficult to isolate when addressing AT issues.
Figure 2 The C-HAAT Model. Venn diagram showing the interaction of the AT component with the Activity, Context and Human components of the HAAT Model from an AT-focused compensatory frame of reference.

1.5 Research questions

The overarching questions that this study sought to address were:

1. What are the perspectives of users and service providers about the usability and safety of MMS technology?

2. What are the perspectives of users and service providers on how the usability and safety of MMS technology can be enhanced?

I elaborate on these main questions by asking the following sub-questions:
1. What aspects of MMS technology makes its use challenging for different user populations, in different contexts and for different activities?

2. What aspects of MMS technology can be enhanced to improve its safety and usability for different user populations, in different contexts and for different activities?
Chapter 2: Methods

2.1 Synopsis

This chapter gives an overview of the methods used in conducting this research. As this work was part of a broader study, I start by distinguishing the overarching aims of the broader research from the specific aims of this study. I then provide a description of this study’s research design, procedures, and the ethical considerations made. Lastly, I discuss the trustworthiness strategies that were employed to ensure credibility of the research findings. I also provide an explanation of my positionality statement, which hopes to show how my philosophical beliefs and background may have influenced the choice of research design and approach to data analyses.

2.2 Study design

This research was part of a larger multi-site qualitative study that was carried out in Vancouver and Montreal (Canada). The overarching aim of the study was to: explore the experiences of both three- and four-wheeled MMS users on activities that are difficult for novice MMS drivers to learn or do; identify the contexts which make driving challenging or unsafe; and explore strategies that can help MMS users manage such activities. This paper, however, only reports data that was collected in the Vancouver location from January 2018 to June 2018 and focuses on exploring technological factors that influence MMS usability and safety and how these can be enhanced.
2.2.1 Selecting a qualitative descriptive design

A qualitative descriptive design was used in this study because its analytical approach enables researchers to stay close to participants narratives. Its approach allows for straight-forward descriptions of participants’ experiences in their “everyday language” rather than abstract interpretations (57-58). This matched the stylistic outcome the study sought to achieve in terms of conserving participants’ accounts of their experiences.

The qualitative descriptive approach is the least theory-laden method of qualitative inquiry, but it is not void of theory, as it conforms to the theoretical underpinnings of naturalism which focuses on exploring human experiences in natural settings (59-60). However, unlike qualitative approaches such as phenomenology, grounded theory, ethnography and others, it is not restricted by predetermined guidelines concerning specific methodological processes (57-61). The qualitative descriptive approach is more flexible and can accommodate for features of other methods of qualitative inquiry or the use of guiding frameworks (57-59). As this study sought to investigate participants’ experiences, it carries some phenomenological undertones (62).

According to Neergaard et al. (63), qualitative description differs from interpretive description mainly in its approach to data analyses. As qualitative description stays closer to the data obtained and is less focused on conceptualizing phenomena, it generally requires minimal inference from the researcher (63). Nevertheless, minimal inference, as argued by Sandelowski (57, 60), does not imply the absence of it. Thus, this study sought to balance descriptive and analytic interpretations by presenting the results of the study from an emic viewpoint (i.e., from the perspective of the participants) but the discussion findings from an etic viewpoint (i.e., from
the perspective of the researcher) (64). All the inferences made, however, were substantiated with evidence from participants’ accounts.

2.3 Sampling and recruitment

The primary location for data collection was Vancouver, but participants were also recruited from neighboring cities in the Greater Vancouver Area to capture challenges that may be peculiar to other settings. The study sites for participant recruitment were the GF Strong Rehabilitation Center and the Blusson Pavilion which are health institutions in Vancouver that provide assistive mobility services. Participants were recruited through clinical contacts of the researchers, posters (Appendix B. 1) at the GF Strong and the Blusson Pavilion research sites, and via a list of participants from previous MMS-related studies who had given consent to be contacted for future studies. Letters of contact (Appendix B. 2 and B.3) were sent via e-mail to potential participants and this was followed up by a second e-mail or a phone call as required. A stipend of 40 Dollars (CAD) was given to participants who took part in the study.

2.3.1 Choosing study participants

For this study, clinicians and vendors were selected as participants because of their experience with providing MMS related-services and MMS users were selected as participants because of their experience with MMS use. This choice is supported by literature on assistive technology (AT) design and evaluation which emphasizes the importance of stakeholder feedback in improving existing AT or developing new AT designs (65-71).
2.3.2 Inclusion and exclusion criteria

Clinicians and vendors were selected if they were at least 25 years of age and had at least 2 years of experience in providing MMS-related services. MMS users were selected if they were at least 19 years old, had a minimum of 3 months of experience driving a 3- or 4-wheeled MMS and were cognitively competent to answer the interview questions as assessed by a minimum score of 24 points on the Mini-mental State Exam (MMSE) which indicates normal cognition (72) (Appendix C. 1).

2.3.3 Sampling strategy

Maximum variation sampling (73) was used to purposively select participants for the study. This method was employed to help gather rich data by capturing the perspectives of a wider range of MMS users and service providers rather than to recruit a representative sample of participants. At the outset of the study, we sought to explore the perspectives of clinicians and MMS users only. However, we later decided to recruit vendors as well, as they were identified by clinicians as being more knowledgeable about technological issues across MMS brands.

Factors that were considered when seeking a diversified sample of MMS users were age, sex, experience with MMS use, and participants’ living location (i.e., whether within or outside Vancouver). Sampling of clinicians and vendors were diversified by considering participants’ years of experience with MMS service provision, sex, and work location (i.e., whether within or outside Vancouver).
The sample size for this study was determined by the number of interviews required for data saturation to be reached. According to Fusch and Ness (74), to attain data saturation, it is more apt to consider a combination of the richness and thickness of the data collected rather than just the number in the sample. They describe richness as the “quality” of data collected which is characterized by being “many-layered, intricate, detailed and nuanced” and thickness as the “quantity” of data collected which is characterized by the largeness of the sample. In this study, data richness, as described by Fusch and Ness (74), was achieved at two levels. The first was by sampling the perspectives of 3 different participant groups (i.e., MMS users, vendors and clinicians) and the second was by recruiting a diversified sample within each participant group. Data thickness, on the other hand, was facilitated by adopting Francis et al.’s (75) principles of initial analysis sampling and stopping criterion for determining an adequate sample size and by following referenced literature on the acceptable sample size for conducting in-depth interviews (75-77).

According to Francis et al (75), an initial analysis sample, as its name implies, are the first set of interviews analyzed. They are selected based on stratification factors that are relevant to the research questions of a study and they inform judgement about further data collection (75). In this study, the initial analysis sample was 5 each for clinicians and MMS users and 3 for vendors. The stopping criterion (75), also as its name implies, is a criterion or criteria that specify when data collection will be stopped, if no new themes or subthemes are found to emerge after a certain number of interviews. This was each set at 3 for clinicians and users and at 2 for vendors. In the case of clinicians and MMS users, this meant that data collection would be stopped if no new themes or subthemes emerged after conducting 3 consecutive interviews with each
participant group after using the appropriate diversity sampling (75), while for vendors, data collection would be stopped if no new themes emerged after 2 consecutive interviews.

Participant recruitment continued until data saturation was reached with regards to richness and thickness of data within each participant group and across participant groups by following the previously mentioned criteria. A total of 12 clinicians, 12 MMS users and 5 vendors were recruited. The number of vendors selected were much lower than other participant groups because vendors generally have the propensity to interact with multiple clinicians and MMS users. Since individual vendors have a wider circle of influence and a higher level of engagement with MMS services across brands, sample quality (i.e., defined in terms of years of experience, company affiliation, location and gender) was given precedence over sample quantity (i.e. number of participants).

2.4 Data collection

2.4.1 Semi-structured interview format

Data collection for this qualitative descriptive study was via in-depth semi-structured interviews (78-79) with the use of an interview guide. Interviews were conducted in-person, over the phone and via Skype. The use of one-on-one interviews provided a private environment for participants to freely share their views and discuss sensitive information about their personal experiences (79). In using the semi-structured interview format, the interview guide was followed but the wordings and order of the main or follow-up questions and probes were not strictly adhered to (79-80). Thus, using a semi-structured interview format facilitated the in-depth exploration of
participants’ experiences and enhanced the collection of rich data. All interviews were audio recorded and transcribed verbatim.

### 2.4.2 The interview guide

The questions asked in the interview guide (Appendix C. 2) were informed by the guiding framework and the gaps identified in literature. The interview guide explored participants’ perceptions about the usability and safety of MMSs. Participants were asked questions regarding their perceptions about different types and models of MMSs; the challenges that MMS users face; and what an ideal MMS is or should be. Some questions were unique to each participant group, but most were similar across groups (see Appendix C.2).

### 2.4.3 Pilot interviews

Seven pilot interviews were conducted. Five were conducted with non-experts to test the clarity and flow of the interview questions and to gain familiarity with the dynamics of conducting interviews, while two were conducted with experts (1 MMS user and 1 clinician) to decide on what questions to modify based on their ability to elicit relevant answers to the study questions (78). The pilot interviews conducted with the experts were analyzed.

### 2.4.4 Demographic forms

For each of the 3 participants groups, demographic forms were administered to collect descriptive data like age, sex, level of experience and other demographic information. These forms can be found in Appendix C. 3.
2.5 Ethics and data management

Ethical approval was sought from the University of British Columbia’s Behavioural Research Ethics Board and approved under the certificate H17-01155. Data management followed the guidelines outlined in the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (81). An information and consent form (Appendix D. 1 and D. 2) which explained the study purpose, procedure for interview and how the interview data would be used was reviewed by the researcher with all the participants in this study and their written consent was sought and obtained. Participants were informed that their participation was completely voluntary, they were under no obligation to answer questions they were uncomfortable with, and that they could choose to discontinue the interview whenever they want to do so. Documents and files containing participants’ data were de-identified to protect their privacy. This was done by using unique study numbers which were not derived from any details (e.g., phone number, date of birth, etc.) associated with participant.

2.6 Data analyses

Data analyses was done in tandem with data collection. The transcribed data was uploaded into NVivo software (NVivo, QSR International) (82) to facilitate in-depth analyses and organization of the coding structure. The analytical technique applied to the textual data was conventional content analysis (83) and the C-HAAT Model was used as a sensitizing concept (84-85) to inform the data analyses. Familiarization with data was achieved by listening to the audio recorded interviews and reading the transcripts. A preliminary open coding was first performed on all the transcripts and this was followed by a more selective and iterative coding (86). Process codes, as described by Saldana (87), were used to identify reoccurring patterns in the data. Figure
3 presents an overview of the 3 main phases of data analyses. Overall, data analyses was iterative within and across the phases.

Figure 3 Data analyses process. The figure highlights the 3 main phases of data analyses for this study.

Sensitizing concepts, unlike definitive concepts, provide the researcher with guidance on areas to investigate, but do not confine the researcher to investigating those areas alone (84). Thus, applying the C-HAAT model as a sensitizing concept, facilitated the exploration of all ideas that were relevant to the research question in the data corpus, whilst reducing the likelihood of missing new insights. Sensitizing concepts also allow researchers to explore developing concepts that are grounded in the experiences of researched populations (85). In this study, its use helped ensure that the resulting subthemes and themes remained as close as possible to the study participants’ accounts of their experiences.

After data analyses, member checking (88) was conducted. This was done by providing each study participant with a summarized version of the findings (see Appendix E) as well as key quotes that they made which aligned with the resulting themes and subthemes. Participants were asked to review their quotes and confirm if the themes and subthemes captured their ideas or
experiences via a brief phone call. The feedback of the 19 participants who responded were incorporated into the findings.

2.7 Trustworthiness strategies

The Consolidated Criteria for Reporting Qualitative Research” (COREQ) (88), which is a reporting guideline for qualitative studies that use interviews and focus groups, was adhered to in this study.

2.7.1 Positionality statement

This positionality statement intends to describe how my philosophical beliefs and background contributed to the choice of research design for this study and how this may have influenced its outcome (89).

My research background in ergonomics (90) informs my belief that any kind of device should be manufactured to meet and fit the needs of its intended users, rather than users having to adapt their needs to the utility a device can provide. Also, my professional training as a physiotherapist informs a positional leaning towards providing client-centered services by investigating clients’ own opinions about their problems and how they intend to achieve their goals or have their needs met.

My philosophical position is postpositivist with a critical realist stance (91). In post-positivism, the need for independence between the researcher and participant(s) perspective is emphasized, but there is an acknowledgement of the fact that theories, background, knowledge and values of the researcher can influence what is observed (91). As such, there is an indication of the importance of using different methods of triangulation to understand reality better (91). In
critical realism, the idea that knowledge may be applied to effect changes is accepted, but not the positivist method of accessing knowledge (91).

My philosophical position is consistent with the pragmatic analytical approach to problem-solving. The philosophical tradition of Pragmatism posits that ideas about reality constantly change in light of their usefulness or applicability under different circumstances; thus, the best methods are those that detect problems and provide the needed answers to effect a desired change (92). These philosophical assumptions informed the development of the guiding framework for this study (i.e., the C-HAAT Model) and the decision to apply it as a sensitizing concept. It also informed my decision to use a maximum variation sampling method and the choice of a qualitative descriptive approach, which conceptually align with the pragmatic paradigm (58-61, 91-92).

2.7.2 Reflexivity

Field notes and analytic memos were kept throughout the research process to help maintain the researchers’ self-awareness about changing ideas or beliefs and this enhanced rigour during data analyses by minimizing researcher bias (93-94). The field notes contained observations about the interview process whilst the analytic memos contained the researcher’s inferences from the data analyses.

2.7.3 Peer debriefing

Feedback was sought and obtained from members of the research team at different decision points during the data analyses. This enhanced the quality of the insights that were drawn from the data and aided the overall interpretation of results (93-95).
2.7.4 Member checking

A summary of the findings was made available to participants for review and to confirm if interpretations made by the researcher were accurate reflections of their thoughts or opinions (88, 96) and their feedback was integrated into the final summary of the findings.

2.7.5 Rigour

Thick descriptions and verbatim quotes were used in reporting the study findings to show that they were grounded in participants’ accounts of their experiences (93-95). The use of a guiding framework (i.e., the C-HAAT Model) promotes the credibility, transferability, dependability, and confirmability of the research findings by providing insights on the assumptions that guided the data analyses and some guidance on how the emergent themes and subthemes were built up from the data (94-95).

2.7.6 Triangulation

Triangulation of data sources was achieved by choosing to collect data from a range of participants with different characteristics and by conducting an extensive literature review (94-95). Investigator triangulation was also achieved by having the coded data reviewed by another member of the research team and by comparing coding structures for consensus (95).
Chapter 3: Findings

3.1 Synopsis

This chapter provides a summary of the findings of this study. The analyses of the transcribed interviews resulted in three main themes and twelve subthemes. The first theme – *Finding the right fit* – explores the technology-related considerations and compromises made along the MMS procurement process. The second theme – *Negotiating everyday challenges* – explores the day-to-day challenges of MMS use that are associated with technological issues. The third theme – *Identifying solutions and barriers* – explores recommendations for enhancing MMS usability and the existing or potential barriers to adopting them.

3.2 Participants

A total of 29 participants consisting of 12 MMS users, 12 clinicians, and 5 vendors, took part in this study. Tables Table 3.1, Table 3.2, and Table 3.3 show the demographic information of the study participants. Most participants were recruited from Vancouver and a few from surrounding cities such as Richmond, Port-Coquitlam, Port-Moody and New Westminster in the province of British Columbia.

The age range of the MMS users that took part in the study was between 37 and 92 years and a majority (n = 8) were over 65 years old. Interviews with all 12 MMS users were held in-person, with most being conducted in their homes (n = 6), some at the research sites ICORD (n = 3) and GFS (n = 2), and at a train station (n = 1). The age range of the vendors was between 36 and 52 years and 3 different AT vending companies were represented. All vendors were interviewed in
person. Most of the interviews were held at their workplaces \((n = 3)\) while the others were at GFS \((n = 1)\) and a public library \((n = 1)\). The age range of the clinicians was between 33 and 58 years. Most interviews with clinicians were held in person and conducted at their workplace \((n = 4)\), GFS \((n = 4)\), and at home \((n = 1)\); while a few were held over the phone \((n = 2)\) and via Skype \((n = 1)\). The length of each interview ranged from about 13 minutes to 98 minutes, adding up to a total of 21.2 hours of audio recorded data for all the study participants.

3.3 Emergent themes and subthemes

The three overarching themes were defined by their prominence and relevance to the objectives of this study. Using the C-HAAT Model as a sensitizing concept aided an all-encompassing but non-restrictive exploration of MMS usability and safety. Each theme revealed participants’ perspectives on MMS efficiency and effectiveness, and their satisfaction with MMS technology (i.e., usability) and safety. Collectively, they provide insights into challenges that span across different phases and contexts of participants’ experiences with MMS technology. Definitions of the three main themes and twelve subthemes are presented in Table 3.4. All themes and subthemes are representative of the perspectives of all participant groups and are described in the following subsections with exemplifying quotes.
<table>
<thead>
<tr>
<th>Pseudonym</th>
<th>Sex</th>
<th>Highest level of education attained</th>
<th>Employment Status</th>
<th>Annual income</th>
<th>Primary diagnosis accounting for MMS use</th>
<th>MMS funding source</th>
<th>Experience with MMS use</th>
<th>Type of MMS used</th>
<th>Other assistive mobility devices used</th>
<th>Brand of MMS used</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMS User 1</td>
<td>Female</td>
<td>Grade 10</td>
<td>Retired</td>
<td>10k - 19k</td>
<td>Stroke</td>
<td>Self-funded</td>
<td>1 year</td>
<td>4-wheeled</td>
<td>Walker</td>
<td>Golden</td>
</tr>
<tr>
<td>MMS User 2</td>
<td>Female</td>
<td>University</td>
<td>Medical leave</td>
<td>10k - 19k</td>
<td>Cellulitis</td>
<td>Government</td>
<td>10 months</td>
<td>4-wheeled</td>
<td>None</td>
<td>Comet</td>
</tr>
<tr>
<td>MMS User 3</td>
<td>Female</td>
<td>College</td>
<td>Retired</td>
<td>30k - 39k</td>
<td>Polio</td>
<td>Insurance and self-funded</td>
<td>25 years</td>
<td>3-wheeled</td>
<td>1 extra MMS and 2 canes</td>
<td>Revo, Pride</td>
</tr>
<tr>
<td>MMS User 4</td>
<td>Female</td>
<td>Senior High</td>
<td>Retired</td>
<td>20k - 29k</td>
<td>Difficulty walking</td>
<td>Gift</td>
<td>Used about twelve times in a span of 1 year</td>
<td>4-wheeled</td>
<td>Walking poles</td>
<td>Unknown</td>
</tr>
<tr>
<td>MMS User 5</td>
<td>Female</td>
<td>Grade 12</td>
<td>Disability assistance</td>
<td>Not disclosed</td>
<td>Knee fusion</td>
<td>Social services</td>
<td>1 year</td>
<td>4-wheeled</td>
<td>Cane</td>
<td>Shoprider</td>
</tr>
<tr>
<td>MMS User 6</td>
<td>Male</td>
<td>University</td>
<td>Retired</td>
<td>Over 50k</td>
<td>Polio</td>
<td>Insurance</td>
<td>16 years</td>
<td>3-wheeled</td>
<td>2 extra MMSs</td>
<td>Pride</td>
</tr>
<tr>
<td>MMS User 7</td>
<td>Male</td>
<td>College</td>
<td>Retired</td>
<td>Below 10k</td>
<td>Spinal injury</td>
<td>Self-funded</td>
<td>13 years</td>
<td>3-wheeled</td>
<td>1 extra MMS, double cane, walker, and manual wheelchair</td>
<td>Shoprider, Vita</td>
</tr>
<tr>
<td>MMS User 8</td>
<td>Male</td>
<td>College Diploma</td>
<td>Disability leave</td>
<td>Over 50k</td>
<td>Multiple sclerosis</td>
<td>Donation</td>
<td>15 years</td>
<td>3-wheeled</td>
<td>1 extra MMS and a</td>
<td>Fortress</td>
</tr>
<tr>
<td>Pseudonym</td>
<td>Sex</td>
<td>Highest level of education attained</td>
<td>Employment Status</td>
<td>Annual income</td>
<td>Primary diagnosis accounting for MMS use</td>
<td>MMS funding source</td>
<td>Experience with MMS use</td>
<td>Type of MMS used</td>
<td>Other assistive mobility devices used</td>
<td>Brand of MMS used</td>
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<tr>
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<td>College, some University</td>
<td>Retired</td>
<td>10k - 19k</td>
<td>Pneumonia</td>
<td>Insurance</td>
<td>Over a year</td>
<td>4-wheeled</td>
<td>Power wheelchair.</td>
<td>Shoprider</td>
</tr>
<tr>
<td>MMS User 10</td>
<td>Female</td>
<td>Masters</td>
<td>Retired</td>
<td>Over 50k</td>
<td>Multiple sclerosis</td>
<td>Self-funded</td>
<td>About 5 years</td>
<td>3-wheeled</td>
<td>Power chair</td>
<td>Pride</td>
</tr>
<tr>
<td>MMS User 11</td>
<td>Female</td>
<td>Bachelors</td>
<td>Retired</td>
<td>Over 50k</td>
<td>Multiple sclerosis</td>
<td>Insurance</td>
<td>10 years</td>
<td>3-wheeled</td>
<td>2 manual chairs, canes and poles</td>
<td>Pride</td>
</tr>
<tr>
<td>MMS User 12</td>
<td>Female</td>
<td>Grade 12</td>
<td>Retired</td>
<td>30 - 39k</td>
<td>Hypertension</td>
<td>Self-funded</td>
<td>1 year</td>
<td>4-wheeled</td>
<td>1 extra MMS</td>
<td>Shoprider</td>
</tr>
</tbody>
</table>
### Table 3.2 Clinicians' demographics

<table>
<thead>
<tr>
<th>Pseudonym</th>
<th>Sex</th>
<th>Practice setting</th>
<th>Years of MMS prescription experience</th>
<th>Average number of MMS prescribed annually</th>
<th>Reported diagnosis of clients served</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinician 1</td>
<td>Female</td>
<td>Residential, Rehabilitation</td>
<td>5</td>
<td>4 to 6</td>
<td>Multiple sclerosis, general back pain or lower extremity pain, obesity, co-morbidities of ageing, COPD, arthritis, CHF, amputation, Parkinson’s, CVA, head injury, developmental disabilities, heart failure, ALS, MMA, SCI.</td>
</tr>
<tr>
<td>Clinician 2</td>
<td>Female</td>
<td>Community</td>
<td>12</td>
<td>3 to 4</td>
<td></td>
</tr>
<tr>
<td>Clinician 3</td>
<td>Female</td>
<td>Community</td>
<td>10</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Clinician 4</td>
<td>Female</td>
<td>Community</td>
<td>20</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Clinician 5</td>
<td>Female</td>
<td>Community</td>
<td>17</td>
<td>10 to 15</td>
<td></td>
</tr>
<tr>
<td>Clinician 6</td>
<td>Male</td>
<td>Residential</td>
<td>12</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Clinician 7</td>
<td>Female</td>
<td>Community</td>
<td>25</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Clinician 8</td>
<td>Female</td>
<td>Community</td>
<td>4</td>
<td>2 to 3</td>
<td></td>
</tr>
<tr>
<td>Clinician 9</td>
<td>Female</td>
<td>Outpatient Clinic</td>
<td>3</td>
<td>5 to 10</td>
<td></td>
</tr>
<tr>
<td>Clinician 10</td>
<td>Female</td>
<td>Community</td>
<td>15</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Clinician 11</td>
<td>Male</td>
<td>Community</td>
<td>8</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Clinician 12</td>
<td>Female</td>
<td>Community</td>
<td>5</td>
<td>4 to 6</td>
<td></td>
</tr>
</tbody>
</table>
Table 3.3 Vendors’ demographics

<table>
<thead>
<tr>
<th>Pseudonym</th>
<th>Sex</th>
<th>Average number of MMS sold annually</th>
<th>Experience providing MMS services</th>
<th>Type of MMS most commonly demanded for by clients</th>
<th>Brands of MMSs sold</th>
<th>Most common maintenance issues addressed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vendor 1</td>
<td>Male</td>
<td>20</td>
<td>15 years</td>
<td>3-wheeled MMS</td>
<td>Fortress, Shoprider, Pride</td>
<td>Batteries, tires (balding, air-pressure, flats), worn-out motor brushes.</td>
</tr>
<tr>
<td>Vendor 2</td>
<td>Male</td>
<td>20 to 25</td>
<td>9 years</td>
<td>4-wheeled</td>
<td>Shoprider, Pride Mobility, Invacare, Fortress</td>
<td></td>
</tr>
<tr>
<td>Vendor 3</td>
<td>Female</td>
<td>60</td>
<td>20 years</td>
<td>3-wheeled MMS</td>
<td>Pride, Invacare, Sunrise, Golden, Drive, Lighthouse</td>
<td></td>
</tr>
<tr>
<td>Vendor 4</td>
<td>Male</td>
<td>12 to 14</td>
<td>15 years</td>
<td>3-wheeled MMS</td>
<td>Shoprider, Invacare, Fortress</td>
<td></td>
</tr>
<tr>
<td>Vendor 5</td>
<td>Male</td>
<td>40 to 50</td>
<td>12 years</td>
<td>3-wheeled MMS</td>
<td>Primarily fortress, some Shoprider and Invacare</td>
<td></td>
</tr>
<tr>
<td>Themes and sub-themes</td>
<td>Description</td>
<td></td>
<td></td>
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<td>-----------------------------------------------</td>
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</tr>
<tr>
<td><strong>Finding the right fit</strong></td>
<td>The technology-related considerations and compromises made along the MMS procurement process.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Opting for a scooter</td>
<td>Bases for choosing to procure MMSs over alternative assistive mobility devices.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Deciding on design features</td>
<td>Features stakeholders look for when selecting MMSs.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Making adaptations</td>
<td>Modifications or adjustments made to MMSs to accommodate for the needs of the MMS user.</td>
<td></td>
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<tr>
<td>Getting an optimum brand</td>
<td>Opinions about the quality of different MMS brands.</td>
<td></td>
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<tr>
<td>Choosing between a 3- and 4-wheeled scooter</td>
<td>Conundrums surrounding the use of 3-wheeled or 4-wheeled MMSs.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Negotiating everyday challenges</strong></td>
<td>Day-to-day challenges of MMS use that are associated with technological issues.</td>
<td></td>
<td></td>
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<tr>
<td>Navigating roads and sidewalks</td>
<td>Challenges with sharing roads and sidewalks with other users and navigating different kinds of terrains.</td>
<td></td>
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<tr>
<td>Facing accessibility challenges</td>
<td>Influence of MMS design on accessibility challenges experienced.</td>
<td></td>
<td></td>
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<tr>
<td>Being predisposed to accidents</td>
<td>Aspects of MMS design that influence the occurrence of accidents.</td>
<td></td>
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<tr>
<td>Maintaining the scooter</td>
<td>MMS maintenance issues encountered, and challenges associated with resolving them.</td>
<td></td>
<td></td>
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<tr>
<td>Being out in bad weather</td>
<td>Challenges with using MMSs under inclement weather conditions.</td>
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<tr>
<td><strong>Identifying solutions and barriers</strong></td>
<td>Recommendations on enhancing MMS usability and the existing or potential barriers to implementing them.</td>
<td></td>
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</tr>
<tr>
<td>Enhancing scooter usability</td>
<td>Perspectives on aspects of MMS technology that require enhancement.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Existing and impending barriers</td>
<td>Current and potential barriers to enhancing MMS usability.</td>
<td></td>
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</tr>
</tbody>
</table>
3.3.1 Finding the right fit

MMS users, clinicians and vendors indicated their considerations, concerns, and the compromises they make regarding MMS technology along the procurement process. While clinicians and vendors indicated that their decisions were primarily guided by the outcome of their assessment and the criteria of the funding agency when applicable, they also spoke about aspects of MMS technology that they scrutinized or that they found to be relevant to their clients.

3.3.1.1 Opting for a scooter

Participants spoke about features of MMSs that made them preferable to other mobility assistive devices. MMS users and clinicians identified the tiller’s ease of use of as a reason why MMSs were a more desirable choice over power wheelchairs. An MMS user explained that she replaced her power wheelchair with a MMS after a few months because she found it difficult to use.

“I went into a power chair for a very short period of time. I realized it wasn’t functional for me in the house. I was always running into things and damaging things.”
(MMS user 11)

The tiller was also seen as a safety-enhancing feature, but this perception was peculiar to MMS users. Some MMS users explained that the tiller served as a kind of safety barrier which gave them some level of protection from the environment; thus, making them feel less “vulnerable”. Some MMS users, who also used power wheelchairs, shared instances of distracted pedestrians falling into their laps while they were driving their power wheelchairs on the sidewalk and explained that if they were on an MMS they would have had the tiller as a barrier to protect them.
“And the thing I looked at about the scooter was there was something in front of me. So, nobody could land on me. And at that time, I was really kind of conscious of, you know, being fragile.”

(MMS user 11)

A MMS user also explained that his knees and toes have some protection in a MMS because of the presence of the tiller; whereas, in a power wheelchair they are exposed and more susceptible to injury in the event of a collision.

“I could run straight into a wall on my scooter and not get hurt. I mean, if it’s slow enough. But on this thing, I mean, if I run into something, BOOM, that’s my knee, darn! Or bump into this, like oh, there goes my toes, you know. You’ve got all this stuff exposed. That’s not nice.”

(MMS user 8)

MMS users, clinicians and vendors identified storage baskets as another feature that made MMSs a desirable choice. They explained that having a basket made shopping more convenient and was easier to access than backpacks that are put on the backrest of power wheelchairs.

“Another big advantage of the scooter is that it’s got that massive basket in the front. It’s great for shopping. So, what do I do when I’m on my power chair and I wanna go shopping? I need to get the apples, and I need to get the bananas, and I need to get the potatoes, and all that stuff. Uhh. Where do I put it? Well, people have to come up with really creative ways of hauling stuff around when they’re in a power chair. I have a friend who, who you know, lives in a power chair. Well, she’s got a whole bunch of bags and these little hooks and things, and she’s got a rail, she can hook a bag, and a bag, and she looks, you know... She’s got this bulk she’s riding around to get the groceries and stuff and get back home. To me, I’m not really interested in doing that. It looks silly, to start with. Plus, turning corners and going through tight spaces and stuff hanging off the sides doesn’t work so good.”

(MMS user 8)

A MMS user, who stated that he only used his power wheelchair indoors, explained that the presence of factory fitted lights on MMSs made navigation in the dark possible, and this made him prefer a MMS over a power wheelchair.
“But also, on the power chair, you -- I had never seen one yet that came with a lighting package already on it – lighting for night. ‘Cause, once again, I like to go out whenever. Whenever I wanna go out I don’t want the equipment limiting me, ‘cause if you’re walking, I mean, you don’t not go outside because it’s dark out; there’s streetlights and stuff. But if you’re on a power chair and there’s no light, well, it’s kind of scary. So, the scooter’s already got lights built into it. It’s got light marking in the back and light in the front.”

(MMS user 8)

MMS users and clinicians also explained that MMSs were preferred to power wheelchairs because they carry less stigma of disability. Some clinicians indicated that for this reason, clients who could benefit more from and are eligible to receive funding for a power wheelchair sometimes decline from procuring them and choose a MMS instead. A clinician explained that in some cases, MMS users who subsequently develop high mobility or seating needs are hesitant about moving to a power wheelchair.

“Scooters typically have been designed for people who are relatively mobile, umm, although, I mean certainly some of my MS clients, because they started on a scooter they are reluctant to move to a power chair even though their mobility has declined”

(Clinician 5)

A MMS user also spoke about rejecting the idea of using a power wheelchair when a clinician recommended it because she did not want to be “wheelchair-bound”; and another MMS user explained that he preferred a using a MMS because it made him “feel” and “look” less disabled.

“Probably the other thing, there’s kind of uh, a mental thing too... of riding a scooter versus riding a wheelchair, a power chair. Like, “That guy must be really uh, disabled” right? So, there’s kind of a mental thing. If you can go with a scooter rather than a wheelchair, you don’t feel so disabled, you don’t look so disabled somehow.”

(MMS user 8)

Generally, clinicians and vendors reported that they seldom refrained from recommending or selling MMSs to clients unless they deemed a client incapable of safely operating it.
“Um, usually we’ve had clients not road test well. But I mean that, in those case, that decision has been made in conjunction with therapist. So, if the therapist deems that they’re not a safe user. Obviously, they’re not gonna write a justification they can use with their insurance that they can use to get the scooter funded”

(Vendor 3)

Clinicians and vendors also indicated that they often found themselves contemplating between recommending a MMS versus a power wheelchair to clients. MMSs were said to be the device of choice when the goal of the client was to use it for more of outdoor mobility, if the client had low mobility or positioning needs, and if the client did not have a rapidly progressive condition.

“I always weigh the scooter against the small powerchair, um, because they’re both the same in cost and so if they want to do, you know, if it’s important for them to be able to take the bus, if there’s a possibility that they might use it in their house or in a small store that they frequent all the time, then I tend to steer them more towards a power chair”

(Clinician 3)

While some MMS users reported that their service providers went along with their decision to get a MMS, some mentioned that they had to get their MMSs on their own because the service provider (usually a clinician) did not support their application or supported an application for a power wheelchair instead. A MMS user shared her experience about being provided with a power wheelchair she did not want. She explained that she ended up giving it away and then had to procure a MMS on her own.

“When I was first diagnosed, and uh, the OT put me in a wheelchair and I resisted it at the time, but the OT was completely close minded about a scooter. So, yea, in an expensive little experiment, some sweet little old lady in the west end benefitted from it”

(MMS user 11)

A few MMS users claimed to have no specific reason for opting for an MMS other than the fact that they just liked “the idea” of a MMS better.
3.3.1.2 Deciding on design features

Participants identified the various features they looked out for when selecting a MMS. These features and participants general comments about them are summarized in Table 3.5.

Most participants indicated that they and the service providers or clients they had engaged with seldom had differences in opinion regarding features that a MMS should have. However, they explained that when differences existed, it was usually related to the function and aesthetics of the MMS. A clinician stated that while he was more concerned about the ease of operation of the MMS, clients were usually more focused on aesthetics and accessories.

“Umm so, for example, is it relatively easy for them to modulate or control speed? Usually it’s a set dial on top of the scooter, but umm is it easy enough for them to access and can [they] modulate pretty easily and is it visible enough for them. Things like that, you know. Whereas, I find that, for the user, they’re just focused more on the aesthetic of it, how does it look, what colour is it, things like the basket and stuff like that”

(Clinician 6)

Generally, clinicians and vendors indicated that the main factors they considered when selecting a MMS were its ability to manage the client and their environment.

Clinicians explained that after conducting their assessments, vendors provided clients with different MMSs to try in order to determine what works best. Although MMS users and clinicians indicated that they consulted with vendors to help identify MMSs that meet their requirements, it was usually up to the client to make a final decision about what they wanted, especially if funding was not an issue.

“I was assigned to an occupational therapist, and she works with a number of suppliers and umm she had the supplier come to my home with 2 or 3 models at the back of the van, and basically it was to... I was being fitted for one. And as I sat in each one to see how, you know, how comfortable it was for my leg,
and for me and for riding. And of course, ... they take other factors into consideration such as your weight, your height and so this one was recommended that it would be best for me. And it seemed to be the best fit that day and that's how I selected this one.”

(MMS user 2)

There were dissenting views about what the size and speed of the MMS should be. Clinicians spoke about clients requesting for faster and bigger MMSs and felt that these could be unsafe for both the MMS user and other pedestrians.

“I would say that most of the scooters because, they’re supposed to be a pedestrian, the scooters don’t need to be, go any faster but some of, we’ve got some of, we’ve got some that are going like 10 or 13 kilometers and hour now and, and that actually puts him... The client thinks that’s great cause they can get wherever they want to go faster, but that can actually make them unsafe. Not only is it... I don’t care about that, because I’m just looking at function and that’s considering, you know, pedestrians, but it can do the reverse in, as in actually making...now they’re unsafe on the scooter. Whereas, on a slower scooter, they might be more safe.”

(Clinician 4)

Conversely, a MMS user spoke about the tendency of service providers to prescribe bigger MMSs to clients, citing the example of a friend who was sold a big scooter but felt intimidated to use it.

“I think occupational therapists and vendors like to sell big ones or if you just go into a store and they like to sell you a big one to get more money for it, probably. Yeah. And, anyway I don’t know if that’s for sure, but I think occupational therapists really do that. When I look at my friend, he’s the one who can’t use his one arm and one leg that doesn’t work, and they sold him this great, big thing. I’ve tried to encourage him to come out but he’s a bit afraid, so I don’t know whether he’s using it much or not.”

(MMS user 3)

Some clinicians and vendors, however, explained that larger MMSs are recommended because they usually have more power; hence, they tend to meet the weight needs of heavier clients and
are better for navigating steep or otherwise challenging terrain. In addition, a clinician indicated that on most existing MMSs, the only way to achieve more power was via greater speed.

“So, I don’t tend to prescribe the biggest, bigger scooters that go 15 km/h. I think for most people there’s no need for that kind of speed. Having said that, however, if a person lives in a hilly area, and they need more power, the only way to get the power is it comes with the speed. (laughs) Umm, so that’s where you get kind of stuck in my opinion.”

(Clinician 5)

Participants explained that compromises always had to be made with regards to MMS design as it was hard to find a perfect balance of all the needed features in one MMS. The main areas of compromise were with regards to size, stability and maneuverability.

“Umm, it, depending on what scooter they ultimately choose, uh, cause there’s usually a compromise for several reasons- for accessibility, for how they want to travel, whether it’s on public transportation or not so they usually have to, usually have to compromise somewhat or one way or another”

(Vendor 2)

While the bigger MMSs met the weight needs of heavier clients, offered more stability, and had more power and range, they were usually less maneuverable and posed accessibility problems. Conversely, smaller MMSs were more maneuverable and offered good accessibility; but had less range, power, and stability.
Table 3.5 Features considered when selecting scooters

<table>
<thead>
<tr>
<th>Features considered</th>
<th>Summary of general comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rain cover</td>
<td>To protect MMS from damage and enhance safe driving in inclement weather.</td>
</tr>
<tr>
<td>Flags</td>
<td>To enhance MMS visibility for safety reasons. Not wanted because it gets caught on things or for aesthetic reasons.</td>
</tr>
<tr>
<td>Size</td>
<td>Smaller MMSs that are foldable or that come apart wanted to enhance transportability and accessibility. Bigger scooters wanted because they fit heavier or taller clients and are more efficient on steep terrain.</td>
</tr>
<tr>
<td>Basket or tot bag</td>
<td>Large ones wanted for shopping. Smaller ones wanted because they do not get in the way. Not wanted for aesthetic reasons.</td>
</tr>
<tr>
<td>Color of the scooter</td>
<td>Preference based on aesthetic reasons.</td>
</tr>
<tr>
<td>Seating</td>
<td>Prefer ones that aid easy transfer on and off MMS, are adjustable, and are comfortable. Ones with armrests and seat belt wanted for clients with balance problems.</td>
</tr>
<tr>
<td>Tillers and control buttons</td>
<td>Wanting adjustable tiller and controls that are easy for the client to operate. Wanting a speedometer.</td>
</tr>
<tr>
<td>Lighting and reflective vests</td>
<td>Brighter lighting to enhance visibility for safety reasons.</td>
</tr>
<tr>
<td>Speed</td>
<td>Faster speeds wanted to help manage steep terrain and travel quicker. Slower speeds wanted for safety reasons.</td>
</tr>
<tr>
<td>Rear-view mirrors</td>
<td>Wanted for safety reasons.</td>
</tr>
<tr>
<td>Turning radius</td>
<td>Smaller turning radius wanted to enhance MMS accessibility.</td>
</tr>
<tr>
<td>Battery</td>
<td>Want ones that are durable and have longer range.</td>
</tr>
<tr>
<td>Tie-down securements</td>
<td>Wanted for MMSs that would be used on transportation, for safety reasons.</td>
</tr>
<tr>
<td>Performance characteristics</td>
<td>Want good suspension, reliability, durability, and stability.</td>
</tr>
</tbody>
</table>
3.3.1.3 Making adaptations

Clinicians and vendors explained that unlike power wheelchairs, only a few features could be adjusted on MMSs; hence, not much could be done with regards to enhancing comfort, drivability, or safety. They indicated that while MMSs were fitted for the client after procurement, clients were also taught how to make those adjustments themselves.

“I mean, so, when a scooter is delivered to a client, and as well as the vendor or sales rep. They set it up for the client, but they also show the client how to adjust in the future if they need changes made. So, it can be done by the user.” (Clinician 2)

The seating component and the tiller were identified as the main adjustable feature on MMSs, but they explained that only limited adjustments could be made to them.

“So, adjustability on a scooter you’ve got seat height, armrest height, the tiller can be set up so that it’s, there’s lots of adjustability in terms of the angle of it, how close it is to the client, umm, and then, there’s not too much else to set up. I mean when you’re choosing features, you can choose different styles of seat. But, yeah, in terms of delivery adjustment, it’s not a lot.” (Clinician 2)

While the seat of a MMS could be switched to different styles of captain seats, they indicated that rehab seating could not be easily put on them; thus, making MMSs inadequate for clients who need extra seating and positioning support.

Some clinicians identified the maximum speed as another adjustable feature but indicated that they were available on only a few MMSs. They explained that this adjustment was usually made for new MMS users until they got comfortable with using their MMSs.

“You might for some first-time MMS user have... the max set lower. And then, as they get more comfortable with it and are saying um, “I really do need it to go a little bit faster so that I can get across the street in time,” then you know, there’s a fine balance there.” (Clinician 12)
Clinicians and vendors explained that the standard features of the MMSs could also be adapted to meet the needs of clients with hemiplegia and other upper or lower limb problems. Modifications involved switching the direction of the driving paddles, adjusting the sensitivity of the tiller, adding footplates, adapting the swiveling direction of the seat, enhancing MMS shock absorption, and changing the location of the key switch or charging port.

“There was certain people that had like uh, an issue with their legs, so we had to make like a footplate of to the one side so that they could still drive the scooter but hold their leg out because that’s the only way they could do it. Whether it was a fixed knee or a fused hip or something, right. So, we could do that. Changing the controls from left hand to right hand, right. Adding control extensions on to it. Umm, changing the location of the key switch because they can’t reach it. Changing the location of the uh, charger plug because they couldn’t reach it. Umm, changing the seat controls, that make the seat swivel or move back and forth because they’re either right stroke or left stroke, so we’d have to change sides to that. Umm, adding vibration control to them, we’ve done that before.”

(Vendor 1)

MMS users explained that they had to improvise in different kinds of ways for features that their MMSs lacked. The most common feature they improvised for was the MMS seat and the adaptations were aimed at making them more comfortable.

“The seats aren’t comfortable. I mean they could do a lot more in, um… seating. And I normally put a cushion on top of it and have a backrest. We were away, and I took the back rest with me, so it kind of hasn’t found it’s way back to my scooter. (chuckles lightly) But I do... I’ve kind of adapted... but it would be nice if you could have more of a customized seat.”

(MMS user 11)

Vendors reported that mirrors, reflectors, lighting packages, baskets, canopies, and holders or attachments for cups, canes or other assistive devices were some of the commonly requested add-ons by clients.
3.3.1.4 Getting an optimum brand

MMS users, clinicians and vendors spoke about their experiences with various brands of MMSs. Vendors identified reliability, durability, service support, and the relationship that they had established with the manufacturer as the main factors that determined the kinds of MMS brands they carried.

“Because for us it’s, it has to be a company that can support us in terms of parts. That’s, you know, stand by their warranties, that are easy to exchange warranty items on, that are able to get us parts in a timely manner, we’re able to get tech support over the phone ... So that’s why we tend to work with the companies we’re working with now, it’s because we know that they are well supported and makes our jobs easier.”

(Vendor 3)

While most clinicians indicated that they usually relied on vendors for information about the reliability of MMS brands, some explained that this information could vary across vendors.

“That, I usually rely on the vendor for, so I don’t know off hand. The vendors would usually say, “Oh these scooters have been good recently and these ones haven’t”. Umm, so I rely on the vendors for that information. But sometimes different vendors give us different information, possibly based on the incentives that they’re getting from those vendors, so, I don’t know.”

(Clinician 4)

Most participants believed that different brands of MMSs had their own unique challenges. Some MMS users and vendors stated that advertisements about MMS performance capabilities were usually false and that MMSs in general were no longer being built to be as reliable as they once were. They indicated that this issue was more common to newer models and was not always a consequence of how the MMS was used.

“I mean even in the advertisements and... everything that they advertise about these scooters, right. They say flat out "This scooter would go 45 miles, absolutely!" There’s not one single person that I sold a scooter to, that I didn’t
say, you’re lucky if you get 20k, maybe, right. And then I describe to them how they’re gonna get that distance and most distance you’re going to get is not stop and start. It’s just hold on to it and just go, and don’t ever let go.

(Vendor 1)

Some participants also expressed their frustrations about the lack of longevity of MMSs. They explained that newer models did not last as long as the older ones, and that sometimes brand names could not be trusted when it came to such problems.

...So, umm, distance would be great, you know, if they were true to... what they advertise. Umm, longevity, okay. If the scooter can actually last, umm, depending on the driving conditions, right. Five years, ten years... I mean some of them used to.”

(Vendor 1)

A MMS user felt that manufacturers should guarantee a length of MMS performance that would last through its funding term.

“And I think the company should guarantee a certain length of performance, at least to match the insurance period... If the insurance says it’s gotta be every 4 years then they should be able to give me a scooter, sell me scooter that’s gonna last for at least 4 years.”

(MMS user 6)

He went further to explain that he receives external funding for his MMS and was concerned that if his MMS did not last till the next funding term of about 4 or 5 years, he would either have to pay for it himself or be without a mobility device till that time elapsed.

ShopRider and Pride were the most mentioned brands that participants had reservations about. Concerns identified were about their reliability, the inadequate design of certain features, and the complicated process of claiming warrantee.

“I think a lot of these things should be built on requirements before they even go on the market. They should be a, they should fit a certain set of features that make them easier to use than they are. And uh, I had a friend who had a Sports Gogo and it was sold on warranty and so she claimed a new scooter because of that, but the process was so complicated, she eventually gave up and had to
just, bought a new scooter. So, they have these things set up to favor them rather than the purchaser.”

(MMS User 6)

Features such as their break release lever and the charging port were reported to be difficult to access by MMS users who lacked the ability to walk or crouch because they are located low to the ground. Some models were also described as being particularly light, which created concerns about their stability.

A clinician spoke about a company that used to carry Shoprider and Pride brands but stopped carrying MMSs altogether because of their dwindling quality.

“Hmm, there’s one company in [Location 4] that is refusing to carry scooters anymore because he says that they say the quality has gone down so much. You could interview them yourself. I don’t know if they just... whatever, didn’t have the space for them anymore. But that’s their story they’re giving us. They don’t do... because they’re... and the brands they would have been carrying would have been Shop Rider and Pride. But I haven’t directly had that experience, so I can’t say, yeah”.

(Clinician 7)

Some clinicians also mentioned that they had heard about problems associated with these brands but had not experienced them directly.

Some MMS users mentioned that ShopRider and Pride were major brands that vendors and clinicians usually recommended. While some vendors and clinicians reported recommending them, they explained that these brands, just like any other, had good and bad sides to them. The ShopRider Cobra, for instance, was said to have a small turning radius which made it great for navigating restricted spaces but was less durable than some other competing brands.

“So, umm, it, it all depends on the type of scooter. I, we could be more, more detailed I guess if you pick one single scooter and we said that okay well, say for example the Fortress scooter; not great indoors cause it’s too big, but great for long distances outdoors. You know that sort of thing. Or say the
ShopRider Cobra scooter, that one is great for tight turning areas. Great to go on and off of the bus because it turns so well, easy to park, right, great for certain indoor environments, you know. It’s an okay all-round scooter but not as durable as the Fortress scooter.”

(Vendor 1)

A clinician also explained that she liked the Shoprider brand because of their good maintenance history, however, she acknowledged that the smaller sized models were less reliable.

“Yeah, I like Shoprider because they’ve just got really good maintenance history. Umm, they also have some really small rinky dinky ones that aren’t as good as they advertise but for the mid-sized scooters, they’re really good.”

(Clinician 3)

Another brand that a few participants identified issues with was Fortress. The main problems reported were related to its large size and battery reliability. It was, however, described as being more durable than brands like ShopRider.

“There’s a brand I would, I try not to suggest but it’s the one my friend bought, and I suggested don’t do it, don’t buy that one cause I’ve heard they have problems all the time. It’s called the Fortress I don’t know if I should tell you, but it’s called the Fortress (chuckles lightly). It’s big and it’s hunky and I’ve heard so many people with problems with it. I don’t know why they’re still going but they’re still going (chuckles).”

(MMS user 3)

Clinicians and vendors also mentioned brands they liked. Positive remarks were made about the Invacare brand with regards to its high durability and ability to manage different kinds of terrain; however, it was described as a high-end MMS.

“Uh, and Invacare has a couple of really good scooters. They’re really good at the high-end scooters umm, and I like them because they are super durable especially for the people that are going to take it out on trails and get out to nature, and you know, take it off the side walk. Umm, I really like using the Invacare scooters for that just because they are so durable.”

(Clinician 3)

Ranger, which used to be manufactured by a Canadian company that no longer exists, was
another brand they made positive remarks about. Because rehab seating could be put on it, it was identified as being ideal for people who had seating needs and it also had the ability to manage hilly terrain well.

“But then another part of it is seating, because it’s just a basic seat, it doesn’t offer any support. There used to be a company, Canadian company in [Location 2] or whatever, they don’t exist anymore, but we used to be able to get wheelchair seating on a scooter for those people who could just not take the next step to get on to a power chair but needed mobility. So, giving them that extra support that they needed so they could continue to be mobile, that’s no longer an option. So basic seating is all you have, no support.”

(Clinician 5)

A clinician explained that after the manufacturers sold the company off, the Ranger brand fizzled out because its quality plummeted. Since then, clinicians and vendors indicated that there have not been MMSs in the market that rehab seating can easily be put on.

3.3.1.5 Choosing between a 3-wheeled and 4-wheeled scooter

Participants gave their thoughts about the benefits and challenges associated with the use of 3-wheeled versus 4-wheeled MMSs. They indicated that the major advantage of 3-wheeled MMSs is the good maneuverability they offer in restricted spaces because they typically have a smaller size and turning radius. Also, clinicians and vendors indicated that their lighter weight was an advantage when the portability of the MMS was of utmost importance to the client.

“3-wheeled scooters have a nicer turning radius, they tend to be more lightweight, umm, they’re easier to maneuver but they just don’t have the same safety and stability. Apparently, there are some that are safe, but I don’t believe it.”

(Clinician 1)

However, opinions about the stability of 3-wheeled versus 4 wheeled MMSs, were mixed. While some MMS users, clinicians and vendors believed that 3-wheeled MMSs were inherently much
more unstable than 4-wheeled MMSs, some felt that there was not a considerable difference between how tippy they are, and that either one could tip if driven in an unsafe manner.

“Some clients uh, are settled and want, they don’t want a 4-wheeled scooter, they don’t want a 3-wheeled scooter because they know that they’re tippy but what we tell drivers is that it’s really more about how you drive. So, if a client can be very safe, if a client is cautious and learns how to drive it properly then the 3-wheeled scooter, umm doesn’t have to be as tippy as they think it is but it still is a little bit more tippy.”
(Clinician 4)

Although 3-wheeled MMSs were generally described as being smaller than 4-wheeled ones, they were said to provide more leg room for large or tall people because their centrally located single front wheel makes it possible for the client to extend their feet along each side of the tiller. Whereas, with 4-wheeled MMSs, the presence of two wheels at the sides of the tiller, provides less room for foot placement; thus, making it particularly challenging to use by people with knee or back problems and those who are tall or large.

“And then the other thing is foot placement. So, on a 3-wheeled scooter, because the tiller is in the middle, the client has space to put their feet on either side of the tiller. With the 4-wheeled scooter, because the wheels are there where you would put your foot on the 3-wheeled scooter, it limits the placement of your feet, so for some clients, that makes the difference because they can’t stretch their feet. If some people put their feet on top of the wheels, but some clients aren’t able or can’t do that and then they find that they’re knees hurt or their position is too tight on a 4-wheeled scooter they can’t put their feet out, can’t extend their knees.”
(Clinician 4)

A MMS user stated she had observed that people who used 3-wheeled MMSs sometimes had difficulty getting into the local transit trains because the front wheel got caught in a gap at the entrance of the train. She explained that this usually happened when the 3-wheeled MMS was not driven across the gap fast enough, and this was difficult to do safely.
“Plus apparently, the umm... when you’re on a 3-wheel and you’re getting on the [Transportation 1] or the umm other one, umm [Transportation 2], the wheel can get caught in that space between the train and, you know that... there’s a space like this, between the platform and the train. And the wheel can get caught in there if you’re not going fast enough. And you know you can’t get on the [Transportation 1] fast, you’ve got to go slow. So, I thought thank God I’ve got the 4-wheel.”

(MMS user 12)

Another challenge highlighted by some clinicians and vendors about 3-wheeled MMSs was that their batteries and motors are typically smaller in comparison to 4-wheeled ones and this makes them less capable of managing steep hills especially when heavier clients are on them.

“Yeah, they just don’t have the same power. You have to go into the really, that high end category of 4-wheeled scooter to get up those hills, and there’s just, I haven’t found an equivalent in a 3-wheeled scooter.”

(Clinician 3)

Clinicians and vendors indicated that 4-wheeled MMSs were primarily recommended for their stability and power.

“They tend to have a more, well, stable platform, just having the four wheels, first of all. Um, they do tend to be less tippy. But as well, they do, with that larger base. Um, you also get a larger base weight. Which, just keeps it more anchored to the ground. Um, uh also once you get into 4-wheel. You get into larger motor size and battery capacity just based again on size of the, size of the scooter.”

(Vendor 4)

They explained that 4-wheeled MMSs were more heavy duty because they had bigger motors and batteries which gave them the ability manage steep hills and larger clients. However, their large size and wide turning radius made them challenging to use in restricted spaces or to transport them.
3.3.2 Negotiating everyday challenges

Participants spoke about the day-to-day challenges of using MMSs in natural and built environments that are associated with technological issues.

3.3.2.1 Navigating roads and sidewalks

Participants stated that features which are supposed to make MMSs more conspicuous to other pedestrians and road users were inadequate and this sometimes made the navigation of roads and sidewalks a challenging experience.

“So just having drivers and other pedestrians aware of them is challenging. Umm, they’re sitting down so cars are not as aware of them coming out umm, in an intersection versus a pedestrian standing taller.”
(Clinician 2)

They reported that lights did not come as a standard feature on some MMSs and when they did, they were not always effective. A MMS user explained that while he could avoid the bumps and potholes on the sidewalks during the day, this was particularly difficult at night because the lights on his MMS did not help much with illuminating his path.

“It’s rather meager. It better serves me of alerting others that I’m coming rather than to see where I’m going and that’s important”
(MMS user 6)

Most MMS users mentioned that they found driving on sidewalks fairly jarring because they were usually bumpy, and this was encumbered by the fact that their MMSs did not have enough suspension to absorb the resulting shocks and vibrations. A MMS user explained that while people who walk can absorb shock with their shoes and limbs and determine how gently they
ought to place their feet on the ground, his MMS which serves as his legs, does not provide him with the adequate amount of shock absorption that it is supposed to when riding it on sidewalks.

“But also, um, another thing about it is that the suspension could be a whole lot better. Somehow or another, really, there’s gotta be a way to do it. You know, if you see people around the neighbourhood, quite often, on a scooter, quite often they’ll ride on the road rather than being on the sidewalk, because all of the sidewalks have these markings on them that make you go, flump, flump, flump. You feel every one of them.”

(MMS user 8)

In addition, he stated that good suspension was especially important for MMS users with multiple sclerosis because without it, the shock that is not absorbed by the MMS is transmitted to their brains with little resistance and can make them feel “really sick”.

Clinicians and vendors indicated that MMSs often do not have the power required to manage upward or downward sloping steep terrains which are drawn-out, and that the weight of the MMS user has an additional impact on this. They explained that MMSs sometimes shutdown when going over a steep hill, especially when carrying a MMS user who is of heavier weight. They also indicated that restarting the MMS is usually a challenge because the restart button is often located at the back of the MMS; thus, the MMS user either has to get off the MMS to reach it or find someone else to help them with that.

“Umm, hilly areas, if they live in a very hilly area, scooters just ultimately aren’t designed that well for long drawn out hills.”

(Vendor 2)

Clinicians and vendors also highlighted the fact that long drawn-out hills were a common feature in cities that some of their clients lived in and that the burning-out of the motors of their clients’ MMSs was a common occurrence.
Some MMS users stated that knowing the kinds of terrains that their MMSs could safely be used on was challenging, and that acquiring that knowledge sometimes came after going through unpleasant experiences. A MMS user mentioned that he experienced an accident and some near misses because he had difficulty determining the kind of uphill and downhill slopes that his MMS could safely manage. He explained that although his MMS had anti-tip wheels, they were not helpful in averting those incidents. Also, he felt that MMSs should have an inbuilt device that warns the MMS user about the steepness of the slope they are travelling on.

“Those anti-tippers are just little plastic wheels and they’ve got no friction to the road surface. So, the front wheel of my scooter came off, and, and then I started to turn, and there was nothing... there’s nothing built into the scooter that prevents it from turning, and it kept turning until, until I was on such a slope that ‘splat!’ it went over, and it fell on top of me, and it was scary, and my wife just about killed me. ‘What were you doing going up that steep road?!’ Anyway, so, scooters probably should have something in them that warns you that you’re getting too close, too uh, too steep. I think some of them have some kind of equipment in them, but it’d be nice to know when it is getting too steep”
(MMS user 8)

He also stated that just as able-bodied people receive feedback from their legs to inform them of surfaces that they can safely step on, his MMS, which is a replacement for his legs, should be able to provide him with feedback that warn him about slopes that are too steep for it to handle.

“For me, this is a replacement for my legs, and do you, if you’re off going for a walk or a hike in the bush or something, do you -- as a person on your own legs, do you stop because that’s too steep for you? Well, if you can’t get a foothold, you don’t go, but if you’ve got good solid footing, you’ll keep going, because you wanna get on, get on with your hike or whatever. Well, for me on the scooter, this is a replacement for my legs, so I am, I’m wanting to just keep going until the machine can’t do it anymore, but if the machine doesn’t tell me that, “Ahh, we’re getting dodgy here,” it doesn’t tell me, and I, I keep trying to push it, and then I overdo it. So... But I’ve had many situations where I’ve had a downhill slope, too, and it’s really hard to tell what’s the actual balance limit of the scooter, what’s it gonna be able to handle?”
(MMS user 8)
Clinicians and vendors mentioned that 3-wheeled MMSs are less capable of navigating steep slopes in comparison to 4-wheeled ones, as they are not as stable and have less power.

“Um, and yeah, we definitely that’s where the terrain aspect of things definitely comes into play. Um you know that limits things like 3-wheeled scooters. A lot of times just based on stability of the scooter and just power through the motor sides of things.”

(Vendor 4)

However, they indicated that batteries usually wore out prematurely in both 3- and 4-wheeled MMSs following constant use in hilly areas.

Clinicians identified the driving speed of MMS users on sidewalks as a safety issue, explaining that people were quite concerned about the high speeds at which some MMSs went. However, there were dissenting views about why some MMS users engaged in this behavior. A clinician explained that this probably had to do with the fact that novice MMS users may have difficulty understanding what speeds are appropriate for different environments.

“I think particularly for newer users, understanding what a safe speed is, is sometimes a challenge. So, uh, knowing whether you need to slow down in a certain environment, and I think this is probably something that comes up with the rest of the community as well. People are very concerned about the speed at which scooters are going, say down a sidewalk or something... Umm, so, negotiating like safe speeds, I think is a challenge...”

(Clinician 1)

Conversely, another clinician felt that those who were more experienced were likely to go at higher speeds just to get to places faster, which was a choice that was probably borne out of overconfidence and a lack of consideration for other pedestrians.

“I think sometimes those who feel more and more comfortable, they may start to operate the scooter in a higher speed and be... sidewalk or they may venture. I guess sometimes when you feel comfortable and confident, they may start to go faster so that they can get from point A to point B. So, I guess the unsafe piece is just around maybe bit of over confidence and then starting to
just be... I would say its more of a become less considerate for other people who are on the shared path.”

(Clinician 11)

Participants also spoke about technology-related challenges that are peculiar to the use of MMSs in urban and rural environments. In urban environments, the primary challenge identified was the visibility of the MMS when navigating crowded spaces; while in rural environments, the main concerns were regarding the range of the battery to cover longer travel distances and the power of the MMS to navigate uneven terrain.

3.3.2.2 Facing accessibility challenges

Restricted spaces were described as challenging to navigate with the MMS and were reported to be generally avoided by MMS users. The size and turning radius of the MMS were the main aspects that influenced its accessibility. With regards to using public transportation, participants explained that only a few MMSs met the required specifications. A clinician reported that a study which was conducted by a local MMS vending company revealed that only about 4 or 5 MMSs could fit into the city public buses.

“At one point in time, Selfcare had done a kind of a little study where they--this was a few years ago now--where they looked at a variety of scooters and I think at the end of it, there were about only 4 or 5 that actually went on the buses with reasonable ease.”

(Clinician 5)

Another clinician stated that she observed a trend in the way MMSs were getting bigger and bigger. She gave an example of a MMS that used to fit on the bus but after it was upgraded, it got longer than the acceptable transit specifications.
“There’s been this little trend to get them longer and longer and longer over the last 10 years. And now the scooter I love, they’ve just upgraded the model, and it’s my favorite scooter, and it’s now one inch too long to get on a bus.”

(Clinician 3)

While participants stated that 3-wheeled MMSs were usually able to get on the bus because of their smaller size and turning radius, they explained that choosing them came at the expense of the stability and power that 4-wheeled MMS had to offer. Some MMS users compensated for these challenges by procuring additional MMSs that had the features their existing MMS lacked.

“Well I got that one first, the Revo first- the bigger one and that’s why it went to England with me in 2005. But then I found that there was another one, a smaller one called the GoGo Travel Elite and it umm was small and uh came apart easily and goes on small elevators and ships and you know, buses and hop on and hop off kind of buses and all that kind of stuff you know. It’s much easier to travel with than this bigger one.”

(MMS user 3)

A clinician indicated that MMSs lacked adequate attachment spaces for walking aids and explained that this could restrict the mobility of MMS users who require them by confining them to their MMS. For MMS users who had the ability to walk independently, concerns were about leaving their MMSs unsupervised because they feared it would get stolen. While the keys to the ignition of MMSs were said to be better than they used to be, participants explained that MMSs could still be easily rolled away when the brakes are disengaged. A MMS user explained that she would have liked to be able to take walks when she went to the park with her MMS. However, she could only do this when she had company, because she feared the MMS might get stolen if she walked away from it.

“So that’s the thing is the scooter would be you know great if I could ride off the house, get to the place where I wanna spend some time, park it and then walk away from it, and when I feel like okay I’ve had enough, come back to it
but I can’t do that because it’ll get stolen. They get stolen very, very easily, very commonly, very easy to steal and that is... that does affect me”
(MMS user 2)

3.3.2.3 Being predisposed to accidents

Generally, participants believed that a lack of features such as flags, reflectors and adequate lighting increased the likelihood of accidents occurring. A clinician explained that while the presence of a flag and lights at the front and rear ends of the MMS were important, there needed to be some reflectors at the sides of the MMS to increase their visibility; thus, reducing the likelihood of MMS users being hit from the sides by cars.

“The flag is one thing that makes them higher but if the seat had a big neon X on the back or if there was neon things or reflective stuff on the scooter, like on the sides too, I think people are getting hit from the sides. So if there was more reflective stuff on the scooter so drivers could see them and maybe there would be less accidents.”
(Clinician 7)

A MMS user reported that the battery indicator lights on his MMS were blinding when driving at night and this was a safety hazard for him. He explained that although he had tried different ways to cover it up, nothing worked.

“And at night, the uh... these lights shining in your face so you can’t see beyond them. A very poor design. And uh, I have, I’ve tried various ways to compensate for that but usually it’s very unsatisfactory.”
(MMS user 6)

Some participants felt that 3-wheeled MMS were less safe to use on terrain that are steep or rough and by people who were heavier in weight or have stability problems.

“Going on a side slope that’s too big is unsafe. So, if somebody’s trying to go across a hill or something, umm, the chance of the scooter tipping because of the way the centre of gravity, particularly if they’re on the 3-wheeled scooter,
is really high. So, anything that is greater than like a 5-degree grade, on a side slope, I would probably be pretty cautious about it, because I would think that would be unsafe.”

(Clinician 1)

Some MMS users felt the malfunction of certain features played a contributory role in causing the accidents they experienced. A MMS user who broke both his hips from MMS-related accidents explained that some of them had do with the malfunction of his MMS speed controls.

“For instance, here I had a malfunction with the little, uh, speed controls, so the lever wouldn’t reset to a neutral position when I was attempting to go press a button for a crosswalk and that was a very busy place at the bottom of [Location 3]”

(MMS user 7)

Some MMS users also spoke about their speed controls getting triggered by accident either from items of clothing catching unto them or parts of their bodies pressing against them.

“The shawl that was draped over my coat around me got kind of caught on the handlebar and it started to drive the scooter. And so [laughs], I’m in this really awkward position in my scooter, so I fell right out of my scooter”

(MMS user 2)

MMS users also shared strategies they employed to enhance their safety. The most mentioned precaution was turning off the MMS when not in use.

“So of course, I have learned from my first accident, always turn off the power when you have to reach for something or pick something up or get off the scooter that’s very important. Secondly, always make sure you have sunglasses; it’s uh, very easy to get blinded when, particularly when one is on sidewalk, driving on the sidewalk.”

(MMS user 7)
Others included establishing eye contact with drivers before crossing intersections, using their voices to alert people of their presence, ensuring that items of clothing or accessories do not hang down loosely, and using personal items such as sunglasses to avoid being blinded by the sun.

### 3.3.2.4 Maintaining the scooter

Generally, participants described MMS maintenance as being a challenge because of the accompanying burden of repair costs, prolonged wait-times, and difficulty finding appropriate and accessible maintenance service centers. When it came to resolving maintenance problems, vendors were identified as the primary contact service providers. Clinicians explained that they always referred clients who required help with MMS maintenance directly to the vendors that they had purchased their MMSs from; hence, they were not actively engaged in the resolution process.

> “Umm, so again, so that’s probably getting out of my area of expertise. A) I’m not involved with people down the road when they’re starting to have some maintenance issues. I’ve certainly had clients call me and say “Oh there’s something wrong” and all I do is say call the man... call the vendor and they can do what they need to do. Umm, so I don’t usually get involved with that.”
> (Clinician 5)

Participants reported that most MMS maintenance issues were related to batteries and tires. With regards to batteries, improper charging practices of MMS users, and the inherent lack of reliability and durability of the batteries, were believed to be the root causes of maintenance problems.

> “The batteries only last so long and it depends on how they’ve been maintained. If they don’t have healthy kind of charging routines, then that wears down the batteries. And it depends on the clients use of it too.”
> (Clinician 2)
The cost of replacing batteries and finding batteries that are compatible with the MMS was also identified as a challenge. A MMS user explained that the batteries he buys do not last long and figuring out the kinds of batteries that are compatible with each other could be challenging.

“"You get some batteries that are, either two double batteries in these scooters and if one is slightly incompatible with the other battery, they don’t last very long. And you have to replace them after 4 or 5 months, which is not good."”
(MMS user 6)

Regarding tire maintenance, pneumatic and solid types had their unique issues. Problems associated with pneumatic tires were that they easily got punctured from driving over sharp objects like broken glass or thorns. Maintaining the right amount of pressure in them was also an issue. Participants explained that when such problems occurred frequently, pneumatic tires were usually replaced with solid flat-free tires. However, these were less comfortable than pneumatic tires as they provided no shock absorption and they were more expensive.

“"Getting flats and stuff based on uh even something as simple as blackberry thorns and what have you can puncture, can puncture a tire. So, uh... so, a lot of times, if, if someone, one of our clients is having issues with that repetitively we’ll look at doing flat-frees on their, on their scooter just to alleviate that uh, that issue and servicing.”
(Vendor 4)

For both pneumatic and solid types, balding of the tires was also another issue that had to be looked into to ensure that they can provide adequate traction required to safely drive the MMS. Vendors explained that if the treads were found to be worn out, the tires had to be replaced.

Getting MMSs repaired was also found to be a challenging process. A vendor explained that the time spent on repairs was usually prolonged by the long wait times for getting approval of funding from the Ministry, which sometimes left clients with no device to use during that period. Some MMS users also expressed their frustrations about the cost of repairs and lengthy wait
times which left them stuck at home or needing to rely on someone to get them around.

“If you don’t have a scooter, you can’t go anywhere. And so it’s frustrating and expensive in some cases.”
(MMS user 6)

Maintenance service centers were found to be lacking or difficult to access. A clinician reported that she knew of only two places where MMS users could get MMS servicing and repairs done. Also, a MMS user explained that it was difficult for her to find a proper maintenance service center after the one she previously depended on got sold out, and this made it hard for her to keep-up the maintenance of her MMS. As an alternative to MMS maintenance centers, some MMS users reported that they went to mechanic shops to get repairs done, but this usually did not always suffice.

“I used to have a place and it closed. Now repairs shops are getting few and far between. To find a place that will know how to fix it or, cause I’ve had to have a few little fixes like the brakes went on my small one just before I was going to [Location 4] and they were able to fix it for me. So, umm that should be part of the study too I think- places to have experienced people who know about fixing scooters. You can’t just take it into every shop because some only deal with specific brands. I’ve had my tires and batteries changed by a tire shop and battery shop, but they have to get in the proper kind of parts.”
(MMS user 3)

Accessing replaceable parts was said to be more of a problem when the MMS brands was not well-known. A vendor explained that when brands of MMSs that are not well-known are purchased over the internet by clients, providing support servicing is challenging, as they are not usually able to access the required parts.

“One of the biggest things we’ve seen in recent years is purchases of brands that are not well-known and brands that are not well-supported, and then of course, the client will have saved a bit of money by
purchasing that item, but then when they bring it into us to service it, we are not able to access the parts to be able to service that.”

(Vendor 3)

MMSs getting rusted from prolonged exposure to moisture was another issue that clinicians and vendors identified, explaining that this usually occurs when MMSs are left outdoors. A clinician gave an example of a client whose MMS developed rust despite covering it up with a tarp, because she left it in her backyard patio. Clinicians explained that this was one of the reasons why having a place to store the MMS indoors was a mandatory prescription criterion that had to be met before a client can be considered for government funding.

“A rain cover only prevents some rain from getting in, but the constant moisture is not good for the electronics. They’re not well sealed in the same way like a car is, for example, because it’s electronics as opposed to like an engine.”

(Clinician 1)

For MMSs that could be dismantled, vendors explained that reassembling and disassembling them could become a challenge after a while, but this could sometimes be resolved by lubrication. Other maintenance issues mentioned were parts getting loose and needing tightening, lights or horns not working and the MMS malfunctioning spontaneously.

3.3.2.5 Being out in bad weather

MMSs were generally described as not being hardy in bad weather. Clinicians and vendors explained that just like with any other mobility device, it was not advisable to use MMSs in the snow as they could get stuck or slide on the ice. Some, however, stated that there were heavy-duty MMSs which could handle a fair amount of snow, but they were usually 4-wheeled MMSs.
“Umm I’ve seen some scooter models like the Forester, where they have the bigger wheels and they’re meant to go more in sturdier environments. So those big scooters, I call them my 4-wheelers, right, so... I prescribed them more in [Location 4] because of the environment.”
(Clinician 10)

While most MMS users stated that they avoid going out in the snow, some stated that there were times when they had to do so. Generally, participants stated that using MMSs in the rain was a lot less challenging than the snow in terms of navigating the environment. However, there were concerns about the electronics getting damaged from moisture.

While some believed that canopies were helpful in shielding the electronics on the tiller from rain, some felt that they were ineffective as rain still blew in from their sides. Participants indicated that they were not usually funded and that they were expensive to procure. Although cost was commonly cited as a barrier to procuring canopies, participants also reported that they were not “user-friendly”. A MMS user explained that she had to take her canopy off because the wind used to catch it, and that made the MMS feel tippy.

“I had a canopy before, but I don’t use it. I’ve had visions of being Mary Poppins with the canopy. The wind catching the canopy and being short of breath to start with. I thought “Oh my God! If I have to go and start handling the canopy and put it back to where it belongs, I would just, it would be beside myself.” so, I don’t bother with the canopy at all.”
(MMS user 12)

A clinician also explained that the condensation that occurs on the canopy’s screen could impede vision when driving the MMS in the rain.

“Umm, I have heard from some people that the canopies that have the plastic that come down in the front and not on the side, that they’re actually a problem because they get condensation on the inside and gets fogged up so then you can’t see very well.”
(Clinician 5)
Some participants also felt that canopies were cumbersome, hence their use would restrict the accessibility of the MMS and could pose an extra hazard in terms of catching unto things because of how they stick out.

Participants explained that when MMSs had to be used in the rain, a plastic bag, a poncho or an umbrella was used as a substitute to protect the controls from getting wet. A clinician gave an example of a client who used a Ziploc bag to cover the controls of his MMS, because he usually had to go out in the rain as he depended on food banks for his meals.

“Some people still go out in the rain and they bring... like I have one client that just always brings Ziploc bags with him and that’s kind of his way of managing. He’ll always put a Ziploc bag over the controls to try to keep them dry because he doesn’t really have a choice. He relies on going to like food shelters and food banks and stuff like that for his meals, so he has to go out whether it’s raining or not. So, he kind of has found ways to manage.”

(Clinician 9)

While some participants believed that these substitutes to canopies worked well, some felt it was challenging to use them. A MMS user stated that in heavy rain, using an umbrella did not help much in keeping the MMS controls dry and that it was difficult to hold on to an umbrella and operate the MMS at same.

“I’ve had a struggle with the weather, I’ll carry an umbrella but again I’m holding something in one hand. I’ve got... it’s really, really tough on the hand that is controlling the scooter, on the wrist. Umm, and the uh... if it’s just a little drizzle it’s not a problem but that like heavier rain, you get really, really wet and it’s not good for the scooter controls. It doesn’t matter how big your umbrella is.”

(MMS user 2)
Besides getting the controls on the tiller wet, the electronics at the base of the MMS were also reported to be susceptible to damage by rain. A clinician spoke about a client whose electronics were affected by driving his MMS over a puddle of water.

“And I have met one guy who went through a puddle that was deeper than he expected, and he burnt out the electrics on the scooter. [Chuckles] So that’s always something that I am now aware of.”

(Clinician 3)

3.3.3 Identifying solutions and barriers

Participants gave diverse recommendations on how the usability of MMSs can be enhanced as well as existing or potential barriers to implementing them.

3.3.3.1 Enhancing scooter usability

Participants described different aspects of MMS design that required modification and extra features that need to be added. Their suggestions were generally related to improving design characteristics such as adaptability, hardiness, anti-theft system, comfort, ease of operation and aesthetics. A summary of their suggestions can be found in Table 3.6.

There were dissenting views about the capacity of some features to enhance MMS usability and safety. While most clinicians and vendors saw flags as important accessories that could help enhance the safety of their clients by making them more visible on the MMS, they explained that most potential MMS users did not want one. Instead, such clients opted for alternative safety features such as reflective clothing or mirrors.

“Yes, yes. Like, I think it’s important to have the safety flag. And I think it’s important to have things where you can be seen. And I have a gentleman who is an ex-Harley driver who’s said, “No way, no flag, forget it!” You know? He liked his scooter but no uh, obvious sort of safety features on it. But he did like
to have the dual rear-view mirrors that were extended and higher up, much like Harley, Harley Davidson? Is that correct? What motorcyclists have on their handlebars. So, that was okay for me to put on.”

(Clinician 12)

Generally, MMS users expressed a disinterest in the use of flags. An MMS user explained that using a flag felt like she was “advertising” her disability. Some MMS users mentioned that they stopped using flags because they usually got caught in elevators, buses, and taxis. Some stated that they did not see that it served a purpose as pedestrians are usually distracted by their phones and will still not notice them. Some also mentioned that they did not like the way it looked and preferred alternative safety features like lights and side mirrors. A MMS user also mentioned building a pole with flashing lights on its top to serve as a substitute for a flag.

“So, people have come up with goofy ways of, of making their scooters more visible. I mean, probably most of the people you see riding around, they have one of those goofy flags, you know that little orange flag? My sister told me she would disown me if I ever put one of those flags, because I would look like a little old geezer. She hasn’t said that for years, but anyways, they do look kind of silly to me, and I won’t do that. So, most often, around the neighbourhood here, I don’t put the marker on. But if, if I was going a distance or at night or something like that, I would set it up”

(MMS user 8)

Tetra lights, which a participant described as being made up of LED lights that are put along the armrest of a MMS and an aerial that has flashing lights on it, was another preferred alternative to flags.

Participants indicated that although horns are standard features on MMSs, they are usually not effective. Most participants made mention of the volume of the horn being too low or producing an odd sound that could hardly be recognized as a warning.

“Uh, a horn that actually can be heard more than by dogs, okay, would be great, okay, so that people would actually know… or a bell, anything. I don’t
think there’s, I don’t think there’s very many people that didn’t replace that horn with a bell or one of those bulb horns, right, almost immediately because you can’t hear the horn.”

(Vendor 1)

One MMS user, however, felt that while a louder horn would be helpful, it might not be appropriate for all situations or environments; thus, having an adjustable horn may be a viable solution.

“It would be nice to have a horn that actually is significant. But you would also like to have some adjustability to it, ‘cause if you’re trying to get somebody’s attention in church or something, you kind of wanna be able to go like, [high pitched beep], not “HONK”! People would be having heart attacks.”

(MMS user 8)

While some participants believed that side-mirrors were useful safety features, some indicated that they tend to increase the footprint of the MMS; thus, making it hard to get in and out of tight spaces. Some MMS users mentioned that side-mirrors needed to be readjusted often and those that were bought as addons had the tendency to shake loose.

“The only thing that I should say doesn’t work is the uh rear-view mirrors that I have on it. They never stay in place, so I ended up just taking them off.”

(MMS user 9)

One MMS user, however, indicated that although she wanted a side-mirror, and was initially informed that she could buy one as an add-on, she later found out that there was no suitable place on the tiller to attach it to.
### Table 3.6 Suggestions on enhancing scooter design

<table>
<thead>
<tr>
<th>Design characteristic</th>
<th>Suggestions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comfort</td>
<td>Enhance MMS seating and suspension. Provide effective and affordable rain covers.</td>
</tr>
<tr>
<td>Hardiness</td>
<td>Should be made weather proof to prevent rusting and damage of body and electronics. Requires durable and reliable batteries and motors.</td>
</tr>
<tr>
<td>Adaptability</td>
<td>Requires Rehab seating to enhance adaptability to populations with seating needs. Needs more adjustability of: seat forward and backward, seat-height, and back rest. Power elevating seat.</td>
</tr>
<tr>
<td>Ease of operation</td>
<td>A more concise manual on operating and maintaining MMS in bigger prints. Reduce turning radius and increase stability. Should have simple display and controls that are easy to operate. More variety of control inputs. Requires accessible charging port and brake release lever. Baskets should be made more easily attachable and detachable.</td>
</tr>
<tr>
<td>Performance characteristics</td>
<td>More motor power to help navigate hills. More speed generally wanted by MMS users. Less or programmable speed wanted by service providers.</td>
</tr>
<tr>
<td>Safety</td>
<td>Improve MMS anti-tip. MMS should have factory-fitted side-mirrors that stay in place and better factory-fitted lighting. Should have flags (divided opinions). Require louder and better sounding horns. Needs a device on the dashboard for detection of slopes that are too steep. Requires a feature that automatically slows down speed around corners and bends; a tipping alert that goes off when the MMS is at an unsafe angle and is likely to tip; and collision avoidance systems. Speedometer. Seat belts.</td>
</tr>
<tr>
<td>Anti-theft</td>
<td>Alarm system. User-friendly immobilizer. GPS for tracking device if stolen. Better locking system. Baskets with lids that can be locked to keep valuables safe.</td>
</tr>
<tr>
<td>Aesthetics and other upgrades</td>
<td>More colors. Covered rainproof utilitarian pockets on the driving stem to store phones or wallets. Rainproof compartments to carry battery charger in. Flat free tires. Bigger wider tires that offer more grip. A cup holder.</td>
</tr>
</tbody>
</table>
While some clinicians felt that seat belts were required for all MMS users, some believed it was only necessary for certain groups of clients. A clinician explained that she encourages the use of a seatbelt if a client has balance problems, but when there are armrests on the seat and the client has good balance, she felt there was no need for it.

“Some people I would strongly encourage that we prescribe them a seatbelt because they don’t generally come with seatbelts, but with other people I don’t because there’s no reason. They have good balance, there’s arm rests on the chair, there isn’t any real reason to have it there.”

(Clinician 5)

A MMS user also explained that he removed the seatbelts that came with his MMS because he was afraid of getting trapped in the seat by them if his MMS accidentally tipped over.

“Anyway, the big scooter it has some uh, seatbelts but I never use it because I am more afraid of the seatbelt when I tumble over and for that reason I’ve removed it even”

(MMS user 7)

While baskets were generally viewed as being helpful, some issues were highlighted regarding their use. A clinician explained that having a heavy basket could restrict the maneuverability of the MMS if the basket directly attached to steering stem of the tiller.

“The client often wants a huge basket on the front and because they want to put all their groceries in. Whereas, from my perspective, umm, and from a safety standpoint, the more you have on a scooter... Like, it’s not weighted to be quite heavy in the front, and if the basket is attached to the tiller, sometimes, that makes maneuverability of the scooter tricky because you’ve added all this weight.”

(Clinician 2)

Participants also mentioned that baskets could sometimes be an encumbrance when driving in certain environments and were difficult to attach and detach. Some MMS users explained that they had to compensate for these problems by attaching their baskets on the inward side of the
tiller or getting an alternative storage container for shopping that can fit between their legs on the MMS platform.

“And I have a little cooler that... I don’t have it with me today, but um, I load that up with groceries and I just put it on the floor by my feet and um, I do all my grocery shopping that way.”
(MMS user 10)

With regards to battery indicators, a MMS explained that although it shows the amount of battery power left on his MMS, it was challenging to estimate what that meant in terms of duration of time.

“Well, estimating the length of time the battery would last. That comes with experience you know.”
(MMS user 6)

While enhancing the suspension of MMSs was generally perceived as being beneficial for improving the comfort, a MMS user explained that it could make the MMS more unstable.

“But, I dare say that these, the suspension and the shock absorbers are not contributing to stability. When I go over a hump, I uh, I sometimes get practically airborne if I go 20 km/h, so better don’t do that you know. And, I try to say the springs and the shock absorbers help or uh, make it more severe to uh create an unstable situation. Umm, when you have no suspension it’s maybe a little bit hard on the back... but in a way it’s safer.”
(MMS user 7)

Participants also spoke about the usefulness of MMS manuals. While they generally agreed that MMS manuals contained a lot of useful information, some stated that it still lacked certain details. A MMS user stated that she searched for information on how to clean her MMS but could not find any in the manual. She explained that although she checked on the internet, there was no information about the kind of detergent she could use, or aspects of the MMS that could be safely cleaned.
“The thing that it didn’t, the part that was not in the booklet that I looked for was how to clean the scooter. Like how much you can wash it, like you know, like so that you… cause I don’t really know underneath the motor, like how exposed it is, like if I should take a hose or whatever.”

(MMS user 2)

Some MMS users explained that manuals contain more information about how the MMS works rather than how it can be used. Some MMS users wished there was some information in manuals about how to turn off the backing alarm of the MMS. Some clinicians and vendors felt that manuals contain a lot of information which makes it hard to find specific things. They also mentioned that manuals had small prints which can make it difficult to read; thus, having a more concise version with larger prints might improve its ease of use.

“I think if it was more, more simplified reading, and maybe bigger print, you know, then people might be more apt to reading it, you know. I don’t know. There hasn’t been, you know, I don’t think everybody that has read the manual, right. But if they made it simple, concise, quick, you know, and bigger print, ‘cuz you have to remember, most of the people getting these scooters are sixty, seventy, older, right. So, that might make it more enticing I guess for them to read, right.”

(Vendor 1)

One MMS user, however, expressed his doubts about the validity of the information in his manual that pertained to not using a cellphone when driving a MMS, because he had never noticed or experienced any problems while driving and using his cellphone.

“But, you know, all the places that I’ve been, all the cool stuff that I’ve seen, electronic this and that, and interference, and transmitters – I’ve never ever, ever noticed even the slightest hint of a change or anything weird about the operation of the scooter, where it was interfered with by, by a cellphone or anything else outside of it”

(MMS user 8)

Participants also spoke about other types of MMS designs that existed and upcoming innovations in the market. A MMS user stated that while some people think that the ideal MMS is one that is
completely enclosed, he would not want one. He gave an example of someone he knew who used
an enclosed MMS explaining that the person usually had problems with the windshield fogging
up in rainy weather and the pod getting very hot in the summer.

“One of the people living in this building had that and he said it’s crazy in the
summer. It gets way too hot in there... I don’t even know if it had windows that
you could open. It would get hot, and he’s in this kind of weather. He’d be out
and it’d have like a manual thing for the windshield to get the rain off the
windshield, but then it would get all fogged up inside.”
(MMS user 8)

A vendor explained that although there are manufacturers whose designs “have been the same
forever”, there were other manufacturers that were coming up with innovative designs. He
mentioned Pride Mobility as an example of a manufacturer who has created a design called the
“Zero Turn” which is a 4-wheeled MMS that has the maneuverability of a 3-wheeled one.

“So now on the Zero Turn they’ve incorporated it. So, they have 2 motors, one
for each rear, rear wheel and then it can function. I would say the turning
radius is, would be that of a 3-wheel scooter. So, I think we’ll probably see
more of that”
(Vendor 2)

There was also mention of a novel mobility device that could serve as an alternative to MMSs. It
was described as manual wheelchair that could be converted to powered mobility by attaching a
tiller-like front end which carries the motors and has a single wheel. A clinician explained that
since some MMS users have to get multiple mobility devices to compensate for the accessibility
challenges that they face, this mobility device could be a viable solution.

Umm if they had a manual wheelchair that you could attach the front end of
the scooter to, so you could either self propel your manual wheelchair short
distances and in tight turning spaces, like inside, but then you could just attach
on a scooter front end so that you could go longer distances. So, you could
have the option of power for outdoors but the manual basic inside”
(Clinician 7)
3.3.3.2 Existing and impending barriers

Participants spoke about existing factors that contribute to the current lack of availability of the features needed on MMSs and the potential barriers to implementing the required changes that will enhance their usability. The main factors identified were cost, the presence of power wheelchairs as alternatives, lack of advocacy, manufacturers’ lack of awareness, lack of regulations, lack of demand, and feasibility of implementing solutions.

Cost was the most mentioned barrier to enhancing MMS technology. On one hand, cost was perceived as a barrier to introducing new features on MMSs, with concerns being that they might become expensive, hence inaccessible to more people.

“So, I think we have to be a little bit careful about what we ask for and what we’re saying we, we need on scooters because then we price it out of people’s range.”  
(Clinician 5)

However, one MMS user mentioned that he would have been willing to pay more for a MMS if only the features he required were made available.

“Well I think they want to produce scooters at the lowest cost. And the adaptations that I would prefer them to have probably are, add to the cost of the scooter which I would gladly pay if they, they did it but they don’t.”  
(MMS user 6)

On the other hand, cost was perceived as a reason why high-quality MMSs were not made, with concerns being that manufacturers were only interested in making the most profit possible. A vendor indicated that it was important for manufacturers to know that they were supplying mobility devices to people who desperately needed and depended on them.

“Better quality. Better made, you know. Definitely not made for profit would be great. Of course, you got to make your profit. You have to make money but don’t try and milk every last dime out of it, you know, with the consequence
being that you have a more inferior product. I think it’s people have to understand that, or the manufacturers have to understand that they’re supplying a product to somebody who desperately needs it.”

(Vendor 1)

A clinician felt that there was a lack of incentive to have a highly adjustable MMS because of the presence of power wheelchairs in the market as an alternative.

“...And so I think because we’re on that edge of ‘when do you make the call to go to a power chair versus a scooter’, there’s not an incentive in the market to make a highly adjustable scooter, when a person could go into a power chair instead.”

(Clinician 1)

In addition, she explained that because therapists are usually not involved in a majority of MMS purchases, there are no advocates to request for the required changes.

“...And so, because there’s a different, it’s a different market, I think that makes a difference too because you don’t have therapists requesting all these differences all the time, because they’re not necessarily involved in a majority of scooter purchases. Whereas, they are involved in every power wheelchair purchase. So, when you don’t have people to advocate for differences”

(Clinician 1)

A MMS user also mentioned that he felt that a lot of modifications could be done, but vendors were not always willing to help follow up with complaints to manufacturers.

“...There’s a lot of small modifications that uh, I would think can be easily done but uh, when you talk to the agents about it they just turn a blind ear to your complaints and uh, well, that’s the way it is. It doesn’t have to be that way.”

(MMS user 6)

Some participants felt that issues with MMS technology existed because manufacturers were unaware of the needs of their client populations.

“...Those are some of the aspects of scooter use that annoy me considerably and they, and I think it’s just case of the designers either not caring or being ignorant of who’s gonna be using their vehicle... I would to say basically
what's the problem is, is that the people that design the scooters, design them as if they were going to be used by able bodied people.”
(MMS user 6)

One clinician indicated that the lack of regulations about features that should come as standard on MMSs, probably leads different manufacturers to design MMSs based on their own discretion.

“Umm, I don’t really know. I mean, there aren’t, as far as I know, there aren’t regulations out there that stipulate what scooters should or shouldn’t have. And so I think that’s why we see like one model that has this slowdown feature and none of the others do. Cause this company has decided “Oh, that might be a good idea.”
(Clinician 5)

Some participants also mentioned that there was a lack of demand for certain features because unlike a power wheelchair, people who use MMSs are usually not in them all the time; hence, they do not need them to fit perfectly.

“So I think people just, you know, “oh it’s like, oh it doesn’t quite fit but I’ll get out of it soon” (laughs) so the complaints just aren’t there.”
(Clinician 3)

Some participants also stated that some of the features they recommended were probably not commercially available because the market for them was not large enough.

“I’ve looked quite a bit for any kind of a scooter that had rehab seating on. Doesn’t exist. There’s just not enough a big enough market for it, I guess.”
(MMS user 8)

Lastly, some participants felt that some of the suggested modifications to MMS design were not practically possible and there will always be a need to compromise one feature for another.

“And sometimes things aren’t realistic too, if you need a specific size scooter but you want, you know, much larger motors and batteries, it just, it can’t fit.”
(Vendor 2)
Chapter 4: Discussion

4.1 Synopsis

This chapter provides a synthesis of the study findings. This study sought to investigate the usability and safety of MMS technology and how these can be enhanced. Using the C-HAAT Model as a sensitizing concept, the various ways in which technological factors influence MMS usability and safety with respect to different user populations, activities, and contexts, were explored and these are discussed with reference to the three overarching themes. The findings offer insights into challenges with various aspects of MMS technology and barriers to implementing the recommended modifications. While there were doubts about the feasibility of implementing certain kinds of technological changes, participants generally believed that enhancing MMS design was an important aspect of promoting its usability and safety.

4.2 Finding the right fit

This theme identified considerations and compromises made with regards to MMS design and concerns about the overall quality of MMS technology. Insights were gained into perceptions about the usability and safety of features that were unique to MMSs and how much they mattered, particularly, to MMS users.

Participants were found to constantly make comparisons between MMSs and power wheelchairs when describing the specific features that informed their respective decisions to opt for a MMS. In this study, the basket, light package, tiller, and appearance of MMSs were identified by participants as tangible features that made MMSs preferable to power wheelchairs. In contrast,
except for appearance, mostly intangible features such as ease of use, safety, comfort, and ability of the MMS to go off the road, were identified by participants in the UK study by Rica (40) as reasons for choosing MMSs over alternative mobility devices. Thus, making appearance the only identified physical feature that was common to both studies.

Although the convenience of having a basket has not been explicitly stated in literature as a reason why MMS are preferred to other wheeled mobility alternatives, this can be inferred by the ample evidence (1-6, 8, 9, 20, 40-43) which shows that shopping is a key activity performed with MMSs. However, the tendency of baskets to limit MMS accessibility due to the extra space they take up was a challenge identified in this study. While attaching the basket to the inside of tiller was cited as means to compensate for the unwanted increase in MMS footprint, this was complicated by the fact that they were difficult to attach and detach. Also, in MMS models where the tiller’s steering head is rigidly fixed to the stem (i.e., the head and stem of the tiller move as a single unit), it was mentioned that steering could be difficult if the attached basket is heavy. This could be particularly challenging for MMS users with arm weakness and presents a safety issue. Possibly to avoid these challenges altogether, there was also mention of the MMS platform being used to store items when shopping, instead of a basket. The complexities surrounding the use of baskets is an example of how a single feature of a MMS can influence a user’s ability, environmental accessibility, activity engagement, and safety; thus, giving some insight into the dilemmas that MMS users face with regards to MMS technology.

In literature (40, 43), lights have been identified as important features that MMSs should have. However, preference for MMSs due to the presence of factory fitted light packages is a unique finding in this study. In a Canadian study by Rutenburg et al. (43), all MMS users and a majority
of other stakeholders which included respondents from Canadian Council of Motor Transport Administration (CCMTA), Canadian Standards Association (CSA), Canadian Transportation Agency (CTA), Federation of Canadian Municipalities (FCM), Industry Canada (IC), dealers, transportation providers, and a scooter manufacturer indicated that lights were safety features that should be required on MMSs. However, the dealers in that study indicated that light packages were available if customers ordered them, which may have implied that MMSs generally did not have lights at that time, or that only some MMSs had them. In the UK, while lights are a mandatory feature for class 3 invalid carriages to have, they are not required on class 2 invalid carriages (21-22, 40). Considering the fact that all MMSs in Canada and class 2 invalid carriages in the UK are strictly for pedestrian use, this raises the question about why lights are seen as an important feature for MMSs to have in one context and not the other.

A unique finding in this study was the perception of the tiller as a safety-enhancing feature. This perception was peculiar to MMS users and was particularly interesting because it was prevalent among participants with multiple sclerosis who lacked the ability to stand or walk independently. Considering the fact that these kinds of populations have been reported in literature (97) and in the present study as clients that tend to be steered away from using MMSs, this could pose a conundrum in real-world situations especially when dealing with clients with high mobility needs or progressive conditions who may be resolute about getting a MMS because of the additional safety they believe the tiller would provide. Thus, this insight has practical implications for MMS provision.

While it has been commonly reported in literature that a MMS is preferred because its appearance carries less stigma of disability (1-6, 97), this has only been explained in the context
of how it is externally perceived by others. An additional finding in the present study, however, is that the appearance of the MMS seems to give the MMS user an inner feeling of being less disabled as well. While this notion is directly supported by the comment of a MMS user about his MMS making him “feel” less disabled, the case of a MMS user rejecting a power wheelchair over concerns about being “wheelchair-bound” and reports from clinicians about MMS users being reluctant to move to power wheelchairs despite declines in their mobility, are probably suggestive of this notion as well.

Although the relatively low cost of MMSs is often cited in literature as one of the main advantages they have over power wheelchairs, the aforementioned physical features of MMSs seemed to take precedence over cost for MMS users in this study. This notion is supported by MMS users opting for a MMS even though they were eligible to receive funding for a power wheelchair and cases of outright refusals or reluctance to use power wheelchairs. A similar trend was observed in the Rica study (40) where the cheap cost of the MMS was the least mentioned response by MMS users for why they chose to procure a MMS. Also, the cases of power wheelchair rejection and abandonment reported in this study because of the preference for MMSs, accentuate the need to carefully consider the views of potential clients about what they prefer and why. Existing evidence in literature suggests that AT abandonment could be substantially reduced through a better understanding about how and why people with disabilities choose to accept or reject technology (98-102).

The features that participants in this study looked for when picking between MMSs were also similar to what was reported in the Rica (40) study and an Australian study by May et al (42). In the Rica (40) study, MMS range, ability to fit in a car, and comfort were mentioned as the top 3
most important features that MMS users looked for, but features like MMS reliability, its ability to handle various terrains, its user weight capacity, and the ease of lifting it into a car boot were also commonly mentioned. In the study by May et al. (42), participants (consisting of 15 MMS users) identified seat comfort, suspension, grip versus thumb-push controls, and choosing between 3- and 4-wheeled MMS as the factors they considered. In the present study, however, participants were also asked to identify common add-ons that they looked for. This question was asked to help identify features that did not come as standard on MMS but were believed to play a vital role in augmenting their usability. These findings could help open discussions about additional features that should be standard on MMSs.

In addition to the differences in turning radius, size, and weight between 3- and 4-wheeled MMSs, which have been previously reported in literature (7, 20, 26, 37, 43-44, 46), some unique findings were also identified. The first is in relation to 3-wheeled MMSs being more deficient in reliability, durability, and climbing ability (or power) than 4-wheeled ones. While the UK study by Rica (40) reported that bigger MMSs were superior to smaller ones with respect to these qualities, they were not indicated as differences between 3- and 4-wheeled MMSs. The second is in relation to 4-wheeled MMSs having less leg room than 3-wheeled ones. The implication of this is that clients who require 4-wheeled MMSs because they meet their weight needs or because they are the only options that can manage their environment, would have to compromise their comfort. The third is regarding the belief that safe driving and not necessarily the design of the 3- or 4-wheeled MMS, determines whether either would tip. As no existing studies have been found to compare the stability of 3- versus 4-wheeled MMSs, this remains an unresolved
conundrum. These findings reveal how complex the differences between 3- and 4-wheeled MMS are, and the far-reaching implications of choosing either of them.

The findings of this study also offer a glimpse into what the quality of MMSs that are available in the Canadian market may be like. Some issues with reliability and durability are similar to what has been identified in MMS studies conducted in the UK and US. Similar to findings reported by Rica (40) and Souza et al (44), advertised performance claims of MMSs were found to be unreliable. A US study by Reis et al. (101) which explored the experiences of 13 powered mobility (i.e., both MMS and power wheelchair) users found durability and reliability to be typical challenges that they faced regardless of how the MMS was funded. As identified in the present study and previous ones (40, 44, 102), the implication of this is that if the MMS does not last through its funding term of between 4 and 5 years, the MMS user would either have to pay out pocket for a new one or do without a mobility device till that time elapsed; thus, negatively impacting their quality of life. Also, the perceived dwindling quality of MMSs is another unique finding in the present study. Although some of these issues have been identified in previous studies (40-41, 43-44, 103-104) that were conducted in previous years (for as long as 5 years ago), it is interesting to learn that similar problems not only still exist but are purportedly even getting worse.

Consistent with the findings of Fomiatti et al (41) on how certain aspects MMS design adversely impacted the experiences of MMS users, findings from this study also revealed that some aspects of MMS design were not properly tailored to meet the needs of certain groups of MMS user populations. Unique discoveries with regards to this were the awkward location of the brake release lever and the power reset switch. While Shoprider and Pride were the most mentioned
brands that participants had reservations about, it is important to note that they were also the most common brands used by MMS users who participated in this study.

4.3 Negotiating everyday challenges

The technology-related challenges that influence the use of MMS for different activities in built or natural environments were explored. This gave rich insights into how well MMS technology is designed to manage the needs of MMS users and the environments they are used in.

Consistent with previous literature (18-20, 40-43), the awareness of other pedestrians and road users about the presence of MMS users and the negotiation of safe speed were identified as the main challenges when sharing spaces. While flags, lights, and horns have been cited as safety features that are supposed to help make MMSs more conspicuous (43, 97, 105), there were dissenting views about their effectiveness in this study.

Similar to the study findings, mixed views have been expressed in literature about flags; with prescribers typically being in support of their use for safety reasons (97), and MMS users being against their use because of the stigma attached to them (105). However, in the present study, the inconvenience of flags getting caught on things was identified as another reason why some MMS users choose not to use them. Another interesting finding was that some MMS users found tetra lights, which consists of an antenna with LED flashing lights at the top, as a more acceptable alternative. These findings indicate that while there is an appreciation of the need for MMS to be visible, flags do not fit in with the aesthetic preferences of MMS users and are challenging to use in certain environments.
In a recent study that compared the effectiveness of orange flags, reflective vests, LED lights, and black clothing on making wheelchair users visible by cars from certain distances, orange flags were found to be the most effective during the day but only LED lights were found to be effective at night (106). Considering the fact MMS users are seated below the eye level of pedestrians and vehicle drivers, having a safety feature that provides visibility height-wise is important. While tetra lights might seem to be an ideal alternative to flags in terms of aesthetics and overall effectiveness, it is important to consider that they also have antennas that protrude like a flag; hence, their use will likely to result in similar problems of getting caught on things. Also, there is a probability that the issue with stigma might arise again with tetra lights if their use becomes too popular. Thus, an understanding of what is aesthetically appealing to MMS users, creating multiple designs to mitigate stigma, and designing an adjustable alternative that can work in different environments may be more effective means of addressing these matters.

Although participants believed that lights were important safety features for MMSs to have, some challenges were identified. One challenge was that lights were not built into some MMSs, so they had to be purchased as addons. Another challenge was that some inbuilt lights only made the MMS more visible by others but did not help MMS users with seeing their way in the dark. While recommendations were made by stakeholders in the study by Rutenberg et al. (43) for light packages to be enhanced and become standard equipment on MMS, findings from this study highlight the specific way in which lights need be improved. In that study, horns were also identified as mandatory features that MMSs should possess. Even though horns were described as standard features on MMSs in this study, findings highlight the need for them to be enhanced and sheds light on precise aspects that require modification.
With regards to previously reported safety concerns about MMS users going at high speeds on sidewalks (8, 10, 17), mixed views were presented in this study. However, contrary to the common representation of MMS users as driving at high speeds because they are inconsiderate of other pedestrians (17), one clinician explained that this behaviour might be due to difficulties with determining what a safe speed is for different environments, which could be particularly problematic for novice MMS users. Interestingly, reports from the study by Rica (46) on the usability of MMS controls, supports this explanation. In that study, it was reported that non-MMS users were less able to predict their speed without the use of a speedometer. Thus, as suggested by participants in this study, having a speedometer on the MMS may be help improve its usability and consequently its safe use. In addition, having default speed settings for indoor and outdoor environments with graded modulations of each, may be another helpful modification in MMS design that could facilitate the negotiation of safe speeds.

The need to have good suspension built into MMSs was also stressed by study participants. The importance of this feature was accentuated by the fact that despite the presence of sidewalks, some MMS users make unsafe decisions to travel on the road to avoid the “sickening” experience of a bumpy ride. While it has been reported that MMS users seek for good suspension to accommodate for the bumpiness of sidewalks (42), findings revealed that MMSs were generally deficient in this feature. Although pneumatic tires were said to help with shock absorption, using them meant that the MMS user would have to be prepared to deal with their high risk of getting punctured; which could present another safety issue. Also, while enhancing suspension seems to be the obvious solution, it was mentioned that this has the tendency to make
the MMS more unstable, especially if travelling at high speeds. Thus, this is a factor that should be carefully considered when enhancing MMS suspension.

Accessibility has been widely identified in literature as one of the leading challenges that MMS users face (20, 43). Although several studies have given different recommendations about how to mitigate such problems, most suggestions and actions have been targeted at making the environment fit for MMS use (1-3, 6, 20, 34, 36, 41-43). While environmental modifications such as the creation of sidewalks, curb cuts, and ramps; widening of elevators; installation of automatic doors; and provision of accessible transportation have substantially improved MMS accessibility, amendments related to the widening of spaces may eventually become impractical if the size limit of MMSs remain unchecked. Thus, in line with recommendations made by Rutenberg et al. (43), findings from this study accentuate the need for regulation of the size of MMSs.

In addition to MMS size, other aspects of MMS design were found to have the tendency to indirectly limit the access of MMS users to certain environments and their ability to perform certain activities. For instance, the lack of suitable attachments on MMSs for walking aids means that MMS users who have some ability to walk with assistance are confined to their seats; thus, limiting their accessibility to environments that the MMS can fit into. Similarly, the lack of secure locking systems on MMSs means that MMS users who have some ability to walk independently, might not be able to leave their MMSs to access certain environments for fear that they would get stolen. Also, the reported experience of a MMS user about not being able to go for a walk when out on her MMS for fear of it getting stolen, supports findings from a recent
study by Thoreau (102) which revealed that older adult non-MMS users believed that MMSs do not provide opportunities for exercise.

Furthermore, these insights provide anecdotal evidence to support the findings of Zagol and Krasuski (1) about the tendency for long-term MMS use to increase cardiovascular risk. The study examined the cardiovascular data and physical activity of patients a year before and a year after MMS provision, and their results showed that MMS use reduced physical activity and increased cardiovascular risk factors. While the authors’ inferred that the diminished physical activity was due to overdependence on MMS use and lack of healthy activity levels, findings from this study implicates the lack of attachment points and secure locking system as possible root causes and physical inactivity as the resulting symptom. Overall, these activity- and accessibility-related challenges are interesting findings which suggest that MMS users who can walk or have low mobility needs and have generally been perceived as ideal client populations for MMSs, are likely to face fairly similar problems as MMS users with high mobility needs, just because of MMS design issues.

Consistent with previous studies (7, 40, 43, 44), technological issues were found to be directly and indirectly indicated in the accidents and near misses reported by some MMS users. Similar to findings of Kirby et al. (7) and Souza et al (44), the malfunction of MMSs was reported as suspected causes of accidents that MMS users experienced. While there is no systematic information on MMS accidents in Canada, Rutenberg et al (43) reported that in a study by Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP), 6 of the accidents from MMS use were from equipment failure. Also, accidental activation of the power switch or drive buttons resulting in freak accidents, have also been reported in other studies (40, 43). An
additional finding in the present study, however, was that anti-tip wheels were found to be ineffective in preventing the MMS from tipping backwards.

The inability to determine surfaces that were safe for the MMS to travel on was a unique finding in this study that has not been identified in literature. Particularly interesting was the case of a MMS user who knew in theory what the maximum slope that his MMS could handle was but found it hard to determine how that looked like in reality, especially when the slope of the travelling surface was drawn out. The participant’s recommendation for MMSs to have a slope detecting device was eloquently supported by his explanation of the fact that his MMS was supposed to serve as his legs; hence, the need for it to have the ability to sense how steep a slope is and relay that information to him so that he could make safe decisions. This underlines the importance of having a slope detecting feature built into MMSs, as MMS users typically have mobility challenges which may likely affect their proprioception.

An interesting conundrum that was identified regarding features of the MMS that had the tendency to constitute safety issues and influenced their usability was the relationship between size, speed and power. Having a MMSs in which power only comes with speed could easily constitute unsafe situations especially for new MMS users when negotiating speed uphill and downhill or uneven surfaces and smooth ones. In addition, as MMSs with these attributes are usually large in size, they also present accessibility limitations.

Similar to findings from the Rica (40) study, participants generally reported that MMSs were not hardy in inclement weather. However, this study also revealed that currently available accessories were ineffective as they did not keep the rain out; constituted a safety hazard because they usually got caught in the wind, and reduced MMS users’ visibility because they usually got...
fogged up. Hence, there is a need for more innovation to go into developing more effective coverings to protect both the MMS user and the MMS during inclement weather. Also, the burning out of electronics located at the base of the MMS by driving over a puddle of water accentuates the need for MMSs to be made more hardy.

Findings offered insights into the challenges associated with maintaining a MMS and the impact it had on MMS users. Similar findings about long wait times due to delays in approval of funds for repairs were reported in a US study by Reis et al. (104). In that same study, it was also reported that the onus of finding qualified personnel to repair or maintain the MMS was on clients and that the processes for approval could only begin when a “qualified and willing” repair technician is identified; which resonates with the findings of the present study. Also, Canadian studies which have assessed AT provision and funding programs have reported that initial and follow-up requests for funding from the government or other agencies typically require repetitive pre-approvals (107-108). All these processes could be particularly frustrating and overwhelming for MMS users to go through and would naturally be compounded by the reliability and durability issues that have been found to accompany MMS use.
4.4 Identifying solutions and barriers

Recommendations on enhancing MMS technology and the existing and potential barriers to implementing the suggested solutions were identified.

The existence of power wheelchairs as alternatives was believed to be a reason why more adjustability was not demanded for on MMSs. This notion seems to be reinforced in literature as certain strengths and limitations of each are sometimes portrayed as rigid dichotomies between their function (1-10). With power wheelchairs described as being typically for those with high mobility needs and MMSs as being for those with low mobility needs, those who fall somewhere within the middle of this spectrum tend to be overlooked. Examples could be people with low mobility needs but who could benefit from seating support or people who use both a power wheelchair and a MMS who may be deprived of seating support when using their MMSs.

While the limited adjustability of the MMS seat is generally cited as one of the main features that distinguish MMSs from power wheelchairs (5-6, 97) it was interesting to find that a Canadian manufactured MMS brand, which no longer existed, used to offer rehab seating; thus, indicating that MMSs can be built to have rehab seating on them. The fact that some MMS users in this study preferred to improvise other means to make their seats more comfortable rather than take advantage of the rehab seating that a power wheelchair could provide, accentuate the need for at least some MMSs to have rehab seating options to help serve such client populations.

The lack of regulations on MMS design was another key barrier that was identified. Interestingly, the regulation of features such as size, turning radius, speed, anchor points, and other safety features have been suggested in Canadian literature (43), but they seem to have
received little attention. Findings from the current study, however, also revealed that establishing regulations on some features may be a challenge. For instance, establishing regulations on MMS size may limit the size of batteries and motors that can fit into it, which will limit the performance of MMSs to the power those batteries and motors can supply. In turn, this will create durability and reliability problems which will invariably lead to the demand for bigger MMSs that larger batteries and motors can fit into; thus, ultimately rendering the regulations ineffective. To adequately address this issue, innovation regarding the design of powerful but compact batteries and motors for MMSs is needed.

While the reason given for the lack of advocacy by clinicians was that they were scarcely involved in most MMS purchases, another factor identified through analysis of the findings was that they were also not usually involved with the client after the MMS was purchased. This means that even if clients experienced issues with their MMS down the line, it will be unlikely for the clinician to be aware of them. In contrast, while vendors tend to be in more frequent contact with clients and have the potential to advocate those needs to manufacturers, there appears to be either no incentive or support to actively play that role.

The lack of demand for the recommended features, which is also closely related to lack of advocacy as well as lack of manufacturer awareness, were mentioned as reasons why MMS design had maintained their status quo. However, considering that some of the recommendations on enhancing MMS technology that were mentioned by participants in this study have been identified in literature (40, 43-44, 46, 103-104), this raises questions about effective channels that can be used to convey these demands to manufacturers.
In literature, users of AT have been described as having substantial spending power due to their constantly growing population (4, 66). As AT is not always affordable, it is important that users get good value for the money they spend and the primary way to achieve this is by getting them involved in the design process. The ability of an assistive device to “effectively and safely” compensate for both an individual’s disability and environmental barriers that may arise within the contexts of its use, has been described as one of the most valuable characteristics it can possess (65). Thus, paying a lot of attention to detail is essential in designing MMSs, as the MMS should be able to compensate for the MMS users’ disability and the barriers they face without creating new ones (65-66).
Chapter 5: Conclusion and future directions

5.1 Synopsis

In this concluding chapter I highlight the limitations of the study and recommendations for future research. The unique contributions that the findings of this study bring to both national and international discussions on MMS usability and safety issues are also presented.

5.2 Limitations

A limitation of this study is that it cannot aim to be transferable to dissimilar settings because of the peculiarity of the location in which it was conducted. This research was limited to eligible participants that resided in Vancouver or the Greater Vancouver Area of British Columbia (BC) which are urban environments that have milder weather in comparison to other regions of BC and Canada. As such, valuable experiences of stakeholders living in more rural-remote areas with harsher weather conditions (i.e., longer winters and heavy snow) might have been missed. Although some insight was gathered from vendors and clinicians who had some previous experience with providing service to clients in such environments, the personal experiences of MMS users living or who had lived in such environments were not captured.

Another limitation of this study was its small sample size, particularly for the vendor stakeholder group. However, by virtue of their job, which requires interaction with multiple clients, clinicians, and manufacturers, vendors were believed to possess a rich breadth and depth of experience to provide the information that was needed. Also, while participants from each stakeholder group were purposively selected via maximum variation sampling to acquire a diverse sample population that could help provide rich data, representative voices from
demographics within each group were not captured. However, the diversity of the sample population helped to strengthen the credibility of the study findings by allowing for data triangulation within participant groups and across them.

While the use of one-on-one interviews enhanced the in-depth exploration of the areas of study interest, employing the use of photovoice and participant observations might have helped in the creation of a more engaging documentation of the findings that reflect reality; thus, reinforcing the credibility of the research.

5.3 Future directions

More research is needed to determine the features of MMSs that currently do not work well, the essential features that are required by MMS users, and which ones can be left out as options. A nation-wide mixed methods study involving focus groups with diverse stakeholders and the use of surveys to capture a larger population of stakeholders could be utilized to gather these data. These data could be presented to relevant decision makers and industry to advocate for potential improvement. Overall, this information can help guide the establishment of regulations about features that a standard MMS should possess and can inform innovation with regards to the future design of MMS.

5.4 Conclusion

Distinct from previous MMS-related studies, this study presents a unique point of view into how the usability and safety of MMSs are influenced by technological factors, whilst preserving contextual insights. The guiding framework that was developed for the study facilitated the exploration of diverse contexts (e.g., social, environmental and industrial); thus, providing an in-
depth understanding of the different ways in which various aspects of MMS technology reinforce safety issues, accessibility barriers, and a ripple effect of other challenges.

The key challenges identified were the lack of reliability and durability of existing MMSs in the market, the inadequate design of physical features, and the lack of resources to ensure proper and timely maintenance of MMSs. These findings highlight the need for more innovation regarding MMS design and reveal that MMS safety and usability issues go beyond matters that can be resolved by regulation of use, user training, or environmental modification; as issues inherent to MMS design directly impact its own use.

This study suggests that MMS design regulation and enhancement could serve as complementary solutions to help improve the outcomes of current approaches that seek to address existing challenges with MMS use. While technological enhancements may not resolve all the problems associated with the use of MMSs, findings reveal that even little modifications in design can make considerable differences in improving the usability and safety of MMSs.
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presentation at the Canadian Association of Occupational Therapists National Conference 2018, Vancouver, BC.


Appendices

Appendix A  Description of the elements and components of the HAAT Model

The AT component consists of 5 elements.

a.  *Human/Technology Interface (HTI):* The HTI are the parts of the AT device that the user directly interacts with when using the device. The feedback given or received from this interaction could be audio (e.g., warning sounds), visual (e.g., displays on MMS control panel), or physical (e.g., using MMS controls and comfort of the seat).

b.  *Activity Output (AO):* The AO describes the type of assistance (e.g., the assistance provided by MMS is mobility) and the level of assistance (i.e., whether the AT augments function or totally replaces the individual’s lack of function) that an AT provides for activity performance.

c.  *Processor:* The Processor connects the HTI and the AO by translating the information and forces received from the human into signals that control the activity output (e.g., pressing the acceleration button should cause the MMS to move). This implies that proper functioning of an AT relies on the proper functioning of the processor.

d.  *Environmental Interface (EI):* The EI provides a link between the AT and the external environment. An example of this is when a rear-view camera is used on a mobility device. The rear-view camera is the EI which provides information about the AT in relation to the external environment and relays this information to a screen (i.e., the HTI) that the user can see. It enhances the use of mobility AT by augmenting a feature on the device or replacing a required physical action.

e.  *Soft Technology (ST):* ST refers to strategies that can directly facilitate operation of the AT by the user (e.g., an instruction manual, written prompts, training or education).
2. **The Context component** consists of 4 elements.
   
a. *Physical context:* This refers to elements of the natural environment (e.g., parks), built environment (e.g., buildings, sidewalks), weather conditions (e.g., rain, snow), transportation (i.e., public or private) and temperature (e.g., heat or cold) that the AT interacts with.
   
b. *Social context:* This refers to the social interactions or networks that are interconnected with the use of AT.
   
c. *Cultural context:* This refers to the beliefs, perceptions or experiences that are entwined with AT use.
   
d. *Industrial context:* This refers to the involvement of bureaucracies or individuals that are responsible for policy-making, decision-making, processes or procedures that are related to AT.

3. **The Activity component** consists of 3 elements:
   
a. *Daily living:* With respect to mobility devices, this refers to general day-to-day use of the AT for basic mobility.
   
b. *Work and productive activities:* This refers to the use of AT for a productive activity e.g., going to school or work using a mobility device.
   
c. *Play and leisure:* This refers to the use of AT to participate in leisure activities.

   A unique feature about the elements of the Activity component is that activities are defined by users’ interpretation of them (e.g., gardening might be considered as work for one person and leisure for another).

4. **The Human component** has 2 elements:
a. *Skill:* Skill refers to the level of proficiency the human has in performing a task. So, a person could be a novice (i.e., not being proficient or experienced with AT use), or expert (i.e., being proficient and experienced with AT use).

b. *Ability:* Ability refers to basic traits a user brings to a new task and this could be physical (e.g., strength, balance), cognitive (e.g., attention, judgement), or affective (e.g., emotional elements).
Appendix B  Recruitment Materials

B.1  Recruitment poster

Driving challenges faced by new users of motorized mobility scooters

Researchers from the University of British Columbia are looking for volunteers to participate in a study that seeks to examine the challenges associated with driving mobility scooters, and the strategies that can help improve users’ driving experience.

We are looking for:

✓ Scooter users who are at least 19 years of age, have at least 3 months of experience driving a three- or a four-wheel scooter; and who speak and understand English.

✓ Clinicians and vendors who are at least 25 years, have at least 2 years of experience in scooter-related services; and who speak and understand English.

What is involved?

- Participation in a 45-60-minute face or phone interview session. Face interviews will be held at GF Strong (4255 Laurel Street, Vancouver), Blusson Spinal Cord Centre (818 W 10th Avenue, Vancouver), or a location of your convenience.
- You will be asked to fill a demographic form prior to the interview session, to get some relevant information that will help contextualize the research findings. This would take a maximum of 15 minutes.
- During the interview, you will be asked questions about the challenges associated with scooter use and how such issues can be resolved.
- A couple of weeks after the interview, you will be given the opportunity to engage in a voluntary 15-minute telephone call to review findings and provide feedback to the researchers.

Participants will receive a $40 honorarium to acknowledge their contributions.

For more information, please contact [email_address]
B.2 Letter of contact for clinicians and vendors

Principal Investigator:

Co-Investigator(s):

Dear potential participant,

Re: Driving challenges faced by new users of motorized mobility scooters research project

You are receiving this letter because you have participated in a study at our lab before and agreed to be contacted about future research study participation. We are writing this letter to invite you to participate in a new research study. This research study is being conducted to determine which activities are difficult for new users of motorized mobility scooters (MMS), which contexts may make these activities challenging or unsafe, and which strategies can help users to complete these activities. You are being asked to take part in this study because you are a clinician or stakeholder that works with MMS users and:

1. Are at least 25 years of age;
2. Have at least two years of experience in services related to the allocation of or the use of MMS;
3. Speak and understand English.

The study will involve participating in a 45-60 minute interview at GF Strong (4255 Laurel St, Vancouver), Blusson Spinal Cord Centre (818 W 10th Ave, Vancouver), your home, or anywhere in the community that is convenient for you. Before the interview, a demographic form will be administered to help contextualize the information that would be subsequently obtained from the interview. During the 45-60 minute interview, you will be asked about what activities MMS users do that are difficult, what makes them difficult, and what could make them easier. After the data for the study has been collected, you will be given the opportunity to engage in a 15-minute telephone call to review findings and provide feedback to the researchers. This session is voluntary, and you can still take part in this study, even if you decide not to complete this session. You will be provided with a $40 stipend for your participation.

For more information about the study, or to arrange for your participation, contact

Alternatively, you may email us at

Sincerely,
B.3  Letter of contact for MMS users

Principal Investigator:
UBC. Tel:

Co-Investigator(s):

Dear potential participant,

Re: Driving challenges faced by new users of motorized mobility scooters research project

You are receiving this letter because you have participated in a study at our lab before and agreed to be contacted about future research study participation. We are writing this letter to invite you to participate in a new research study. This research study is being conducted to determine which activities are difficult for new users of motorized mobility scooters (MMS), which contexts may make these activities challenging or unsafe, and which strategies can help users to complete these activities.

You are being asked to take part in this study because you are a MMS user and:
1. Are at least 19 years of age;
2. Have at least 3 months of experience driving a three- or a four-wheel scooter;
3. Speak and understand English.

The study will involve participating in a 30-60 minute interview at GF Strong (4255 Laurel St, Vancouver), Blusson Spinal Cord Centre (318 W 10th Ave, Vancouver), your home, or anywhere in the community that is convenient for you. Prior to the interview, you will be asked some questions about your memory. You will also be asked to complete a demographic form. During the interview, you will be asked what activities you do that are difficult, what makes them difficult, and what could make them easier. After the data for the study has been collected, you will be given the opportunity to engage in a 15-minute telephone call to review findings and provide feedback to the researchers. This session is voluntary, and you can still take part in this study, even if you decide not to complete this session.

For more information about the study, or to arrange for your participation, contact:

Sincerely,
Mini-Mental State Examination (MMSE)

Participant ID: ________________________________ Date: __________

Instructions: Score one point for each correct response within each question or activity.

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<th>Maximum Score</th>
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<td>5</td>
<td></td>
<td>&quot;Where are we now? State? County? Town/city? Hospital? Floor?&quot;</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>The examiner names three unrelated objects clearly and slowly, then the instructor asks the patient to name all three of them. The patient’s response is used for scoring. The examiner repeats them until patient learns all of them, if possible.</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>&quot;I would like you to count backward from 100 by sevens. (93, 86, 79, 72, 65, ...) Alternative: &quot;Spell WORLD backwards.&quot; (O-L-R-D-W)</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>&quot;Earlier I told you the names of three things. Can you tell me what those were?&quot;</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Show the patient two simple objects, such as a wristwatch and a pencil, and ask the patient to name them.</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>&quot;Repeat the phrase: &quot;No ifs, ands, or buts.&quot;&quot;</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>&quot;Take the paper in your right hand, fold it in half, and put it on the floor.&quot; (The examiner gives the patient a piece of blank paper.)</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>&quot;Please read this and do what it says.&quot; (Written instruction is &quot;Close your eyes.&quot;).&quot;</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>&quot;Make up and write a sentence about anything.&quot; (This sentence must contain a noun and a verb.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&quot;Please copy this picture.&quot; (The examiner gives the patient a blank piece of paper and asks him/her to draw the symbol below. All 10 angles must be present and two must intersect.)</td>
</tr>
</tbody>
</table>

30 TOTAL
**Interpretation of the MMSE:**

<table>
<thead>
<tr>
<th>Method</th>
<th>Score</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Cutoff</td>
<td>&lt;24</td>
<td>Abnormal</td>
</tr>
<tr>
<td>Range</td>
<td>&lt;21</td>
<td>Increased odds of dementia</td>
</tr>
<tr>
<td></td>
<td>&gt;25</td>
<td>Decreased odds of dementia</td>
</tr>
<tr>
<td>Education</td>
<td>21</td>
<td>Abnormal for 8th grade education</td>
</tr>
<tr>
<td></td>
<td>&lt;23</td>
<td>Abnormal for high school education</td>
</tr>
<tr>
<td></td>
<td>&lt;24</td>
<td>Abnormal for college education</td>
</tr>
<tr>
<td>Severity</td>
<td>24-30</td>
<td>No cognitive impairment</td>
</tr>
<tr>
<td></td>
<td>18-23</td>
<td>Mild cognitive impairment</td>
</tr>
<tr>
<td></td>
<td>0-17</td>
<td>Severe cognitive impairment</td>
</tr>
</tbody>
</table>

**Interpretation of MMSE Scores:**

<table>
<thead>
<tr>
<th>Score</th>
<th>Degree of Impairment</th>
<th>Formal Psychometric Assessment</th>
<th>Day-to-Day Functioning</th>
</tr>
</thead>
<tbody>
<tr>
<td>25-30</td>
<td>Questionably significant</td>
<td>If clinical signs of cognitive impairment are present, formal assessment of cognition may be valuable.</td>
<td>May have clinically significant but mild deficits. Likely to affect only most demanding activities of daily living.</td>
</tr>
<tr>
<td>20-25</td>
<td>Mild</td>
<td>Formal assessment may be helpful to better determine pattern and extent of deficits.</td>
<td>Significant effect. May require some supervision, support and assistance.</td>
</tr>
<tr>
<td>10-20</td>
<td>Moderate</td>
<td>Formal assessment may be helpful if there are specific clinical indications.</td>
<td>Clear impairment. May require 24-hour supervision.</td>
</tr>
<tr>
<td>0-10</td>
<td>Severe</td>
<td>Patient not likely to be testable.</td>
<td>Marked impairment. Likely to require 24-hour supervision and assistance with ADL.</td>
</tr>
</tbody>
</table>

**Source:**

C.2 Interview guide

INTERVIEW QUESTIONS : CLINICIANS

1. What are the difficulties or challenges that scooter users face when driving their scooters?
   • More specifically, what tasks do scooter users find hard to accomplish:
     a. Around the house?
     b. Outside (e.g. on sidewalks)?
     c. On public or private transportation
     d. In smaller/more restricted public spaces (shops, restaurants, elevators, toilets etc.)?
     e. In large public spaces (mall, community center, hospital, etc.)?
     f. In an urban city like Vancouver, or a more rural setting?
     g. In the snow or rain?
   • What daily activities are the most challenging for them to perform?
   • What environments or situations do scooter users tend to avoid? Why?
   • What activities or tasks do new users find particularly challenging?
   • Generally, what attributes of a scooter makes its use challenging or difficult?

2. Looking back at the tasks and activities you have just described, which ones would you describe as being unsafe? What activities or tasks do new users perform in an unsafe manner?

Now I would like to ask a few questions about the assessment and prescription of scooters.

3. What criteria do you consider when prescribing scooters for clients (expert and new)?
   • What groups of clients would you recommend a scooter to and why?
   • Do you sometimes refuse to recommend a scooter? Why and how often does this happen?
   • Do certain clients or groups of clients have more difficulties using a scooter than others? Why?
   • What key attributes do you look for in scooters when prescribing them? Why are they important?
   • Are there differences between what you think is important and what the client thinks is important? Why are those attributes important to them?

4. What are your thoughts about 3-wheeled versus 4-wheeled scooters?
   a. What considerations do you make when prescribing each of these?
   b. What challenges are specific to 3-wheeled users? What about 4-wheeled users?
      Follow-up questions to (b)
      - What activity barriers are associated with using 3- and 4-wheeled scooters, respectively?
- What environments favor or impede the use of 3- and 4-wheeled scooters, respectively?
- What safety challenges are associated with the use of 3- and 4-wheeled scooters, respectively?

These last set of questions are generally about scooter technology.

5. Just like power wheelchairs require adjustments to make them fit user’s needs, in your experience what adjustments are required in scooters?
   - What adjustments do you make to enhance comfort?
   - What adjustments do you make to enhance their drivability?
   - What adjustments do you make for safety reasons?

6. In your experience, what kinds of maintenance issues do scooters usually have?
7. Which scooter models are particularly problematic and what problems do they have?

8. What attributes do scooters currently lack that you think they should all possess?
   - Why are those attributes important?
   - What factors affect the availability of scooters with these attributes?

9. How do you think scooters can be modified to enhance:
   a. Safety for users?
   b. Safety in relation to pedestrians or other road users?
   c. Their drivability for new and expert users?
   d. Their use for different activities and in different environmental contexts?
   e. Their use by diverse user populations?

10. In a nutshell, how would you describe an ideal scooter?

INTERVIEW QUESTIONS: SCOOTER USERS

1. Please tell me about your experience with using your scooter. What works well for you and what doesn’t?
   - More specifically, what challenges do you experience when using your scooter:
     a. Around the house?
     b. Outside (e.g. on sidewalks)?
     c. On public or private transportation
     d. In smaller/more restricted public spaces (shops, restaurants, elevators, toilets etc.)?
     e. In large public spaces (mall, community center, hospital, etc.)?
f. In an urban city like Vancouver, or a more rural setting?
g. In the snow or rain?
• What challenges do you experience on a daily basis?
• What activities have you stopped because of issues you encountered when driving your scooter?
• What environments or situations do you tend to avoid? Why?
• As a new user, what activities or tasks did you find particularly challenging?
• What are the attributes of your scooter that makes its use challenging or difficult (in reference to your current and previous scooters)?

2. What safety concerns do you have about your scooter?
• Have you ever experienced an accident or near accident? What happened?
  - Were any of them caused by issues related to your scooter?
  - Do you think any of them could have been avoided if your scooter was designed differently? Please explain how.

3. When thinking about the future, do you worry about your scooter or your ability to keep driving it?
• If your health condition were to change, could this affect your ability to drive your scooter?
  - What makes you think so/not think so?
• What would make the scooter unfit or unsafe for use if these life changes were to occur?
  - What modifications in design could be made to help you maintain its use longer?

The next set of questions are about the acquisition of your scooter.

4. Why did you choose to get a scooter?
  - What was your mobility challenge?

5. What key attributes did you look for when you were searching for a scooter?
• Why were those attributes important?
• Were you able to find the exact kind of scooter you wanted?
• If no:
  - What compromises did you have to make?
  - What limited its availability?

6. Was a clinician involved during your scooter acquisition process?
• If yes, were there differences between what you wanted and what the clinician thought was important with regards to scooter design?
  - What were those differences?
  - Why were those attributes important to the clinician?

The last set of questions are generally about scooter technology.

7. What do you like about your scooter? What don’t you like about it?
• How satisfied are you with the comfort of your scooter (e.g. seats, armrest, backrest, shock absorption etc.)?
• Do you have any issues with the battery display (i.e., visibility and reliability of information)?
• What do you think about the horn, backing alarm (i.e., in terms of usefulness, loudness and type of sound)?
• Are you comfortable with operating the controls (e.g., switches and buttons, tiller, brakes, speed control, etc.) of your scooter?
• What modification have you made to it (in terms of accessories or parts)?

8. Did your scooter come with any written instructions?
• How useful did you find that information?
• What kind of information would you have liked to see in it?

9. What are your thoughts about 3- and 4-wheeled scooters respectively (e.g., in terms of safety, activities it can be used for, environments it can be used in)?
  - Which one do you prefer?
  - Why?

10. Are there scooter models that are known to be problematic?
  - What problems do these scooters have?

11. What attributes do scooters currently lack that you think they should all possess?
  - Why are those attributes important?
  - What factors affect the availability of scooters with these attributes?

12. In a nutshell how would you describe an ideal scooter?
INTERVIEW QUESTIONS: VENDORS

1. What are the difficulties or challenges that scooter users have with scooter technology/design?
   • More specifically, which ones pertain to:
     a. Indoor use
     b. Outdoor use (e.g. on sidewalks)
     c. The use of public or private transportation
     d. Use in an urban city like Vancouver, or a more rural setting?
     e. Use under different weather conditions (e.g., snow or rain)?

2. In your opinion:
   • What environments do scooters work best in?
   • What environments do they work worst in?

3. Generally, what are the attributes of a scooter that most users complain about?

Now I would like to ask a few questions about the criteria you consider prior to selling scooters.

4. What key attributes do you look out for in scooters before stocking them? Why are they important?

5. What criteria do you consider before selling a scooter to a potential user?
   • What groups of clients would you not sell a scooter to? Why?
   • Have you ever refused to sell a scooter to a user? Why and how often does this happen?

6. What key attributes do users look out for in scooters? Why are those attributes important to them?
   • With regards to scooter design, are there differences between what you think is important and:
     • What the user thinks is important?
     • What the clinician thinks is important?

7. What are your thoughts about 3-wheeled versus 4-wheeled scooters?

These last set of questions will be about scooter technology.

8. Just like power wheelchairs require adjustments or modifications to make them fit user’s needs, in your experience, what modifications or adjustments are usually required in scooters?
   More specifically, what adjustments are made:
   • To enhance comfort?
9. In your experience, what kinds of maintenance issues do scooters usually have?
   • Which scooter models are particularly problematic and what problems do they have?

10. Do all scooters come with written instructions or a manual?
   • Do you refer users to read the manual before using the scooter?
   • In your opinion, does the manual provide sufficient information about how the scooter should be used?
   • What kind of information do you deem important, that isn’t in the manual?

11. What attributes do scooters currently lack that you think they should all possess? Why are those attributes important?
   • What factors affect the availability of scooters with these attributes?
   • How do you think scooters can be modified to enhance:
     - safety (for user, pedestrians, and other road users)?
     - it’s drivability for new and expert users
     - it’s use for different activities and in different environmental contexts
     - it’s use by different user populations

12. In a nutshell, how would you describe an ideal scooter?
C.3 Demographic forms

MMS user Demographic Form  Participant ID: ______________

The questions in this form are asked to provide a detailed description of participants’ characteristics. This information will complement the data obtained from the interviews and will promote a more comprehensive research analyses. All the information obtained will be kept confidential.

Instructions: Please provide a response for the following questions or check the boxes that apply:

1. Where do you live (town/city)? ______________________
2. What is your age? __________
3. What is your sex? Female ☐ Male ☐ Prefer not to answer ☐
4. What is your marital status?
   Married or common law relationship ☐ Single ☐ other: ______________
5. What is the highest level of education that you have attained? __________________
6. What is your employment status?
   Employed ☐ Volunteer ☐ Retired ☐ Student ☐ Other: ______________
7. What is your annual income (or combined annual income if you have a spouse)?
   Less than $10,000 ☐ $10,000 to $19,000 ☐ $20,001 to $29,000 ☐
   $30,000 to $39,000 ☐ $40,000 to $49,000 ☐ Greater than $50,000 ☐
8. What primary diagnosis accounts for your scooter use?
   ____________________________________________
9. How was your scooter funded?
   ____________________________________________
10. How much experience do you have using scooters?  
________________________________________

11. Where do you reside?  
A care home☐ An assisted living facility☐ Apartment☐ Town home☐  
Other: ___________________________  

12. What type of scooter do you use? 3-wheeled scooter☐ 4-wheeled scooters☐ Both ☐  

13. How many scooters do you have? _________  

14. What brand(s) of scooter do you currently use?  
______________________________________________________  

15. Is your scooter your main means of mobility? ☐ Yes☐ No☐  
If no, what other mobility assistive device(s) do you use?  
__________________________________________________________  

16. Where do you currently use your scooter? (Please check all that apply)  
☐ Home  
☐ Work/Volunteer activities  
☐ School  
☐ Community  
☐ Recreation or Sports  
☐ Hospital/Health Care Facility  
☐ Other: ________________________________________________________
Clinician Demographic Form

Participant ID: __________

The questions in this form are asked to provide a detailed description of participants’ characteristics. This information will complement the data obtained from the interviews and will promote a more comprehensive research analysis. All the information obtained will be kept confidential.

Instructions: Please provide a response for following questions:

1. Where do you work (town/city)? ______________________

2. What is your professional designation? ______________

3. What is your age? __________

4. What is your sex? Female ☐ Male ☐ Prefer not to say ☐

5. What practice setting do you currently work in?

   Residential ☐ Acute ☐ Rehabilitation ☐ Community ☐

   Other: __________________________

6. What practice settings have you previously worked in? Please tick all that may apply.

   Residential ☐ Acute ☐ Rehabilitation ☐ Community ☐

   Other: __________________________

7. How many years of clinical experience do you have?

   1-5 years ☐ 6-10 years ☐ 11-20 years ☐ Over 20 years ☐

8. For how long have you been prescribing scooters? ____________

9. On average, how many scooters do you prescribe annually? ________________

10. What client populations have you prescribed scooters to:

    - Based on age group?

      Below 13 years ☐ 13-18 years ☐ 19-35 years ☐ 36-59 years ☐ 60+ ☐
- Based on diagnosis? Please list below

________________________________________________________________

11. What is the highest level of education that you have attained? ________________
Vendor Data Information Form

The questions in this form are asked to provide a detailed description of participants’ characteristics. This information will complement the data obtained from the interviews and will promote a more comprehensive research analysis. All the information obtained will be kept confidential.

Instructions: Please provide a response for the following questions or check the boxes that apply:

1. What town is your store located in? ______________________

2. What is your age? __________

3. What is your sex?
   Female ☐     Male ☐

4. What is your professional designation and role?
   __________________________________________

5. On average, how many scooters do you sell in a year? ________________

6. For how long have you been selling scooters?
   __________________________________________

7. Based on age, what user groups have you sold scooters to?
   Below 13 years ☐ 13-18 years ☐ 19-35 years ☐ 36-59 years ☐ 60+ ☐

8. What brands of scooters do you currently sell?
   __________________________________________

9. What type of scooter do most users demand for (or prefer)? 3-Wheeled Scooter ☐ 4-Wheeled Scooter ☐ No preference ☐

10. What are the most common maintenance issues that scooters have?
    __________________________________________

11. What are the most common accessories that users demand for?
    __________________________________________
Appendix D  Information and consent forms

D.1  Clinician and vendor consent form

Information and Consent Form – Clinicians/Stakeholders:
Driving challenges faced by new users of motorized mobility scooters

Principal Investigator:  

Funding:
AGE-WELL (Canada Networks of Centers of Excellence)

Purpose:
Many people use motorized mobility scooters (MMS), but driving a MMS is not without risk or injury and/or accident. The purpose of this study is to determine which activities are difficult for new users, which contexts may make these activities challenging or unsafe, and which strategies can help users to complete these activities. You are being asked to take part in this study because you are a clinician or stakeholder that works with MMS users and:

1. Are at least 25 years of age;
2. Have at least two years of experience in services related to the allocation of or the use of MMS;
3. Speak and understand English.

Study Procedures:
Prior to the study session, you will be provided with a letter of introduction and consent form to review. On the day of the session, you will meet with the researchers to collect your consent form, and the researchers will answer any questions you may have. The session will take place at GF Strong (4255 Laurel St, Vancouver), Blusson Spinal Cord Centre (818 W 10th Ave, Vancouver), your home, or anywhere in the community that is convenient for you. Prior to the interview, you will be asked to complete a demographic form asking questions about your professional background and experience. This information will help contextualize the subsequent data that will be obtained from the interview. Review of the consent form and completion of the demographic form will not exceed 15 minutes. During the 45-60 minute interview, you will be asked about what activities MMS users do that are difficult, what makes them difficult, and what could make them easier. A voice recorder will record the interview in order to ensure accuracy of our transcription. After the data for the study has been collected, you will be given the opportunity to engage in a 15-minute telephone call to review findings and provide feedback to the researchers. This session is voluntary, and you can still take part in this study, even if you decide not to complete this session. You can stop participating in the study at any time. The researchers will provide a brief final written summary of the results to interested study participants.
Potential Risks:
There are low risk involved in participating in the study. You will be asked a series of semi-structured questions, some of which could make you feel slightly uncomfortable. You are not obligated to answer any questions that you feel uncomfortable answering and may pass on any question that makes them feel uncomfortable.

Potential Benefits:
There are no direct advantages for your participation in this study. Results from this study, however, will contribute to the creation of knowledge, specifically in rehabilitation.

Remuneration:
You will be provided with a $40 stipend for participating in this study. If your session is held at GF Strong, your parking costs will be paid for.

Confidentiality:
You will be assigned a unique study number as a subject in this study. Only this number will be used on any research-related information collected about you during the course of this study, so that your identity [i.e., your name or any other information that could identify you] as a subject in this study will be kept confidential. Information that contains your identity will remain only with the Principal Investigator and/or designate. The list that matches your name to the unique study number that is used on your research-related information will not be removed or released without your consent unless required by law.

Signing this consent form in no way limits your legal rights against the sponsor, investigators, or anyone else, and you do not release the study investigators or participating institutions from their legal and professional responsibilities.

Contact for information about the study:
If you have any questions or want further information about this study, you may contact the principal investigator.

Contact for concerns about the rights of research subjects:
If you have any concerns or complaints about your rights as a research participant and/or your experiences while participating in this study, contact the Research Participant Complaint Line in the UBC Office of Research Ethics at 604-822-8598 or if long distance e-mail RSIL@ors.ubc.ca or call toll free 1-877-822-8598.

Disclosure Regarding Rights of Subject to Withdraw from the Research
Your decision to take part in this study is voluntary. You may refuse to participate or you may withdraw from the study at any time. You are not waiving any of your legal rights by signing this consent form nor releasing the investigators from their legal and professional responsibilities.

Driving challenges faced by new users of motorized mobility scooters:
- I have read and understood the information and consent form.
- I have had sufficient time to consider the information provided and to ask for advice if necessary.

Version 4: March 7, 2018
• I have had the opportunity to ask questions and have had satisfactory responses to my questions.
• I understand that all of the information collected will be kept confidential and that the result will only be used for scientific objectives.
• I understand that my participation in this study is voluntary and that I am completely free to refuse to participate or to withdraw from this study at any time without changing in any way the quality of care that I receive.
• I understand that I am not waiving any of my legal rights as a result of signing this consent form.
• I understand that there is no guarantee that this study will provide any benefits to me
• I have read this form and I freely consent to participate in this study.
• I have been told that I will receive a dated and signed copy of this form.
• I consent to participate to be audio recorded. I have signed the attached Consent for Audio Recording form.

I will receive a signed copy of this consent form for my own records.
I consent to participate in this study.

Subject’s Signature ___________________ Printed name ___________________ Date __________

Signature of ___________________ Printed name ___________________ Study Role ___________________ Date __________
Person Obtaining Consent

Please provide your contact information for this study:
First Name: ___________________ Last Name: ___________________
Mailing Address: ____________________________________________________________
City: ___________________ Province: ___________________ Postal Code: ___________________
Telephone: (_________)
Mobile Phone: (_________) __________________________
Email: __________________________

Future research studies:
• Yes, I would like to be contacted for future studies.
If you check “YES”, we may contact you in the future for participating in another study, at that time, you will be asked to sign another consent form specific to that study.

Are you interested in receiving results from this study?

Version 4: March 7, 2018
• Yes, I would like to be contacted regarding the study results.

Consent for Audio Recording:

Name:

I hereby authorize University of British Columbia to take:

Sound Recordings:

This information / material may be used for the purpose(s) of:

(Please initial selections)

_____ Research
_____ Teaching/ medical / client education, & health promotion

I relieve and hereby agree to hold University of British Columbia free and harmless from any and all liability arising from the media activity and its subsequent use (publishing, broadcasting, internet use etc.). I acknowledge that the activity is carried out with my consent to University of British Columbia and without payment to my family or myself.

Restrictions for Use:

SIGNED at Vancouver, BC this _____ day of ___________ 20__.  

<table>
<thead>
<tr>
<th>Signature of Model:</th>
<th>Signature of Witness:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Printed Name of Witness:</td>
</tr>
</tbody>
</table>
D.2 MMS user consent form

Information and Consent Form - MMS Users:
Driving challenges faced by new users of motorized mobility scooters

Principal Investigator:

Funding:
AGE-WELL (Canada Networks of Centers of Excellence)

Purpose:
Many people use motorized mobility scooters (MMS), but driving a MMS is not without risk or injury and/or accident. The purpose of this study is to determine which activities are difficult for new users, which contexts may make these activities challenging or unsafe, and which strategies can help users to complete these activities. You are being asked to take part in this study because you are a MMS user and:

1. Are at least 19 years of age;
2. Have at least 3 months of experience driving a three- or a four-wheel scooter;
3. Speak and understand English.

Study Procedures:
Prior to the study session, you will be provided with a letter of introduction and consent form to review. On the day of the session, you will meet with the researchers to collect your consent form, and the researchers will answer any questions you may have. The session will take place at GF Strong (4255 Laurel St, Vancouver), Blusson Spinal Cord Centre (818 W 10th Ave, Vancouver), your home, or anywhere in the community that is convenient for you. Before the interview, you will be asked some questions about your memory which will take up to 15 minutes. After this, you will be asked to complete a demographic form asking questions about your background and the history of your scooter use. These questions are being asked to help contextualize the subsequent data that will be obtained from the interview. Review of the consent form and completion of the demographic form will not exceed 15 minutes. During the 30-60 minute interview, you will be asked about what activities MMS users do that are difficult, what makes them difficult, and what could make them easier. A voice recorder will record the interview in order to ensure accuracy of our transcription. After the data for the study has been collected, you will be given the opportunity to engage in a 15-minute telephone call to review findings and provide feedback to the researchers. This session is voluntary, and you can still take part in this study, even if you decide not to complete this session. You can stop participating in the study at any time. The researchers will provide a brief final written summary of the results to interested study participants.

Version 3: January 11, 2018

1 of 4
Potential Risks:
There are low risk involved in participating in the study. You will be asked a series of semi-structured questions, some of which could make you feel slightly uncomfortable. You are not obligated to answer any questions that you feel uncomfortable answering and may pass on any question that makes them feel uncomfortable.

Potential Benefits:
There are no direct advantages for your participation in this study. Results from this study, however, will contribute to the creation of knowledge, specifically in rehabilitation.

Remuneration:
You will be provided with a $40 stipend for participating in this study. If your session is held at GF Strong, your parking costs will be paid for.

Confidentiality:
You will be assigned a unique study number as a subject in this study. Only this number will be used on any research-related information collected about you during the course of this study, so that your identity [i.e., your name or any other information that could identify you] as a subject in this study will be kept confidential. Information that contains your identity will remain only with the Principal Investigator and/or designate. The list that matches your name to the unique study number that is used on your research-related information will not be removed or released without your consent unless required by law.

Signing this consent form in no way limits your legal rights against the sponsor, investigators, or anyone else, and you do not release the study investigators or participating institutions from their legal and professional responsibilities.

Contact for information about the study:
If you have any questions or want further information about this study, you may contact the principal investigator,

Contact for concerns about the rights of research subjects:
If you have any concerns or complaints about your rights as a research participant and/or your experiences while participating in this study, contact the Research Participant Complaint Line in the UBC Office of Research Ethics at 604-822-8598 or if long distance e-mail RSIL@ors.ubc.ca or call toll free 1-877-822-8598.

Disclosure Regarding Rights of Subject to Withdraw from the Research
Your decision to take part in this study is voluntary. You may refuse to participate or you may withdraw from the study at any time. You are not waiving any of your legal rights by signing this consent form nor releasing the investigators from their legal and professional responsibilities.

Driving challenges faced by new users of motorized mobility scooters:
- I have read and understood the information and consent form.
- I have had sufficient time to consider the information provided and to ask for advice if necessary.
- I have had the opportunity to ask questions and have had satisfactory responses to my questions.
- I understand that all of the information collected will be kept confidential and that the result will only be used for scientific objectives.
- I understand that my participation in this study is voluntary and that I am completely free to refuse to participate or to withdraw from this study at any time without changing in any way the quality of care that I receive.
- I understand that I am not waiving any of my legal rights as a result of signing this consent form.
- I understand that there is no guarantee that this study will provide any benefits to me.
- I have read this form and I freely consent to participate in this study.
- I have been told that I will receive a dated and signed copy of this form.
- I consent to participate to be audio recorded. I have signed the attached Consent for Audio Recording form.

I will receive a signed copy of this consent form for my own records.
I consent to participate in this study.

Subject’s Signature __________________________  Printed name __________________________  Date __________

Signature of Person Obtaining Consent __________________________  Printed name __________________________  Study Role __________________________  Date __________

Please provide your contact information for this study:

First Name:_______________________  Last Name:_______________________

Mailing Address:________________________________________

City:______________ Province:__________ Postal Code:__________

Telephone: ( )________________________

Mobile Phone: ( )________________________

Email:________________________________

Future research studies:
- Yes, I would like to be contacted for future studies. ________________
If you check "YES", we may contact you in the future for participating in another study, at that time, you will be asked to sign another consent form specific to that study.
Are you interested in receiving results from this study?

- Yes, I would like to be contacted regarding the study results.

**Consent for Audio Recording:**

Name: ________________________________

I hereby authorize University of British Columbia to take:

Sound Recordings: __________

This information / material may be used for the purpose(s) of:

(Please initial selections)

_____ Research

_____ Teaching / medical / client education, & health promotion

I relieve and hereby agree to hold University of British Columbia free and harmless from any and all liability arising from the media activity and its subsequent use (publishing, broadcasting, internet use etc.). I acknowledge that the activity is carried out with my consent to University of British Columbia and without payment to my family or myself.

Restrictions for Use: ________________________________________________

SIGNED at Vancouver, BC this _____ day of ____________ 20__. 

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Appendix E  Infographic for member checking

**Scooter Usability Challenges:**
A Summary of the Resulting Themes and Subthemes

- **Finding the right fit**
  - Choosing to procure a scooter
  - Selecting design features
  - Making adaptations
  - Dilemmas regarding scooter types

- **Negotiating everyday challenges**
  - Facing accessibility challenges
  - Navigating roads and sidewalks
  - Predisposing factors to accidents
  - Being out in bad weather

- **Appraising scooter technology**
  - Impressions concerning brands
  - Enhancing scooter usability
  - Barriers to improving technology

**Definition of subthemes**

**Finding the right fit**
- Choosing to procure a scooter
  - Reasons users choose to procure scooters and the assessments that inform the decisions of service providers to recommend or refrain from recommending scooters to clients.
- Selecting design features
  - Aspects of scooter design that are considered to be of utmost importance when procuring scooters and the compromises that are made when certain features are not available.
- Making adaptations
  - Modifications or adjustments made to scooters to accommodate the needs of users.
- Dilemmas regarding scooter types
  - Conundrums surrounding the use of 3-wheeled, 4-wheeled, or close-coupled scooters.

**Negotiating everyday challenges**
- Facing accessibility challenges
  - Influence of scooter design on accessibility challenges experienced.
- Navigating roads and sidewalks
  - Challenges with sharing roads and sidewalks with other users and navigating different kinds of terrains.
- Predisposing factors to accidents
  - Scooter accidents witnessed or experienced and aspects of scooter design that influence their occurrence.
- Maintaining the scooter
  - Scooter maintenance issues encountered and challenges associated with resolving them.
- Being out in bad weather
  - Challenges with using scooters under inclement weather conditions.

**Appraising scooter technology**
- Impressions concerning brands
  - Perceptions about the dependability and reliability of scooter brands.
- Enhancing scooter usability
  - Perceptions about the overall usability of scooters and suggestions on enhancing usability.
- Barriers to improving technology
  - The current or potential barriers to implementing the suggested solutions on enhancing scooter usability.