

**IDENTIFYING AWARENESS AND KNOWLEDGE SOURCES FOR MOBILITY  
ASSISTIVE TECHNOLOGY AMONG PEOPLE WITH DISABILITIES IN SAUDI  
ARABIA**

by

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Submitted to the Graduate Faculty of the  
School of Health and Rehabilitation Sciences in partial fulfillment  
of the requirements for the degree of  
Doctor of Philosophy

University of Pittsburgh

2022

UNIVERSITY OF PITTSBURGH  
SCHOOL OF HEALTH AND REHABILITATION SCIENCES

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# **IDENTIFYING AWARENESS AND KNOWLEDGE SOURCES FOR MOBILITY ASSISTIVE TECHNOLOGY AMONG PEOPLE WITH DISABILITIES IN SAUDI ARABIA**

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University of Pittsburgh, 2022

Lack of knowledge and awareness about mobility assistive technology (MAT) devices and services available to MAT users, family members, and caregivers remains a global challenge and a barrier to accessing appropriate MAT devices. Thus, understanding the gaps in knowledge and awareness about available technologies, emerging technologies, clinical skills, delivery provision process, and laws and standards is a critical step toward accessing appropriate MAT devices and informing future development and dissemination strategies. This dissertation extends the available information on this topic. It aims to understand the demand for MAT at a global level, particularly in Saudi Arabia. Thus, the English survey used in a previous U.S. pilot study was translated into Arabic and culturally adapted for MAT users within Saudi Arabia to address the gaps in knowledge, training, and emerging technology about MAT and to identify consumer preferences regarding information sources. Two cross-sectional studies were conducted. One cross-sectional study followed Beaton's guidelines for translating and performing cultural adaptation by assessing the adapted version and its face validity to ensure that its contents are equivalent to the original version, and then addressing the ensuring issues relating to wording, clarity, and relevance to aid cultural understanding. After the modification and preparation of the final version of the Arabic survey, a second cross-sectional study was conducted on a large group of Saudi MAT users to empirically assess the level of knowledge on skill training, emerging technology perceptions, and preferred information sources among MAT users in Saudi Arabia. The survey findings revealed

some gaps in knowledge among Saudi MAT consumers with respect to clinical skills and emerging technologies, suggesting the need for further research in this area. The survey results also indicated that healthcare providers, the internet, social media, and family and friends using MAT (i.e., via word-of-mouth) were the resources that the participants most frequently used for finding information about MAT. The results of this dissertation build on the existing literature, and they can help inform researchers, clinicians, and other stakeholders to increase their knowledge and awareness about MAT, thereby enhancing dissemination and knowledge translation efforts in Saudi Arabia and probably other countries.

## TABLE OF CONTENTS

<b>ACKNOWLEDGMENTS .....</b>	<b>xii</b>
<b>1.0 INTRODUCTION.....</b>	<b>1</b>
<b>1.1 RATIONALE AND SIGNIFICANCE OF THE PROBLEM .....</b>	<b>2</b>
<b>1.2 RESEARCH OBJECTIVES.....</b>	<b>4</b>
<b>2.0 STAKEHOLDER PERSPECTIVES ON RESEARCH AND DEVELOPMENT</b>	
<b>PRIORITIES FOR MOBILITY ASSISTIVE TECHNOLOGY: A</b>	
<b>LITERATURE REVIEW .....</b>	<b>7</b>
<b>2.1 INTRODUCTION .....</b>	<b>7</b>
<b>2.2 METHODS.....</b>	<b>14</b>
<b>2.2.1 Search Strategy .....</b>	<b>14</b>
<b>2.2.2 Inclusion and Exclusion Criteria .....</b>	<b>14</b>
<b>2.3 RESULTS.....</b>	<b>16</b>
<b>2.3.1 Study Selection .....</b>	<b>16</b>
<b>2.3.2 Study Characteristics.....</b>	<b>17</b>
<b>2.4 DISCUSSION.....</b>	<b>18</b>
<b>2.4.1 Priorities and Needs of Mobility-Assistive Technology .....</b>	<b>18</b>
<b>2.4.2 Priority Research Areas of Mobility-Assistive Technology .....</b>	<b>24</b>
<b>2.4.3 Mobility Technology Service Delivery .....</b>	<b>29</b>
<b>2.4.4 Barriers and Facilitators Encountered by Mobility Technology Users .....</b>	<b>30</b>
<b>2.5 LIMITATION.....</b>	<b>33</b>
<b>2.6 CONCLUSION .....</b>	<b>34</b>

<b>3.0 CURRENT STATE AND CONCEPTUAL FRAMEWORK OF ASSISTIVE TECHNOLOGY PROVISION IN SAUDI ARABIA .....</b>	<b>36</b>
<b>3.1 INTRODUCTION .....</b>	<b>36</b>
<b>3.2 SERVICE DELIVERY MODELS MULTIDICIPLINARY MODELS.....</b>	<b>39</b>
<b>3.3 THE POLICY, HUMAN, ACTIVITY, ASSISTANCE, TECHNOLOGY, AND ENVIRONMENT (PHAATE) MODEL.....</b>	<b>40</b>
3.3.1 Policy .....	42
3.3.2 Human.....	44
3.3.3 Activity .....	45
3.3.4 Assistance .....	46
3.3.5 Technology .....	47
3.3.6 Environment .....	48
<b>3.4 DISCUSSION.....</b>	<b>49</b>
<b>3.5 CONCLUSION .....</b>	<b>51</b>
<b>4.0 CROSS-CULTURAL ADAPTATION AND VALIDATION OF CONSUMER PRIORITIES FOR MOBILITY ASSISTIVE TECHNOLOGY SURVEY .....</b>	<b>53</b>
<b>4.1 INTRODUCTION .....</b>	<b>53</b>
<b>4.2 METHODS.....</b>	<b>55</b>
4.2.1 Phase 1: Modification of the English Survey .....	56
4.2.2 Phase 2: Translation and Face Validity Process .....	57
4.2.3 Statistical Analysis .....	60
4.2.3.1 Face Validity.....	60
<b>4.3 RESULTS.....</b>	<b>61</b>

4.4 DISCUSSION.....	71
4.5 LIMITATIONS.....	73
4.6 CONCLUSION.....	74
5.0 THE SAUDI ARABIA VOICE OF THE CONSUMER: A SURVEY OF CONSUMER PRIORITIES TO INFORM KNOWLEDGE TRANSLATION AMONG PEOPLE WITH DISABILITIES WITHIN SAUDI ARABIA WHO USE MOBILITY ASSISTIVE TECHNOLOGY.....	76
5.1 INTRODUCTION.....	76
5.2 METHODS.....	79
5.2.1 Statistical Analysis .....	81
5.3 RESULTS.....	82
5.4 DISCUSSION.....	95
5.5 CONCLUSION.....	100
6.0 CONCLUSION, CONTRIBUTION, AND FUTURE RECOMMENDATIONS.....	101
6.1 RECOMMENDATIONS .....	101
6.1.1 Saudi MAT Users, Family Members, and Caregivers.....	102
6.1.1.1 MAT Users .....	102
6.1.1.2 Family Members and Caregivers .....	103
6.1.2 Healthcare Providers in Saudi Arabia .....	104
6.1.3 Policy Makers and Academic Institution Decision Makers .....	106
6.1.3.1 Policy Makers.....	106
6.1.3.2 Academic Institution Decision Makers .....	108
6.2 FUTURE WORK.....	111



6.2.1 Other AT Users .....	112
6.2.2 Healthcare Providers .....	112
6.2.3 Policy Makers and Academic Institution Decision Makers .....	113
Appendix A MODIFIED ENGLISH VERSION OF THE SURVEY .....	114
Appendix B ARABIC VERSION OF THE SURVEY .....	137
Appendix C ARABIC VERSION OF THE SURVEY_FINAL .....	156
Appendix D SURVEY CONSENT FORMS.....	181
Appendix E IRB APPROVAL.....	183
BIBLIOGRAPHY .....	184

## **List of Tables**

<b>Table 1. Summary of Full-text articles discussed priorities and needs of mobility-assistive technology .....</b>	<b>23</b>
<b>Table 2. Summary of Full-text articles discussed priority research areas of mobility-assistive technology .....</b>	<b>28</b>
<b>Table 3. Summary of Full-text articles discussed mobility technology-related service delivery issues.....</b>	<b>30</b>
<b>Table 4. Summary of Full-text articles discussed barriers and facilitators encountered by mobility technology users .....</b>	<b>33</b>
<b>Table 5. Face Validity Index of Clarity and Comprehension of the Arabic version of the survey .....</b>	<b>62</b>
<b>Table 6. Participants Demographics (N=20) .....</b>	<b>63</b>
<b>Table 7. Participants Demographic (N=54) .....</b>	<b>66</b>
<b>Table 8. Participants Diagnoses (N=54) .....</b>	<b>67</b>
<b>Table 9. Primary MAT and length of time using device (N=54) .....</b>	<b>68</b>
<b>Table 10. Information sources (N = 54) .....</b>	<b>69</b>
<b>Table 11. Most important information source (N = 54) .....</b>	<b>70</b>
<b>Table 12. Participant demographics (N = 353).....</b>	<b>84</b>
<b>Table 13. Participants diagnoses (N = 353).....</b>	<b>85</b>
<b>Table 14. Primary MAT and length of time using device (N = 353) .....</b>	<b>86</b>
<b>Table 15. Information sources (N = 353) .....</b>	<b>90</b>
<b>Table 16. Most important information source (N = 164) .....</b>	<b>92</b>

## List of Figures

Figure 1.Modified flow diagram of the review process. ....	15
<i>Figure 2. PHAATE Model</i> .....	40
Figure 3.Flowchart of the cross-cultural adaptation process of the translation and validation of the consumer knowledge sources survey from the English version into Arabic. .	59
Figure 4. Exclusion Flowchart .....	65
Figure 5. Exclusion flowchart .....	83
Figure 6. Importance of consumer and doctor knowledge of mobility assistive technology (MAT).....	87
Figure 7. Manual wheelchair skills ability (N = 353) .....	88
Figure 8. Power wheelchair skills ability (N = 353) .....	89
Figure 9. AT Information desired (N=353) .....	93
Figure 10. Preferred Methods of Receiving Information (N=353) .....	94
Figure 11. Knowledge of new technology (N = 353).....	95

## **ACKNOWLEDGMENTS**

First, I am sincerely thankful to my god for giving me the strength and knowledge to accomplish my PhD study. I would like to express my profound gratitude to everyone at the Human Engineering Research Laboratories (HERL) for their support and assistance over the past six years. My special thanks and acknowledgment also go to my advisor and committee chair, Dr. Rory Cooper, for his invaluable guidance, continuous support, patience, and mentorship during my PhD study. His immense knowledge and plentiful experience have encouraged me throughout my period of study. I am likewise thankful to my other committee members - Dr. Mary Goldberg, Dr. Brad Dicianno, and Dr. Jongbae Kim- for their assistance at every stage of the research project. Furthermore, I am deeply thankful to James Joseph for his time, patience, and support for my study. I would like to express my heartfelt thanks to my mother, soul of my father, wife, brothers, sisters, and my beautiful kids. Without their tremendous understanding and encouragement in the past few years, the completion of my study would have been impossible and my study and life in the United States would not have been fruitful and enjoyable. Finally, I would like to convey gratitude to my government Saudi Arabia and Taibah University for all the support during the time of my study.

## 1.0 INTRODUCTION

According to a recent report by the World Health Organization (WHO), over 2.5 billion people with disabilities (PWDs) and older adults are currently in need of one or multiple type of assistive technology (AT), but only 10% have access to these devices [1]. This number is expected to grow to more than 3.5 billion by 2050, as a result of the increase in the global prevalence of chronic diseases, the world percentage of population age, and other factors such as road traffic accidents and natural disasters [1]. AT has been defined as “any product (including devices, equipment, instruments, and software), either specially designed and produced or generally available, whose primary purpose is to maintain or improve an individual’s functioning and independence and thereby promote their overall well-being.”[2] Mobility assistive technology (MAT) is one of the most common categories of AT devices on which millions of PWDs worldwide rely as their primary means of mobility. For example, mobility impairments in Saudi Arabia is the most frequently reported type of disability, which is consistent with the disability statistics in the U.S and India [3]–[5]. In the U.S for example, more than 23 million Americans with disabilities use MAT devices, including wheelchairs, canes, walkers, or crutches as their primary means of mobility [6]. However, only over 300,000 Saudis with disabilities use MAT devices, which is considered too low compared to the number of American MAT users [3]. These statistics are aligned with the findings that the prevalence rate of disability in Saudi Arabia is lower than the world disability rate [3],[7].

Access to appropriate and quality AT can make a major difference in a person’s life by improving mobility function, home and community participation, confidence and self-esteem, independence, and productivity, among others [1]. Despite the benefits of accessing the

appropriate AT, many vulnerable people have been left behind without any access to AT, particularly in low-and-middle-income countries [1]. As a result, international organizations such as the WHO, represented by the Global Cooperation on Assistive Health Technology (GATE), the United Nations (UN), and the International Society for Wheelchair Professionals (ISWP) have taken substantial steps to address the gap of AT provision globally by supporting a global research priority. Notwithstanding the efforts of stakeholders at the international, national, regional and local levels, the mobility needs of PWDs and older adults are not being met. Thus, satisfying the PWDs' needs requires researchers and designers to heed the voice of MAT customers [8]. The term "voice of the customer" is often used in relation to satisfaction strategies; it refers to a form of customer input [8] that provides a description of the problem to be solved from the viewpoint of the customer. In addition, the voice of the customer is a methodology used for identifying, structuring, and prioritizing customer needs and gaps to provide the customers with the best-in-class service or product quality [9]. Several factors have been documented as primary barriers to access appropriate AT devices, particularly in low-and middle-income countries, including the lack of financing, limited availability, high cost, and inadequate knowledge and awareness about available products and services [10][11][12][13].

## **1.1 RATIONALE AND SIGNIFICANCE OF THE PROBLEM**

The increasing number of PWDs and older adults worldwide has created an urgent need to access appropriate and quality AT. Access to AT is a multi-step process, starting with potential users' awareness of possible AT solutions and services, and ending with the realization of their rights and needs. As previously mentioned, several factors have been documented as primary

barriers that hinder access to appropriate AT devices, especially in low-and-middle-income countries [10][11][12][13]. A crucial step in addressing these barriers and improving access is heeding and learning from users' experience of accessing and using their AT devices. For example, in mobility technology, users' input is beneficial for informing research and development (R&D) areas that address their needs and priorities to design wheelchairs that appropriately fit and work in real-life circumstances or to improve their functionality during a wide range of activities [14]. Moreover, AT user data can be utilized for addressing the needs of rapidly growing groups of wheelchair users such as the active elderly, obese individuals, and people with multiple sclerosis [14]. AT user data can also inform R&D areas that lead to a potential improvement in product quality and user satisfaction. AT user data can ultimately help governments and insurance providers to develop coverage policies, leading to people who need AT to obtain the equipment that best meets their needs [15].

Saudi Arabia is one of the developing countries that provides modern and more appropriate means of achieving improved healthcare and community integration. However, with regard to MAT services, applications, service delivery, and awareness, barriers continue to impede access to the appropriate MAT. The level of knowledge and awareness about available, new, and advanced MAT products is among the top barriers that Saudi MAT users, caregivers, family members, community members, policy makers, and healthcare providers are encountered. Low literacy rate, lack of internet access, and inaccessible or untrustworthy information are other barriers to cultivating awareness of the need for and benefits of MAT usage. In addition, information about product costs and the process of gaining access to MAT tends to be fragmented across several public institutions (e.g., health, social welfare, and education), and private or NGO

providers. Without a centralized and accessible MAT information source, the burden of finding basic information is placed on the user and their support networks.

Therefore, to keep up with the global demand for accessing the appropriate AT and address this gap in the literature, this study examines the level of knowledge on skill training, emerging technology perceptions, and preferred information sources among Saudi MAT users. In an effort to contribute to the extant literature, this study: 1) comprehensively reviews past research on the topic; 2) translates, culturally adapts, and assesses the face validity of a previously developed English survey; and 3) and presents empirical data on the level of knowledge gaps in training, emerging technology, and preferred information sources among MAT users in Saudi Arabia.

## **1.2 RESEARCH OBJECTIVES**

The aim of this work is to identify the level of knowledge on skill training, emerging technology perceptions, and preferred information sources of individuals who utilize MAT (e.g., manual wheelchairs, power wheelchairs, scooters, lower-extremity prostheses, lower-extremity orthoses, walkers, canes, or crutches) within Saudi Arabia. The overarching objective of this study is to create a data-driven dissemination and knowledge translation strategy, which could be applied to future work in this area involving users from different cultures.

This study is guided by the following research questions:

- 1- What are the preferred sources of information that MAT users in Saudi Arabia utilize to find information about MAT?
- 2- What is the level of knowledge of MAT users within Saudi Arabia on skill training in using MAT, and what are their perceptions about emerging technologies?



The overall aim of this study consists of the following sub-aims and their respective objectives:

Aim 1: To adapt the English version of the U.S. VOC survey.

Objective 1.1: To adapt the survey items that are deemed to be applicable to the Saudi culture.

Aim 2: To translate the English version into the Arabic language.

Objective 2.1: To translate the survey using the forward-backward translation method and modify culture-specific items that are deemed necessary in the Arabic version.

Aim 3: To test the pre-final version on a small sample of Saudi MAT users.

Objective 3.1: To ensure that all of the contents could be understood and to address the ensuring issues relating to wording, clarity, and relevance to aid cultural understanding.

Aim 4: To test the final version of the Arabic survey on a large diverse sample of users within Saudi Arabia.

*Objective 4.1: To identify, investigate, and document the information sources that MAT users utilize to find information about MAT.*

*Objective 4.2: To identify, investigate and document the perceived gap of knowledge on skill training and emerging technologies that MAT users may report.*

Aim 5: To examine the geographic and cultural differences in MAT users' preferences of information sources as reported by VOC survey respondents.

To identify the potential future areas of R&D and to recognize present knowledge relating the priorities in MAT, a systematic review is conducted, with an emphasis on consumers' involvement in the design and development process of MAT. The results of this systematic review are presented in Chapter 2. The current state and conceptual framework of AT provision in Saudi Arabia are explained in Chapter 3. Chapter 4 focuses on the cultural adaption and validation of the Arabic version of the consumer priorities survey to inform knowledge translation among PWDs who use MAT within Saudi Arabia. This chapter also describes the initial findings of the survey. Chapter 5 includes the empirical findings of the final version of the Arabic survey on a large group of MAT users in Saudi Arabia. The dissertation concludes with Chapter 6, in which the implications of the results are discussed and future recommendations are provided.

## **2.0 STAKEHOLDER PERSPECTIVES ON RESEARCH AND DEVELOPMENT PRIORITIES FOR MOBILITY ASSISTIVE TECHNOLOGY: A LITERATURE REVIEW 1**

### **2.1 INTRODUCTION**

As the 2010 World Report on Disability estimates, over one billion people are in demand of one or multiple ATDs, the majority of whom are PWDs and older adults [16]. This number is projected to grow to more than two billion by 2050, as a result of rapidly increasing aging population, increasing in global chronic diseases prevalence such as cancer, increasing of athletes with an impairment originating from battlefields, and other factors such as road traffic accidents and natural disasters [16]. Unfortunately, only 10% of those who need ATDs currently have access to them, and the problem is even more critical in low-and-middle-income countries (LMICs) [16]. For instance, 75 million PWDs around the world need a wheelchair, but only 5-15% of them have access to one [16] ; only 5% of over 40 million amputees have access to prosthetic devices; while 10% of people who need hearing aids (3% of them in the LMICs) have access to them [16]. Researchers have recognized several factors as primary barriers that affect the provision of ATDs, particularly in LMICs, including a lack of financing, limited availability, high cost, and lack of awareness, and trained personnel [10]–[13]. Without access to ATDs, people in need are often

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<sup>1</sup> Alqahtani S, Joseph J, Dicianno B, et al. Stakeholder perspectives on research and development priorities for mobility assistive-technology: a literature review. *Disabil. Rehabil. Assist. Technol.* 2019;1–15

socially isolated and or condemned to poverty, and ultimately in the absence of ATDs, the impact of their disability is magnified at the level of the individual, family, community, and country [16].

To bridge the gap between the requirement for and provision of ATDs, and to increase access to increased quality and inexpensive ATDs in all countries, the World Health Organization (WHO) introduced an international initiative in 2014, called the Global Cooperation on Assistive Health Technology (GATE) [10], [17]. One of the key focus areas of this initiative is to prioritize research and innovation in all categories of ATDs [10]. The Priority Assistive Product List (APL) was the first level of WHO's GATE initiative to improve access globally to ATDs [10]. The APL includes 50 priorities of ATDs that were selected based on the needs and impacts on the life of individuals with disabilities. The list can be used as a guideline for product development, production, service delivery, and reimbursement policies including insurance coverage [10]. The Global Research, Innovation and Education in Assistive Technology (GREAT) Summit occurred in August 2017 to further support the progress of global priority research [17]. At this Summit, nearly 200 ATDs stakeholders, including researchers, engineers and designers, and expert users from over 70 countries discussed the service delivery, policy, personnel, provision, and use of ATDs, and to promote the global priority research agenda in innovation and education of ATDs [17]. Also, the significance of ATDs for human development is perceived by the Convention on the Rights of Persons with Disabilities (CRPD), which commits to enforcing national government and international organizations to provide appropriate measures to facilitate access to ATDs solutions for those who need them, particularly in LMICs [18]. Therefore, the CRPD has encouraged the development of ATDs provision systems, policies, and procedures to ensure that users with all kinds of disabilities have a right to available, accessible, and affordable ATDs [18], [19]. Another international mandate and a platform to build on existing effort to improve access

to ATDs is the Sustainable Development Goals (SDGs), which were adopted by all United Nations Members States in 2015 [20]. The 17 SDGs have placed great emphasis on a global partnership to make significant effort to improve health and education, reduce inequality, and promote social inclusion of marginalized groups such as PWDs; older adults; poor and the vulnerable; etc. Achieving the SDG's 2030 will not be possible if PWDs do not receive the appropriate ATDs. Also, promoting the fact that accessing essential assistive products is beneficial to everyone and is an essential step to developing an inclusive society [20]. The Paralympic Movement is another global network of individuals and organizations that aims to provide sporting opportunities and to make a more inclusive society for athletes with an impairment. The International Paralympic Committee (IPC) is an international non-profit organization and the global governing body of the Paralympic Movement, where its purpose is to organize the summer and winter Paralympic games [21]. The IPC is organizing the VISTA conference to promote and advance the mission, goals, objectives of the IPC. Also, it aims to provide a platform for sport scientists, researchers, coaches/trainers, and athletes to exchange knowledge, research, and expertise related to Paralympic Sport. To address the mission of the IPC and achieve sports excellence and ensure resources exist to improve access and opportunities in para-sport, the Paralympic Movement needs to develop technology and equipment continually. Therefore, in the VISTA conference in 2013, the major theme was around the equipment and technology in Paralympic Sports [22]. The conference asserted the importance of equipment and technology development in winter sports, wheelchair; handcycles; and other means of propulsion development, using technology and equipment fairly, and performance enhancement of Paralympic Sporting equipment [22].

From an organizational perspective, it is critical for organizations to set a comprehensive framework that complements the research. As an example, the IPC has a general policy on sports

equipment (adapted for para-sports) that outlines general principles that need to be followed for equipment and technology to be approved. That means researchers and commercial partners work in close collaboration with these organizations to avoid the development of equipment that turns out not to be compliant with sports rules [21].

These are signs of the greater focus adopted by international organizations on supporting the development and design of a wide range of possible technologies. As a result, this reinforces the proposition that research in AT has been recognized as such devices that will considerably enhance the desired life activities participation for a wide span of older adults and PWDs in the coming years [17].

AT research has made considerable progress over the previous 50 years, mainly for MAT. The advantages from the attention to AT may be seen in the growth of ATDs options provided in today's marketplace [23]. As a result, many countries around the world have already taken steps toward the research and development of ATDs, particularly in MATs. In the United States, for instance, there was a recommendation by the President's Council of Advisors on Science and Technology (PCAST) to create a "road map" for the next decades to continue for more federal funding support [24]. The report discussed the developing importance of advanced MATs that recognize the needs and priorities of technology users and translational research into technologies that enhance the life of PWDs in the United States. In Australia, a centralized program like the National Disability Insurance Scheme (NDIS) has initiated a model to enhance the research and development of ATDs by having consumers and industry take the lead in shaping the future of the AT market [25]. Another example from the LMICs can be found in Brazil where the Assistive Technology Innovation Program (PITA) provides financial support for innovation activities including development and enhancement of ATDs targeting PWDs, older adults, and others with

mobility impairments [24]. Furthermore, promotion of the development of useful technologies together with the experiences and feedback of the technology user was recognized through some international competitions including the Cybathlon, Paralympic Movement, and the Mobility Unlimited Challenges supported by the Toyota Mobility Foundation [26], [27]. These organizations promote the development of advanced technologies through encouraging researchers, engineers, and designers to address the deficiencies in the current technologies and to come up with new technological ideas.

However, studies have shown that there is a general lack of applying user-centered approaches in AT research, service delivery, and product design [10]. Many researchers have advocated that ATDs consumers are critical as attentive decision-makers in the development of ATDs, including MAT to resist abandonment and enhance satisfaction, which could consequently improve quality of life [28], [29]. On the other hand, ignoring consumers' input during the assessment and design process can result in a mismatch between the consumers and the products prescribed, which results in costly and early abandonment (e.g., 29.3% of all ATDs were completely abandoned, and mobility aids were more frequently abandoned than other AT categories) of these products [29]–[33]. Martin et al. (2011) [34] found an important relationship between users' perceptions of feeling informed and their degree of being satisfied with ATDs. This study also reported that lower satisfaction was associated with unmet personal need and that the lack of involvement of the users in the decision-making procedure concluded in higher abandonment of ATDs. Thus, assessing the need and desires of the end user before translating them into specific engineering requirements is considered one of the greatest challenges in the development of MATs.

Moreover, recent researches in ATDs development have highlighted that ATDs users are the experts about their current and anticipated mobility needs [35]. William Graves, former director of the National Institute on Disability and Rehabilitation Research (NIDRR), called for participatory action research (PAR) that would maximize consumers' participation and involvement in research [36]. PAR allows consumers to have the opportunity to re-shape the future research agenda of AT by providing direct input and collaborating with researchers to better understand their needs and priorities. Until recently, only a few innovative researchers have adopted such protocols to assess consumers' needs and priorities about their current and anticipated ATD within their own countries. However, there has been little recognition to the importance of globally gathering technology users' feedback or evaluating the technology to determine the degree to which a device meets worldwide needs and priorities. A few studies have been conducted in multiple countries to compare consumers' perspectives about their priorities and needs of different available technologies, such as the study that the WHO, with help from the Japanese Ministry of Health, Labor and Welfare conducted in 2014. This study surveyed 100 older adults about assistive and medical devices as a first step in recognizing priority need, acts, and possible outcomes to meet the demand of the aging population [37]. The survey was administered in six countries including, Malaysia, the Philippines, China, the Republic of Korea, Japan, and Viet Nam. The respondents were asked to rate and rank 12 activity and functional areas that are more related to older adults. Then, the respondents were told to rank their highest priority ATDs under each functional area and the activity. The results suggested establishing proof-based tasks and programmatic efforts to facilitate access to both assistive and medical devices at an affordable cost. However, there were some restrictions to the survey used in this study, including its length, complexity, and only provided with an English version.



Another multi-cultural study was conducted in Sweden, the United Kingdom, and Canada to obtain prosthetic arm users' opinions about their current devices and the factors that lead to improvements in prostheses provision [38]. The results of the questionnaire stated that the kind of prosthesis which is generally used was associated with the level of loss, gender, and whether it is used for work.

Overall, there is limited research into obtaining users' opinions about the future area of research in MATs. To our knowledge, there has been only one such study preceding two pilot studies that was conducted in the United States and which was mainly designed to obtain the opinions of Veterans and other consumers who utilize MATs to recognize priorities for future research and development [39]. No previous study otherwise has taken place to compare the opinions of PWDs, older adults, and or athletes with an impairment who use MATs in different countries and cultures about their priorities for the future area of research and development. Thus, in an attempt to recognize present knowledge relating the priorities in research and development of MAT, we performed an extensive literature review with an emphasis on consumers' involvement in the design and development process of MAT. This research identified previously published, primarily MAT-focused literature, on future research priorities and needs. The review will provide a compiled list of reports and publications that have been done to shape the future areas of research and development of MAT.

## **2.2 METHODS**

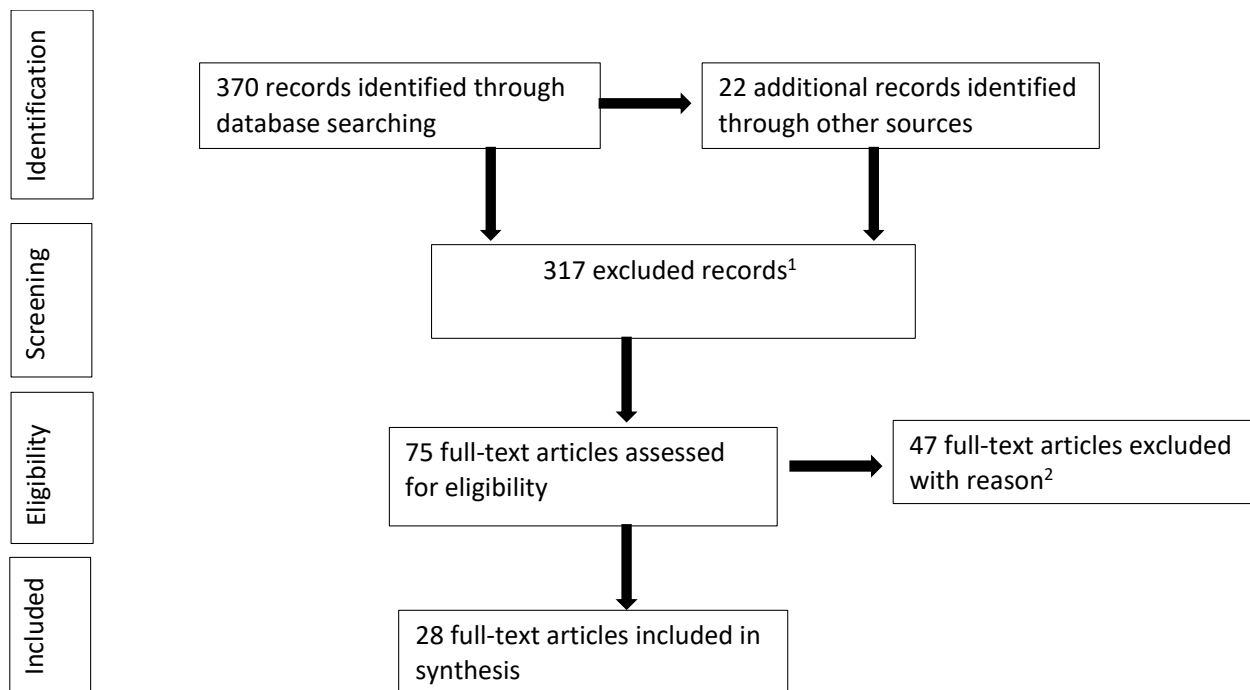
### **2.2.1 Search Strategy**

A comprehensive review was conducted for literature in scientific and medical electronic databases including CINHALL, PubMed, SCOPUS, Engineering Village (INSPEC, COMPENDEX), and Google Scholar. A combination of keyword search terms, corresponding to the medical subject heading (MeSH) terms were used. These adopted terms and synonyms include disabled person, people with disabilities, disabled consumer, assistive technology, self-help device, mobility-assistive technology, research, priorities, user needs, future trend, barriers, and service delivery model. Different groups of these words were used together in Boolean combination. An initial search of the grey literature was conducted to accumulate a variety of sources, to produce an overview and more transparency regarding this topic. The same keywords and combinations utilized for the scientific literature research were used in this search. Various databases were searched, including ProQuest Digital Dissertations, REHABDATA, the National Institute on Disability and Rehabilitation Research Program Directory, and the Rehabilitation Engineering & Assistive Technology Society of North America (RESNA).

### **2.2.2 Inclusion and Exclusion Criteria**

Explorations were not restricted to published articles written in the English language. Other languages such as Arabic; Spanish; Chinese; Korean; Hindi were also included in the search method. However, no study written in these languages were found to meet the inclusion criteria based on their abstract and titles. A comprehensive review was conducted for the literature between

1990 and 2019. The inclusion criteria for selecting the publications relevant for the review purpose included: (1) type of study must be an empirical study, conference proceedings, dissertation or thesis, anecdotal articles such as case studies, commentaries, technical reports, or opinion articles, and peer-reviewed literature review articles, (2) article focused on users' priorities/needs for MAT, (3) article focused on barriers leading to MAT future development, (4) article focused on older adults and/or PWDs with mobility impairments who use any kind of MATs, (5) the study's participants must be age 18 years or older. We excluded papers that referenced future areas of research but focused on other ATDs rather than MATs, and papers that did not provide explicit or implicit contributions to the MATs development and future research agenda.



**Figure 1. Modified flow diagram of the review process.**

- (1) Records were excluded if they did not fulfil the inclusion criteria or due to duplication.  
 (2) Records were excluded if:
- Priorities and future needs were not explicitly or implicitly investigated (n=24),
  - Studies that are related to other AT devices rather than MAT (n=15),
  - Studies with participants whose <18 (n=8).

Results from the overall search process along with the reasons and the number of excluded articles that did not meet the criteria are shown in Figure 1. A total of 370 papers were gathered using the above search method (i.e., scientific and grey literature). There was also a manual screening of reference lists of relevant studies for any missing articles. Twenty-two additional articles were extracted from the references of the papers identified using the above electronic databases. The authors reviewed titles and abstracts with these keywords to validate their inclusion in the review. Full-text articles were reviewed if both the titles and abstracts indicated that the paper might meet the full inclusion and exclusion criteria. All publications that addressed future areas of research and development of MAT or seemed to help in the future area of research were reviewed.

## **2.3 RESULTS**

### **2.3.1 Study Selection**

A total of 392 papers including 22 articles that were extracted from the references, were identified using the scientific and grey literature, and the search terms. Following the screening, 317 were excluded according to the titles and the abstracts. Of the remaining seventy-five studies, forty-seven more were excluded based on the review of their abstract against the inclusion and exclusion criteria. After careful analysis, the remaining twenty-eight articles have been reviewed in full by two study team members with the task of addressing issues related to the future area of research and development of MATs. Not all the articles examined consumers and or other stakeholders' opinions to identify new future areas of research for MATs explicitly; however, all

articles included some form of methods and recommendations that could assist in shaping the future research agenda as a part of their objectives.

### **2.3.2 Study Characteristics**

Eighteen articles were research-based surveys, interviews, or group panel discussion methods that utilized consumers and or other stakeholders' opinions as to the primary source of data. These articles aimed to investigate the perspectives of PWDs and or older adults who use MATs about their needs and priorities either about a specific kind of mobility device or about their future needs in developing and designing new MAT. Of the studies included, only two pilot studies were preceding an extensive study which was designed to explicitly identify consumers' and providers' opinions about their needs and priorities related to MAT to assist a research agenda in information and mark priorities [40][41]. These two pilot studies revealed several themes that helped to construct a preliminary road map. Following these studies, a nationwide survey study was conducted with a large and diverse sample of users with the same objectives [39]. The other fifteen articles provided recommendations for future area of research for MAT in different themes. The remaining ten articles were mixed of peer-reviewed literature, commentaries, technical reports, or conference proceedings. They discussed different areas for future research, including issues in AT service delivery provision, particularly in LMICs; survey priorities of individuals with Spinal Cord Injury (SCI); present issues and future challenges of some advanced mobility devices; and community mobility barriers and facilitators.

Future areas of research for MAT are identified by grouping the publications into four main categories: (1) consumers' and other stakeholders' needs and priorities of MAT; (2) priority

research areas of MAT; (3) Mobility technology-related service delivery issues; and (4) barriers encountered by mobility technology users.

## **2.4 DISCUSSION**

### **2.4.1 Priorities and Needs of Mobility-Assistive Technology**

Specific design features, priorities, needs, and future recommendations of particular types of advanced MAT were examined in this review. Within the literature, there is a consensus among researchers about the need for future research in advanced mobility systems with an emphasis on the importance of the user's involvement in the design process. According to Cooper et al. (2006,2007,2010) [15], [42], [43], the need for future research and development in all advanced mobility technologies with particular attention to wheelchair-related technologies has been asserted.

Out of the 28 papers included in this review, twelve studies report users' and or other stakeholders' perspectives about current design features, issues, and future recommendations (see Table 1). Smart technologies which are defined by Davenport et al. [44] as "any electronic device (including but not limited to actuators, sensors, computer processor/software, and supporting structures) that create an integrated system capable of monitoring and supporting individuals in real-time" have been the subject of research for a decade. In this section, special attention has been dedicated to the comparative analysis of users' experience with different types of these smart technologies. For example, Brienza et al. (1995) [45] conducted a series of focus group discussions to examine priorities for the enhancement and application of conceptual power mobility input

devices and controls. The groups' consensus was that reliability and durability were the most important criteria. The paper concluded with different recommendations including enhancing advanced features of input devices and control systems and developing a "smarter" power wheelchair that can on its own detect barriers and provide more feedback to the users. However, the sample used in this study was small (i.e., only 10 participants, including power wheelchair users, clinicians, rehab professionals, and suppliers from the United States), which could affect the generalizability of this study to other populations. Consequently, this may not reflect the real needs and priorities of other users and or stakeholders in other countries about the future development of power mobility input devices.

In contrast, Simpson (2005)[46] asserted that although smart wheelchairs can be an alternative option for those who find it hard or challenging to use wheelchairs on their own, various barriers must be overcome before smart wheelchairs become used widely. These barriers include the cost versus accuracy of existing sensors and the lack of standard communication between users' interface with wheelchair input devices. Wang et al. (2013) [47] reached a similar conclusion to Simpson, finding that some design and utilization issues of collision avoidance (CA) technology by evaluating the opinions of power wheelchair users, caregivers, and providers from Canada. These issues include the need for context awareness (i.e., the CA systems' knowledge about the driver's intentions and immediate environment and how different obstacles are differentiated), system reliability in detecting obstacles, and users' interface specifications. Some future development needs have been recommended, including designing a CA system that can help people with cognitive impairments to use power wheelchairs, maintaining driving autonomy, and developing advanced sensors to detect natural and varied obstacles. Davenport et al. (2012) [44], which concentrated on adults with mobility impairments from the United States, evaluated

interviews exploring their perspectives about smart technologies. The findings were similar to the above studies in that these technologies are not practical (i.e., costly, too expensive to their current needs), not the preferred option to perform all activities of daily livings (ADLs), difficult to use, and have privacy and reliability concerns. The results also show that few smart technologies interventions (e.g., remote control voice/touchscreen, household automation) are still not accepted by older adults with mobility impairments. Consumers' views and future recommendations about the use of technology in general and four intelligent systems, in particular, were examined by Matthews et al. (2010)[48]. 1,610 adults with and without disability from the United States were recruited for this web-based survey. Respondents were supportive of using technology in general to reduce dependence on others. Respondents' recommendations included developing technologies that enhance independence at home and community, and systems that monitor and support driving behaviors to improve safety. Lane et al. (1997) [49] used 100 participants from the United States to examine the designs of battery charging devices using 11 evaluation criteria. The authors found that reliability, safety, effectiveness, and durability are the most characteristic issues in current battery charger devices. Participants concluded that the ideal battery charger would enhance independence, quality of life, and promote more community involvement and activity participation.

Other examples of studies utilizing users' and or other stakeholders' views to evaluate specific design features, issues, needs, and recommendations of other kinds of advanced MATs such as exoskeletons, prostheses, orthoses, and brain-machine interface technology (BMI), include Wolff et al. (2014), in which 481 wheelchair users and healthcare providers from both the United States and Canada were recruited to evaluate their perspectives about the design priorities and future development of exoskeleton technology. The findings indicated several priorities that must



be considered when designing exoskeleton devices. These priorities include minimization of fall risk; comfortable; ease of use (i.e., putting on/taking off the device); affordable cost; functionality; and weight reduction. A recent systematic review paper by Hill et al. (2017) [50] to identify and review existing literature about exoskeleton technology confirmed the findings from Wolff study: the main issues that could affect the functionality of this technology were speed, weight, size, and efficiency.

Similarly, Yakub et al. (2014)[51] discussed the current issues and some future challenges of assistive robotics in rehabilitation. Within this review, the authors provided an overview about some commercial types of robotic assistive devices that can be used by patients with lower mobility impairments such as LOPES, Lokomat, ReWalk, GaitMaster5, and HAL. Although these assistive robotic devices are designed to improve the quality of life of PWDs with motor or cognitive limitation and older adults, there are some key technology and current issues including safety, user interface, cost and maintenance, and ethical aspects. The review suggested several challenges that should be considered when designing robotic assistive devices. These recommendations include the need to involve end-users in the design process, ease of use, low maintenance, user reparability, affordability, compatibility and convenience, and safety.

The users' perspectives about the design priorities associated with the ADLs would like to be performed using Knee Ankle Foot Orthosis (KAFO) devices were evaluated [52]. Twenty-nine KAFO users from three different centers in India were recruited in this study. A recurrent theme in the interviews was a sense amongst the interviewees that there are biomechanical issues with the KAFO devices including insufficient knee-flexion to perform activities such as kneeling, cross-legged sitting, and squatting. Other design priorities were reported in this study included weight reduction, compatibility of the foot design with a user's footwear, affordability, and ease of

maintenance. However, the study had some limitations such as that the sample size was small compared to the total population of India, and other KAFO users in other countries may not report some of the design issues identified by the participants in this study (i.e., activities that would like to be performed such as kneeling; cross-legged sitting, and squatting). In a recent study by Swinnen et al. (2018) [53], the authors reported several design issues related to lower limb orthoses using the opinions of 20 patients with Multiple Sclerosis (MS) who use lower limb orthoses as well as seven healthcare providers from Belgium. These concerns include stigmatization, use (i.e., difficulties to put on and off the device), appearance, and adaptability. Two recommendations were reported to improve the design of lower limb orthoses: designing more rigid devices and taking to account the severity of the limitations of the users when delivering these devices.

A study conducted by Laher et al. (2015) [54] explored the opinions and knowledge of 131 adults with disabilities from Germany about the BMI technology, particularly their attitudes toward invasive BMI treatment options. The findings show that the majority of the participants have adequate knowledge about invasive BMI technology, which reflected a positive attitude toward accepting this technology. The results also show that there is a high demand for therapeutic BMI in people with physical disabilities. Some of the top priorities in using this technology have been reported including improvements in mobility; grasp/grip; gait/posture; and communication skills.

**Table 1. Summary of Full-text articles discussed priorities and needs of mobility-assistive technology**

Article	Sample	Study Design/Country	Objectives	Design concerns/needs	Priorities/Areas of Future Research & Development
(Brienza, Angelo & Henry, 1995)	N= 10 people including consumers, clinicians, rehab professionals, and rehab technology suppliers	Focus group discussion/ United States	To determine priorities for the development and application of power mobility input devices and control concepts.	-Durability and reliability are the essential criteria of concerns.	- Improving and developing the characteristics of input devices and control systems. - Designing "smarter" power wheelchairs that provide users with feedback and independently detect obstacles
(Lane, Usiak, Stone, & Scherer, (1997)	N= 100 participants	Focus group discussion/survey/ United States	To explore how the users of ATDs define the ideal battery charger devices.	Concerns with current battery chargers design include: -Reliability, - safety, - effectiveness, - durability	- Improving or designing new ideal battery chargers that meet users' needs and be more reliable, safe, and durable.
(Simpson, 2005)	N/A	Literature review	To summarize the current state of the art and directions for future research of Smart Wheelchairs	Current design concerns include: - Sensors accuracy and cost - Liability concerns for indoor .	- Conducting long-term studies to evaluate the effectiveness of smart wheelchairs. - Developing smart wheelchairs that comply with users' input to avoid distractions , to prevent collisions, and to provide navigation assistance.
(Matthews et al., 2010)	N= 1610 adults with/out disability	Web-based survey/United States	To identify consumers' views and their future recommendations about the use of technology in general and four categories of intelligent systems in particular. To explore perceived smart technology needs.	Factors considered very important in deciding whether to use a quality of life technology to perform daily tasks included: Safety, cost, ease of use, how adequately it could meet one's needs, and its impact on privacy. - Not practical - Should not aspire to perform all activities of daily living (ADLs) such as bathing, dressing, preparing meals, etc. -Difficulty of use (i.e., users with upper extremity impairment are not able to use touch screen devices) - Privacy concerns - Reliability concerns	- Developing technologies that enhance independence at home and reduce burden on others - Engineered systems should enable assistance to accommodate both physical and cognitive disabilities.
(Davenport, Mann, & Lutz, 2012)	N=11 adults with mobility impairment	Interview/ United States	To explore perceived smart technology needs.	- Not practical - Should not aspire to perform all activities of daily living (ADLs) such as bathing, dressing, preparing meals, etc. -Difficulty of use (i.e., users with upper extremity impairment are not able to use touch screen devices) - Privacy concerns - Reliability concerns	- Developing smart technologies such as remote control technologies, automation technologies, robotic assistance technologies, monitoring technologies, reminding and prediction technologies. - Making such technologies affordable, reliable, easy to use, and effective.
(Wang at al., 2013)	N=29 power wheelchair users, 5 caregivers, and 10 prescribers	Interview/Canada	To examine view on design and utilization of collision avoidance (CA) technology for future development.	Few issues with the design of CA technology were identified, including the requirements for awareness, system reliability in detecting obstacles, user interface specifications.	- Developing CA systems that maintains driving autonomy - Designing a CA system that can help people with cognitive impairment to use power wheelchairs, - Developing sufficient sensor sensitivity and reliability for different obstacle types, and materials.
(Wolff et al., 2014)	N= 481 participants including 354 wheelchair users & 127 healthcare professionals	Survey/Canada, United States.	To set consumer design priorities for the future development of exoskeleton technology	Design issues include: -Impactical - Inefficiency - Potential for harm (safety) - High cost	Developing exoskeleton systems that minimize of fall risk, affordable, easy to use, comfort, enable functional abilities, and light weight.

**Table 1: Continued**

Article	Sample	Study Design/Country	Objectives	Design concerns/needs	Priorities/Areas of Future Research & Development
(Yakub, Ahmed, & Mori, 2014)	N/A	Literature review	To present an overview of the trends of rehabilitation as therapy and assistive robotics for human use with current issues and some future research challenges.	Some key technologies and current issues related to rehabilitation robots include safety; user interface; cost and maintenance; ethical aspects.	-Developing new robotic devices that can address the current issues - Conducting research to determine the particular conditions and requirements of PWDs and older adults with mobility impairments - Making advancements in signal processing, artificial intelligence, cognitive and cloud computing, sensors, and actuators.
(Lahr et al., 2015)	N= 131 adults with disabilities	Questionnaire/ Germany	To explore opinions and knowledge on invasive brain-machine interfaces (BMI) technology and their attitude toward invasive BMI treatment options.	Design issues include: - Long setup time - Fatigue - Daily maintenance - Complexity	Improvement in mobility, grasp/grip, gait/posture, and communication skills were rated the top priorities using this technology.
(Hill et al., 2017)	N/A	Systematic review	To identify and review existing literature that reports user perspectives of exoskeleton technology to inform the design and technical development of the future devices.	Several limitations were reported including affordability, size, weight, speed, and efficiency.	- Developing exoskeleton devices that address the current design issues. - Conducting studies that involve users' perspectives in exoskeleton design process.
(Bapat & Sujatha, 2017)	N= 29 user of KAFO	Survey/India	To set consumer design priorities with regards to ADLs the subjects would like to perform.	Biomechanical issues - Insufficient knee-flexion to perform activities such as kneeling, cross-legged sitting & squatting). - Stance Control KAFOs and powered KAFOs seem to use sophisticated electronics, mechanism and are operated on battery backs, which makes them bulky, expensive, and less practical in term of routine usage.	- Developing KAFO devices address the current biomechanical and functional issues associated with the conventional drop-lock-type knee joint - Developing lightweight KAFO devices - Foot part design to be compatible with user's footwear, - Developing affordable KAFOs with ease to maintain.
(Swinnen et al., 2018)	N= 20 patients with MS, and seven healthcare professionals	Focus group discussion/ Belgium	To collect patients' and healthcare professionals' opinions about lower limb orthoses (LL-orthoses) including the positive and negative aspects, the differences in wearing them according to location, and their recommendations for future modifications.	Concerns relating to lower limb orthoses include: - Stigmatization - Difficulties in putting on and off the LL-orthosis - The aesthetic aspects - Lack of information about the adaptability and use of the orthoses.	- Designing more refined and firmer orthoses - Taking to account the severity of the limitations of the patients when delivering the LL orthoses.

## 2.4.2 Priority Research Areas of Mobility-Assistive Technology

The studies reviewed in this section were mainly designed to investigate users' and other stakeholders' perspectives about the top priorities in research areas in MAT (see Table 2). While this section distinctly focuses on research, some of the findings overlap with those suggested in the previous section regarding priorities for specific technologies. Scherer and Lane (1997) [36] examined 700 participants' views using a mixed method approach to identify their top needs regarding the development of several categories of ATDs. Ten product categories ranked as the most in need of development or improvement included manual wheelchairs, wheelchair cushions,

battery chargers, wheelchair tires, wheelchair tie-downs, van ramps and lifts, voice input interfaces, output voice reading devices, workstations, and portable ramps. Reid (2002) [55] reviewed the literature to find the gap between seating interventions and their impacts on adults with mobility impairments to shape future research in this area. An interesting finding that the authors discussed concerning future research in seating interventions was that the impact of any seating intervention is based on how much a user engaged in the development of research approaches. The more a user is involved in the design and research process, the better impact and success of seating intervention outcomes. Similarly, Sprigle et al. (2007) provided an in-depth analysis of the top priority research areas in seating and wheeled mobility. A focus group discussion was conducted during a conference meeting using the perspectives of 110 researchers, clinicians, policy-makers, manufacturers, and wheelchair users. The results of this discussion suggested several research priorities in mobility and seating. In wheeled mobility, the top identified research priorities included the impact of long-term wheelchair use, activity and participation-related health outcomes, translating research into design, and effect of wheelchair design on function. The top research priorities in seating included cushion adequacy, positioning abilities of cushions, the long-term impact of sitting, and the impact of seating and mobility interventions. Eight top trends in mobility technology research were identified during a collaborative study between a committee of European and American professionals in mobility technology including engineers and clinicians [56]. The team worked closely with the World Technology Evaluation Center (WTEC) to arrange a five-day tour around 33 leading mobility laboratories in Western Europe. The areas of research suggested by the team involved improving existing MATs (e.g., functional electrical stimulation systems, prostheses, powered wheelchairs, and exoskeletons) to be more integrated with the abilities of the user; developing sensors which can be worn; pervasive

systems to enhance monitoring health and wellness; security; and early detection of disorders for people with mobility impairments. The research priorities identified by people with SCI have also been mentioned as a part of this review. For instance, a commentary report written by Hammel (2010) [57] to highlight research priorities of people with SCI revealed some functional priorities and recommendations for future research in this avenue. Examples of the top functional priorities include reducing fatigue, pressure sores, depression, spasticity, and restoring bladder as well as bowel control. The author also recommended that PWDs, including those with SCI, must be involved in the research process. Similarly, Collinger et al. (2013) [58] developed a survey to examine functional priorities, knowledge of technology, and preferences of new technology such as Brain-Computer Interfaces (BCI) using 700 Veterans with SCI. The top functional priorities reported by the users were the restoration of bladder/bowel control, walking, and arm/hand function. The top design priorities identified in the BCI technology were an independent operation, cost reduction, and non-invasiveness.

In contrast to the previous studies where the identification of future areas of research was either implicitly investigated or focused on specific kinds of mobility devices, the following two pilot studies preceding a large nationwide study mainly designed to identify users' and providers' opinions to shape the road map of future areas of research in advanced mobility technologies. The two pilot studies [40], [41] used a web-based survey to identify users and providers' priorities for future research and development in MATs. These studies revealed that developing assistive robotics and intelligent systems, smart home technologies, alternative power sources, and human-machine interfaces were the top priority for future areas of research. The following national study following the pilot studies used a web-based survey as well but surveyed a large sample of MAT users and was conducted to identify consumers' priorities for the future areas and development in

MAT [59]. The results of this study confirmed the findings of the two pilot studies regarding the top priorities of future areas of research. The survey results also asserted the importance for researchers and or designers to understand that translation research requires the involvement of both users and other stakeholders.

**Table 2. Summary of Full-text articles discussed priority research areas of mobility-assistive technology**

Article	Sample	Study Design/Country	Objectives	Design concerns/needs	Priorities/Areas of Future Research & Development
(Scherer & Lane, 1997)	N= 700 participants	Mixed method approach (qualitative focus group, and quantitative survey data)/ Unites States	To identify consumers' needs and preferences regarding several categories of AT.		Ten product categories identified to be in need of new product development or existing product improvement include manual wheelchairs, wheelchair accessories such as cushions; battery chargers; wheelchair tires; wheelchair tied-downs, van ramps and lifts, voice input interface, voice output reading machines, portable ramps, workstations.
(Reid, 2002)	N/A	Literature review	To review the literature concerning the effectiveness or impact of seating interventions for adults who have mobility impairments. Both the scope and the gaps in the literature are defined to identify areas for future research	Several areas of concerns about the impact of seating interventions were discussed including: - Variables such as comfort, pain, seat pressure, fatigue, stability, balance, etc. - Societal variables such as environmental factors, community integration issues. - Functional activities in relation to the seating systems.	- Conducting research studies to measure the outcome of seating intervention that should consider the impact at the level of users and also the level of various key individuals in that person's life, such as therapist, family, friends, etc. - Conducting research studies where occupational therapists and other assistive device providers need to participate in the development of research approaches that will enable them to address how various factors interact and proceed toward successful seating outcomes.
(Sprigle, Cohen, & Davis, 2007)	N= 110 researchers, clinicians, policy-makers, manufacturers, wheelchair users	Conference Meeting/ focus group/ United States	To identify and report seating and wheeled mobility research priorities.		Mobility priorities: Impact of long-term wheelchair use, the relationship of activity and participation to health outcomes. Seating priorities: Cushion adequacy, cushions positioning abilities, the impact of long-term sitting, and the impact of seating & mobility interventions
(Hammell, 2010)	N/A	Commentary	To highlight research priorities of people with spinal cord injury (SCI), outline the present state of rehabilitation research and suggest potentially fruitful avenues for future research.		- The findings reported identified depression, pain, fatigue, pressure sores, spasticity and the management of bowel and bladder as research priorities.
(Reinkensmeyer et al., 2012)	N/A	Commentary	To gather information on European innovations and trends in technology that might lead to greater mobility technology development.		Several major trends in mobility technology research have been identified, examples of which include: 1- Integration the existing ATDs with the capabilities of the user. 2- Wearable sensors and pervasive systems 4- Improvements in actuators and power supplies to be stronger, lighter, and more efficient 5- Multidisciplinary teams work to produce transformative mobility technology
(Collinger et al., 2013)	N= 57 Veterans with SCI/ United States	Survey	To prioritize desired functions, with a preference of new technologies such as Brain-Computer Interfaces (BCI).		- Prioritized functions of SCI participants include restoration of bladder and bowel control, walking, and arm/hand function.
(Kelleher et al., 2017)	112 individuals	Survey (Pilot Study)/United States	To set consumer priorities for future research and development in mobility-assistive technologies.		Needs and Priorities: - Developing new assistive robotics - Developing smart home technologies - Innovation in alternative power sources
(Dicianno et al., 2018)	N=161 providers	Survey(Pilot Study)/ United States	To set consumer priorities for future research and development in mobility-assistive technologies		The findings revealed themes for advanced wheelchair design, assistive robotics and intelligent systems, human machine interfaces, and smart device applications. These included: - Research in advanced wheelchair design - Development of new assistive robotics and intelligent systems - Innovation in human machine interfaces - Development of new smart devices
(Dicianno et al., 2018)	N= 1022 individuals with different disabilities	Survey/ United States	To set consumer priorities for future research and development in mobility-assistive technologies		Priorities include: - Advanced wheelchair design - Smart device applications - Human-machine interfaces - Assistive robotics and intelligent systems.



### **2.4.3 Mobility Technology Service Delivery**

While the majority of the studies included in this review focused on specific design features and issues as well as users' priorities and needs to improve MATs, few studies discussed service delivery issues in AT to identify whether such issues could have any potential contribution to the future area of research (see Table 3). Three studies [17], [60], [61] examined the opinions of users and other stakeholders about the current issues in AT service delivery provision. The most common issues identified from these three studies were the effect, cost, and economic impact of ATDs, AT policies; systems; service provision models and best practice, high quality and affordable ATDs, human resources for the AT sectors, and standards and methodologies for the ATDs assessment need and unmet needs. Also, the results asserted the importance of the need for ATDs users to be actively involved in the process of service delivery and to express their needs. Other papers reviewed the literature in AT delivery service provision. For example, in a literature review, Borg et al. (2011)[62] summarized the current knowledge on ATDs for LMICs and provided recommendations that facilitate the implementation of the CRPD. The results of this review reported the lack of access to ATDs and particularly to mobility devices. It also reported several factors that affected the AT provision process in these countries. These factors include limited availability, high cost, and lack of awareness and trained personnel. The review also asserted the need for action research as well as the importance of product development that is affordable, durable, and easy to use in such countries. Greer et al. (2012) [63] focused on the issues of service delivery process as well as the areas of future research in wheeled mobility. The paper suggested additional research areas that are needed to develop the wheeled mobility service delivery including evidence-based practice, different models of specialty seating and mobility clinics, and telerehabilitation services to serve patients in rural areas.

**Table 3. Summary of Full-text articles discussed mobility technology-related service delivery issues**

Article	Sample	Study Design/Country	Objectives	Design concerns/needs	Priorities/Areas of Future Research & Development
(Borg, Lindstrom, & Larsson, 2011)	N/A	Literature review	To summarize current knowledge on AT for LMICs and to provide future recommendations.	Several factors affect the AT provision include limited availability, high cost, and lack of awareness and trained personnel.	
(Greer, Brasure, & Wilt, 2012)	N/A	Literature review	To describe the wheeled mobility service delivery process to identify issues and areas for future research.		-The need for the development of an evidence base for wheeled mobility service delivery. - Other interventions including different models of specialty seating and mobility clinics and telerehabilitation for patients without access to specialty clinics.
(De Jonge et al., 2015)	N= multiple stakeholders including AT users and other stakeholders	Empirical-work conference with panel discussion	To analyze AT service delivery from the perspectives of key stakeholders.		-Conducting research where AT users should be actively involved in the process of service delivery and to express their needs.
(Layton, Murphy, & Bell, 2018)	N=200 global researchers, innovators, users, and AT educators	Focus group discussion through WHO GREAT Summit	To discuss the service delivery, policy, personnel, provision, and use of AT, and to promote the global priority research agenda in innovation and education of AT	Three aspects were identified to be diverged across regions including AT provision, accessibility of information, and health workforce.	The Summit suggested a global collaborative partnership to address the gap in AT provision by conducting future research to understand the diversity, similarities, and the potential innovations in the field of AT

## 2.4.4 Barriers and Facilitators Encountered by Mobility Technology Users

Exploring barriers and challenges that PWDs and or older adults encounter including the physical environment, lack of ATDs, negative attitudes, transportation, service, systems, policy, etc. is essential for researchers and designers to consider when developing new technologies that enhance their participation in community and quality of life. Barriers from the side of the industry partners regarding Paralympic Sport technologies also exist (e.g., no interest if there is no commercial market). The IPC encountered this problem when reaching out to commercial partners to develop sledges for para ice hockey; lots of adaptive equipment are garage fabric by the athletes themselves. In the past decade, a considerable amount of research has been conducted to discuss different barriers that PWDs and or older adults face [64]. Specific examples of the barriers identified by mobility devices users and other stakeholders have been discussed in this review (see Table 4). To explore environmental barriers to community participation during the winter season, Ripat et al. (2015) [65] surveyed 99 users with wheeled mobility devices. The study supported the knowledge that winter weather conditions impact participation levels for wheeled mobility users

greater than general ambulatory population. The results of the survey revealed several barriers and design concerns that must be considered during the winter season, including lack of caregivers' assistance for transportation; tires becoming jammed in the snow or slipping on ice; ascending inclines/ramps difficulties; frozen wheelchair/scooter components such as batteries, seat cushions, or electronics; non-accessible sidewalks/roads; safety concerns; and isolation due to limited community participation. A study by Crytzer et al. (2017) [66] was conducted to examine 31 ATDs experts' views about the impact of the built environment on the wheelchair transfer process and to identify future research directions in this area. Suggestions included: developing and testing new devices to support transfer training for new wheelchair users; performing studies concerning multiple variables that impact transfers (e.g., type of wheelchair, user preferences); conducting research that should attempt to observe, survey, and describe the transfers in natural environments; identifying essential aspects of transfer training (e.g., movements that are least injurious to the tissues); and expanding the American with Disabilities Act (ADA) guideline to address assisted transfers.

In conclusion, examples of users' and other stakeholders' needs and priorities of particular types of MATs are discussed in this section. These technologies include smart technologies, wheelchair accessories (e.g., battery charger devices), exoskeletons, prostheses and orthoses, and BMI technology. The section also discusses several priority research areas in MAT identified by users and other stakeholders. These areas include seating and wheeled mobility, research priorities of people with SCI, and other advanced MAT such as assistive robotics and intelligent systems, smart home technologies; alternative power sources; and human-machine interfaces. Also, the section discusses some current issues related to AT service delivery. Examples of identified issues include effect, cost, the economic impact of ATDs, AT policies; systems; service provision

models; and best practice, lack of awareness, and trained personnel. Also, the section shows that geographical distant service delivery may discourage and even prevent users from accessing services. Several barriers and challenges encountered by mobility technology users are also discussed to identify potential future areas of research and development. These barriers include but are not limited to the physical environment, lack of ATDs, affordability, transportation, service, systems, and policy.

The evidence from this section confirms that users can play an active role in the process of design and development of MAT, and can be the most likely source to provide information about his/her current and anticipated mobility needs. Also, it was noticed that future areas of research and development were mostly identified using the voices of users from the High-Income Countries (HICs), which indicates the lack of research in investigating users' opinions in LMICs. That is said, differences in mobility needs and priorities between users from HICs and those who live in LMICs are most likely to exist according to several factors such as cultural, environmental, and psychosocial diversity. Addressing current issues related to AT service delivery and barriers encountered by mobility technology users can be a good subject for future areas of research and development, particularly in LMICs, where the lack of access to ATDs is more critical.

**Table 4. Summary of Full-text articles discussed barriers and facilitators encountered by mobility technology**

users					
Article	Sample	Study Design/Country	Objectives	Design needs, priorities, and concerns	Priorities/Areas of Future Research & Development
(Ripat, Brown, & Ethans, 2015)	N= 99 users with wheeled mobility devices	Survey	To identify environmental barriers to community participation during the winter season.	Barriers and design concerns include social barriers, technology-related challenges, accessibility (i.e., sidewalk), and safety concerns	<ul style="list-style-type: none"> <li>- Conducting further research to explore the details and processes of winter weather barriers or service and policy-related barriers.</li> <li>- Developing new wheelchairs that are suited to winter weather.</li> </ul>
(Crytzer et al., 2017)	N= 31 AT experts/United States	Focus group meeting using live web-based conferencing	To facilitate the exchange of thoughts on (1) the effect of the built environment on the transfer process of a wheelchair, (2) wheelchair users' needs during transfers in the built environment, and (3) future research directions.		<ul style="list-style-type: none"> <li>- Development and testing of new equipment that will enhance transfer training (e.g., body weight supported system) should be required for new wheelchair users.</li> <li>- A multitude of variables that impact transfers must be considered (e.g. type of wheelchair, user preferences)</li> <li>- Future studies should attempt to observe, survey, and describe the transfers of wheelchair users in natural environments.</li> <li>- The ADA guideline should be expanded to address assisted transfers.</li> </ul>
(Jónasdóttir & Polgar, 2018)	N/A	A scoping review	To bridge the literature on existing community mobility barriers and facilitators of mobility device users.	Specific barriers such as open-space planning, architecture, transportation, and construction, influence community mobility opportunities were reported as the major barriers encountered by mobility users.	

## 2.5 LIMITATION

A few significant limitations need to be considered. It is known in most scientific research methods that users are usually excluded from the mechanism of research production, and their voices are most frequently filtered through professionals. Also, several papers were identified using the grey literature, which is known to be less reliable when compared to works formally published in academic sources (i.e., journals or books). Although the grey literature could weaken the review outcomes, it was used to gather a variety of sources that otherwise may not have been available in other academic sources. There are a few gaps in this review, such as the one regarding the population studied. For example, studies of the priorities of PWDs in a particular country may not reflect the same requirements of other users in other countries according to the culture, socioeconomic differences, religion, and environments. Another potential limitation to this review

is that the discussion of both the service delivery process and barriers that mobility devices users encounter lie beyond the scope of this review. However, the reason for including such articles was to gather any contribution that might help in the future studies of the requirements of new MATs. For instance, the findings of the GREAT Summit would suggest that researchers and practitioners must consider pragmatic constraints in any work related to AT, as without attending to service delivery, the potential of ATDs will not be realized [17].

## **2.6 CONCLUSION**

This review provided an overview of existing knowledge of future areas of research and development in MAT. Although 392 publications were found in the initial search, only 28 papers met the inclusion criteria. Out of these 28 papers, 19 papers used users' and other stakeholders' opinions as the primary source of data to shape the road map of future areas of research in advanced mobility technologies. The majority of the articles reviewed discussed areas related to ATDs in general and mobility technologies in particular such as specific design features, needs, priorities, and recommendations. Other areas, such as service delivery issues, and the barriers and challenges that mobility users experience have also been discussed to identify any potential contributions to future areas of research and development in mobility technology.

The following conclusions can be drawn from this review. First, recent advances in mobility technologies including robotics, intelligent systems, exoskeletons, prostheses and orthoses, substantially expand participation in desired life activities for millions of PWDs and older adults. Therefore, there is a need for future research and development in MATs to ensure that these technologies are safe, effective, functional, affordable, and widely available. Finally,

this review confirms that designers and researchers must consider user involvement in the design and development process.

In other words, to innovate a new device appropriately and competitively, consumers' voices should be heard, and other factors should be considered. Example of these factors include the context of use, tasks to be accomplished, the environment in which activities will be performed, real needs and priorities, economic, religious, psychological and climate factors, available technology, material and resources, and cultural diversity. Since users' needs vary greatly between countries and even regions within countries, and technologies that are used in HICs may not be designed to be used in the environment or cultures of LMICs, further work is required to identify globally informed and globally relevant opportunities. One idea may be to determine the perspectives of PWDs or older adults from other cultural regions about future research and development needs and priorities in MATs.

### **3.0 CURRENT STATE AND CONCEPTUAL FRAMEWORK OF ASSISTIVE TECHNOLOGY PROVISION IN SAUDI ARABIA<sup>2</sup>**

#### **3.1 INTRODUCTION**

According to the World Health Organization (WHO), AT has been defined as “any product (including devices, equipment, instruments, and software), either specially designed and produced or generally available, whose primary purpose is to maintain or improve an individual’s functioning and independence and thereby promote their overall well-being.”[2] Advances in materials and electronic components have led to the increased availability and capabilities of these technologies [67],[68],[69]. Today, improvements in technology have made AT devices more affordable, flexible, portable, and easier to use and maintain [67]. Within the past three decades, there has been immense growth in the different types of AT being designed and developed [67]. In the United States alone, there are over 23 million PWDs use AT for mobility [6]. The impetus for this growth lies in three primary factors: an increased number of PWDs, technological improvements, and legislation that provides access to appropriate AT for PWDs [67]. As the technology has improved, so have the well-being, social activity, participation in life domains, and self-esteem of PWDs and older adults [70]. For example, technology allows individuals with spinal cord injury (SCI) to perform many of the same activities they did before their injuries and reduces their difficulties and dependencies on others [70].

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<sup>2</sup> Alqahtani, S., Cooper, R., & Cooper, R. A. (2021). Current state and conceptual framework of assistive technology provision in Saudi Arabia. *Disability and Rehabilitation: Assistive Technology*, 1-7.



Disability and impairment constrain some of the most valuable aspects of life, including independence, social interaction, self-esteem, education, career development, and access to public facilities [71],[72]. Many research studies have emphasized the importance of using appropriate AT to improve the quality life of PWDs [73]. In one study, for example, tasks that depended entirely upon mobility devices (e.g. traveling, obtaining a job, shopping, going to the movies) were rated as being of more significance than other activities [73]. Accordingly, AT is essential in almost all aspects of the rehabilitation and reintegration process to return PWDs to active lives [67]. However, inappropriate AT interventions have the potential to produce adverse consequences for physical functioning, safety, quality of life, and vocational and economic standing if they do not meet a clients' functional and health needs or are not regularly used [70] [74].

In the past decades, Saudi society's view of PWDs was based on a rudimentary idea of disability [75], which was viewed in the context of helplessness, continuing dependence, being homebound, and experiencing less productivity and social participation [75]. However, since the initiation of the country's economic development the Saudi government has tried to shift this conception of PWDs by providing modern and more appropriate means to achieved improved health and community integration. Saudi Arabia offers universal healthcare coverage for everyone, including non-residents, under the administration of the Ministry of Health (MOH) and the Ministry of Human Resources and Social Development (MHRSD) [76]. Citizens and non-citizens alike have the right to free healthcare services. Employees and their families, regardless of nationality, who work in government ministries/agencies or private companies that operate these facilities have access to healthcare services in private hospitals and primary clinics [76]. Unlike the healthcare system in the United States, governmental hospitals, with the cooperation of private

institutions in Saudi Arabia, have created budgets to provide healthcare services, along with the equipment needed to PWDs.

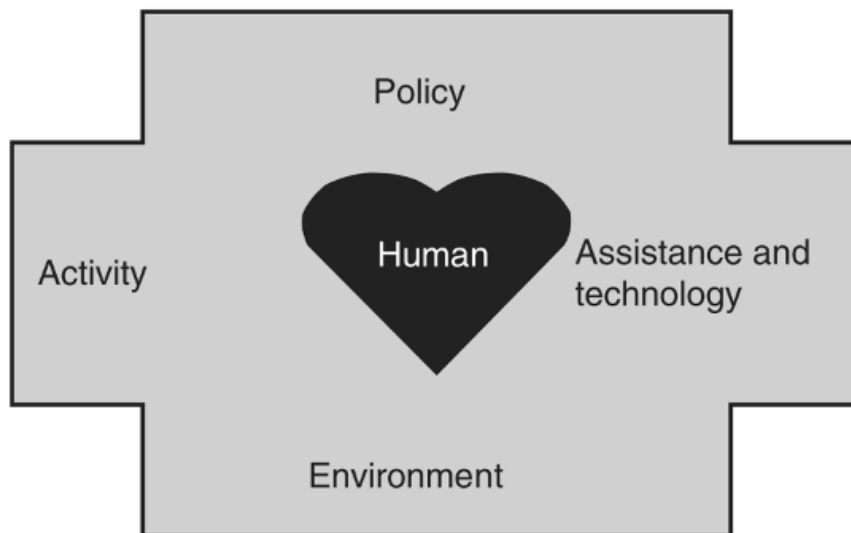
The AT services in Saudi Arabia is relatively new. The Joint Research Center for Prosthetics, Orthotics, and Rehabilitation Program for PWDs was the first established AT-related services center in 1987. In 2006, the center services were merged under the rehabilitation hospital at King Fahad Medical City. During that time, the department services were expanded and the first AT clinic was established. The clinic has served in and outpatients with mobility devices, seating, and positioning equipment. Recently, the AT services have received great attention from the Saudi government. There are over 12 governmental and non-governmental hospitals and centers that are specialized in providing AT and prosthetics and orthotics services around the country. In addition, over four universities have already created specialized undergraduate programs to graduate students who are skilled in AT and prosthetics/orthotics services provision. However, despite the Saudi government offering support and funding resources for AT devices, there is limited awareness and knowledge about AT application and services, as well as AT service delivery models, demonstrated by the professionals and healthcare providers (e.g., occupational therapists, physical therapists, speech language pathologists, and rehabilitation engineers), and the clients, and their caregivers [77],[78],[76]. Thus, in this paper, clinical practice guidance for AT service delivery provision is highlighted. Such guidance may help clinicians and other medical providers, particularly in Saudi Arabia, to make informed decisions about the provision of AT device services.

### **3.2 SERVICE DELIVERY MODELS MULTIDISCIPLINARY MODELS**

Several AT conceptual models or frameworks have been developed to serve a wide range of stakeholders (e.g., researchers, product developers, practitioners, third-party reimbursement entities, consumers, and educators) with regard to designing new AT or developing a service delivery system [79]. Such models provide the basis and guidance for advancing scientific knowledge and evidence-based practice [79]. These service delivery models outline the processes involved in AT device selection, which consists of obtaining approval for the selected AT device; delivering the device to the client; setting up, fitting, customizing, and user training the user on the AT device; and providing follow up and consultation. Examples of models include the human-activity-assistive technology (HAAT) model; the matching person and technology (MPT) model; the US Institute of Medicine (IOM) model; and the most recent one is the policy, human, activity, assistance, technology, and environment (PHAATE) model [80],[81],[82],[83]. Each of these models shares a common orientation in that they capture the relationship between the person, the technology, and the environment. Within these examples, the PHAATE model is viewed as offering a broad theoretical framework for AT research, design, and provision. Thus, in this paper, the PHAATE model is used to incorporate the critical aspects and factors that should be considered in the development of a service delivery system.

### 3.3 THE POLICY, HUMAN, ACTIVITY, ASSISTANCE, TECHNOLOGY, AND ENVIRONMENT (PHAATE) MODEL

The PHAATE model is comprised of key factors to be considered when designing AT devices and developing AT service delivery systems [83]. The model provides a framework that recognizes the interaction factors between the individual, the AT, and the individual's contexts and environments, and also includes policy as a factor (see Figure 2). Each component of the model must be considered both individually and in combination with the other components when considering, designing, selecting, implementing, and evaluating an appropriate AT device [79],[83],[84]. The model involves both assistance and technology components, recognizing that AT may be used in conjunction with assistance through personal assistance care [83]. For example, in adults with SCI, the need for assistance changes with time post-injury and may affect the AT selection and use over time [83].



*Figure 2. PHAATE Model*

Often, abandonment or rejection of the AT is more likely if the assessment focuses on the device. One way to reduce this issue is to incorporate all the components of PHAATE model. During the service delivery process, multiple factors must be considered to ensure that the choice of AT will meet the individual's needs and that the technology is appropriate and available to the user [84],[85]. AT models such as PHAATE provide a structure to identify, organize and address these variables [86]. First, the individual's needs and goals should be defined and careful consideration should be given to the activities they will be performing. However, it is acknowledged that no activity is performed in only one context, hence, it is important to identify the influence of factors such as the physical, sociocultural, and institutional elements in the contexts in which the activities will be performed [83],[86]. Thus, practitioners must undertake a careful evaluation of the activities to be performed and the contextual factors under which those performances will occur. Once the goals have been identified, the individual's residual skills and abilities must be identified [86]. After consideration of these components (the activity, context, assistance, and human components), the process of implementing the AT requirements and characteristics that match the consumer's needs begins [84], [86]. Finally, each individual's medical benefits and personal goals must be prioritized and the reimbursement policy must also be carefully considered to achieve reimbursement coverage if necessary. However, the final clinical recommendation should not be influenced solely by the coverage policy when prescribing AT devices for the end user [83], and consideration should be given to financing or payment by the user as well as coverage from other sources.

The PHAATE model has been shown to be a useful framework for AT development and service delivery. As usability assessments are carefully considered in several areas of manufacturing and product development, incorporating the PHAATE model to assess usability is

worthwhile [87],[88]. For example, implementing a theoretical framework such as participatory action design and engineering (PADE) in research and development requires a thorough understanding of all the components of the PHAATE model [83]. In other words, incorporating the PHAATE model into a PADE framework enables researchers and developers to understand the context in which the product will be used, determine how effectively and efficiently AT users interact with the device prototype to accomplish activities in different contexts and environments, and understand the relevant reimbursement policies to avoid coverage being denied when the AT device enters the marketplace[83],[89]. The components of the PHAATE model applied to AT are detailed in the following paragraphs.

### **3.3.1 Policy**

Policy considerations are unique to the PHAATE model. They influence the decisions intended to promote safe activity, produce inclusive environments, provide cost reimbursements, and protect quality of life [83],[84]. PWDs are usually affected by public and often private policies. The reimbursement policy for AT and AT services is influenced, if not determined, by the public and private sectors. To underestimate the impact of policy on the design and service delivery process is to risk the denial of reimbursement or the entry of the AT device into the marketplace [83]. In the United States, the primary sources of funding for AT are Medicare, Medicaid, private insurance, private donations from service clubs, and Offices of Vocational Rehabilitation, and US Department of Veteran Affairs [74]. However, obtaining approval for funding from these sources may be time consuming, especially as the first claim may be denied, in which case further explanation and additional justification are required for resubmission [74]. Every funding source for AT has its own criteria that must be met to obtain funding for the recommended equipment

[74]. For this reason, in some cases, the client may not meet the criteria and therefore may not receive the recommended equipment, which may affect their desired goals and outcomes [74]. Some studies have indicated that the major reasons for claims being denied include: (1) missing or incomplete information supplied in the request; (2) the conclusion that the requested device was not medically necessary; (3) the notion that the equipment would not enhance self-care; and (4) the fact that another less costly device could be substituted for the recommended one [74].

In Saudi Arabia, there are several regulations that underlie, enhance, and promote the rights of PWDs. Within a framework of legality and equality, the Kingdom of Saudi Arabia has taken it upon itself to preserve the rights of PWDs in a manner that promotes dignified living and improves the services provided to them [90]. This includes, but is not limited to, providing PWDs with appropriate means of prevention, care, and rehabilitation. These efforts have resulted in the development of a network of medical, psychological, social, and legal provisions, which are aimed at the prevention and/or early detection of disabilities [90] [77]. The systems of provisions include a comprehensive care system for those who require it based on factors such as health status, the severity of the disability, and professional background. This system includes enhancing efforts toward providing PWDs with adequate medical care, social support, psychological support, and educational assistance, thereby aiding the PWD to integrate into society and become productive, self-sufficient members of society [90] [77].

The process of AT provision to a PWD in Saudi Arabia differs according to the internal policies of the provision in each sector. For example, the MOH provides AT services to inpatients only who are admitted to their hospitals for free of cost. In some cases, AT devices such as prosthetic and orthotic devices are provided to outpatients who reside in rural areas due to the lack of prosthetic and orthotic centers in those areas. Other governmental sectors such as the MHRSD,

and non-profit organizations such as the Children with Disabilities Association, Association for Mobility Disability for Adults provide AT services to all Saudi PWDs with free of cost. However, most of these sectors do not follow a specific clinical guideline during the service-delivery process of AT services. Therefore, factors such as the absence of following a specific clinical guideline during AT service-delivery process, lack of involvement of users, lack of knowledge and awareness about existing technologies, and contextual factors (i.e., physical and structural factors, and personal factors) may result in providing inappropriate AT. In addition, such factors may result in an increased risk of secondary complications, poverty and social isolation, limited access to education and work, equipment abandonment, and an increased physical burden for caregivers and society [71] [91].

### **3.3.2 Human**

Different aspects of disability arises from various physical and mental illnesses; sensory, cognitive, and intellectual impairments or limitations; as well as learning impairments and various types of chronic diseases, all of which can hamper or reduce a person's ability to carry out their daily living activities [16]. Disability is defined by the interaction of an impairment or limitation and the physical, social, and cultural environment. Impairments can be sorted into a number of sub-categories, which include mobility/physical, SCI, head injuries (traumatic brain injury), vision, hearing, cognitive/learning, psychological, and invisible impairments. For mobility and physical impairments, the category of disability includes people with varying types of physical limitations including upper limb(s) impairments, lower limb(s) impairments, manual dexterity, and dysfunction in coordinating different organs of the body. Disabilities in mobility can be either from birth, acquired through trauma or disease, or accumulated through aging [16].



According to the WHO report on disability, there are currently over two billion PWDs in the world, which represents 37.5% of the global population, of whom 20% of whom live with significant functional difficulties in their everyday lives [92]. In addition, over 1.3 billion people are affected by some form of blindness and visual impairment, 466 million people have deafness and learning disabilities, and approximately 200 million people have an intellectual disability [92]. It is also estimated that over one billion PWDs and older adults are currently in need of AT devices, but only 10% of them have access to these devices. For example, 75 million PWDs around the world need a wheelchair, but only 5-15% of them have access to one; only 5% of over 40 million people with limb loss have access to prosthetic devices, while only 10% of people who need hearing aids are able to acquire them [92].

In Saudi Arabia, over two million (i.e. 7.1%) of the total Saudi population of 32.5 million have some form of disability, with males representing approximately 3.7% and females 3.4% of the population, according to the Saudi General Authority for Statistics [93]. Visual impairment was reported as the most prevalent disability type accounting for 46.02% of Saudi's PWD population, while 29.13% of the Saudi population of PWDs are registered as having a physical impairment. The Riyadh region has reported the highest rate of PWDs (25.13%) compared to the other Saudi regions. In addition, the aging population in Saudi Arabia is 5% and this number is expected to increase to 20.9% by 2050 [93].

### **3.3.3 Activity**

The activity component in the PHAATE model includes the evaluation of the consumer's desired goals based on their daily activities, performance, and roles [94]. It is important for PWDs to have opportunities to engage and participate in all of life's activities, including education,

employment, sports, recreation, family life, shopping, and voting. There is a growing population of PWDs and the technologies available for them are expanding as well. For instance, PWDs frequently face challenges in academic, social, and community participation, and may also be subjected to discrimination and social stigma based on their age, gender, language, ethnicity, religion, and social status [95] [96]. Therefore, AT along with accommodations such as personal assistance, sign language interpreters, and other removal of barriers are the key element to support full inclusion of PWDs in areas such as education [95] [96]. In addition, AT is crucial in removing barriers and promoting success in the workforce, which enable PWDs to work and be more productive and independent, and achieve job stability, and greater job satisfaction [97]. Adaptive sports and recreation activities are other examples of activities where AT plays an important role in promoting the greater inclusion of PWDs in society, which may contribute to changing perceptions about their capabilities [98]. Such activities can also build strength, flexibility, stamina, and improve the quality of life for PWDs [99]. Furthermore, adaptive sports create opportunities that allow people with and without disabilities to participate and engage in these activities together.

### **3.3.4 Assistance**

AT products may enable PWDs and older adults to live healthy, productive, and independent lives and to participate in education, work, and civic life [100]. Although AT products can help to reduce the need for formal healthcare and support services as well as informal care by family and friends, there is still a need and demand for assistance [101]. PWDs may require assistance due to their functional disabilities, meaning that help may be needed with personal care, mobility, activities of daily living, or home healthcare [101]. The support provided by health

professionals, family members, friends, or informal caregivers plays an important role in the lives of many PWDs and older adults [101]. For example, family members and friends may provide support to their PWDs and/or older adults by obtaining information and coordinating services, and assisting with daily activities. Healthcare professionals may provide means of support and assistance by supplying healthcare services, reliable information about their medical condition, providing equipment, and other care. PWDs may require a range of services and assistance, which range from minor and inexpensive interventions to complex and costly ones [16]. Examples of often unmet needs for support include everyday activities such as personal care; access to aids and equipment; participation in education, employment, and social activities; and modifications to the home or workplace [16].

### **3.3.5 Technology**

Many ATs are currently available on the market today. They range from low-technology or no-technology devices (e.g., mechanical assistive devices such as crutches, canes, grab-bars, walkers, etc.) to high-technology devices (e.g., electromechanical or computerized tools such as speech and communication devices, power wheelchairs, assistive robots, and intelligent systems, etc.) [67]. AT includes products that reduce sensory and functional impairments by providing the means to move (e.g., wheelchairs, prosthetic devices, lifts, portable ramps, etc.), to communicate (e.g., augmentative and alternative systems, text-to-speech software programs), to listen (e.g., hearing aids), and to manage self-care tasks (e.g., environmental control units) [67].

A successful AT service delivery outcome requires a team of AT professionals with specialized knowledge of the proper technology, as it has a tremendous impact on an individual's health and quality of life. The specialized knowledge should begin with a multi-disciplinary team

AT assessment team that includes a physiatrist, occupational and/or physical therapists, a speech and language therapist with specialty training/certification, a rehabilitation engineering technologist, and a RESNA (Rehabilitation Engineering and Assistive Technology Society of North America) certified AT professional (ATP) who may also need to be consulted depending on the needs and goals of the end user. Rehabilitation counselors, nurses, personal care assistants, and other professionals can also make important contributions to the AT team. A proper assessment begins with an initial interview that involves paying attention to the end user's needs, concerns, and goals. It is important to understand the medical variables, assessed by the physiatrist and shared with the team concerning how any underlying medical conditions may impact the AT recommendation process. The physical and functional variables assessed by the therapists with regard to how the individual's physical, sensory, and cognitive capacities and limitations affect their mobility and activities of daily living should also be included. It is important to know how the end user performs tasks and what their limitations are. The team members must explain the intended outcomes, reasons, and facts upon which they have based the final AT recommendation.

### **3.3.6 Environment**

Several factors influence the extent of AT use and development including environmental factors related to the device, intervention-related factors, factors related to the surroundings, and personal factors. The environment concept is complex and includes not only the physical and structural environment but also the social and psychological environment and the attitudinal environment [102]. The experiences of environmental factors are subjective and may therefore be regarded differently by individuals, either as barriers or facilitators, and by their presence or absence [102]. According to the International Classification of Functioning model (ICF),

environmental factors can have a significant impact on the scope of AT use, participation in the society, and development including environmental factors related to the device, intervention-related factors, factors related to the surroundings, and personal factors [103].

In Saudi Arabia, there are several factors such as cultural traditions, socioeconomic status, lived experiences, and environmental barriers that have an impact on the Saudi's society's view of disability, PWDs' perceptions of their life satisfaction. Consequently, the provision of AT services has been impacted by these factors. For example, barriers such as the vast geographical areas in Saudi Arabia have an effect on the provision of medical care and rehabilitation services to the Saudi PWDs. People who live in rural areas may not get the appropriate AT devices due to the lack of specialized care clinics and trained professionals. It is not surprising to find that medical services, rehabilitation institutions, and health education programs are more available in urban cities than rural areas because the incidence of disability in cities is higher than in rural areas [104],[105]. Other important barriers that might impede the appropriate AT provision to Saudi PWDs include, but are not limited to, high cost of AT, availability of AT, a lack of trained personnel, a lack of awareness about existing AT and associated services, a lack of users' involvement, inaccessible environments, a lack of accessible and affordable transportation, and policy and system barriers [77],[104],[105].

### **3.4 DISCUSSION**

The Saudi Arabian government seeks to enable all its citizens, particularly PWDs, to be active in all areas, including social, educational, and economic spheres [77]. Thus, PWDs and older adults in Saudi Arabia receive attention and support from the Saudi government through the

amelioration of the barriers that impact their participation in society and through the provision of services and facilities that enhance their quality of life [77]. AT service is one of the primary services that the Saudi government seeks to provide for people with different disabilities and older adults. According to the Legislation of Disability that was enacted in 1987, the rights of PWDs are equal to those of other individuals in Saudi society in terms of medical care and rehabilitation [77].

Nonetheless, in Saudi Arabia, the availability of AT devices is mainly limited to basic mobility and daily living aids such as wheelchairs and seating systems, prosthetics and orthotics, communication devices, low-vision devices, and adapted transportation equipment. Although assistance from family members and/or caregivers is available, formal AT services are still distinctly limited or unavailable. Most AT services are provided by the government through the MOH and the MHRSD. Both ministries provide services for evaluation and rehabilitation along with AT devices that meet the needs of people with various disabilities. Another way of obtaining AT devices is through the private sectors whereby individuals either pay out of pocket for their devices or through private medical insurance. However, there is still a lack of awareness and knowledge concerning AT applications and services, as well as the optimal service delivery models for AT devices. As a result, this paper highlights the PHAATE model as a conceptual framework that is able to serve a wide range of stakeholders in Saudi Arabia (e.g., researchers, product developers, practitioners, clinicians, third-party reimbursement entities, consumers, and educators) when developing service delivery systems.

To effectively address these issues, a few recommendations should be considered. First, the PHAATE model could serve as a comprehensive guideline for clinicians and healthcare providers, and administrators to create feasible and reliable AT devices and services for PWDs, thereby, helping PWDs to resume their social activities and enhancing their participation and

interactions with their families, friends, and communities. Such a guideline could help clinicians and other healthcare providers in Saudi Arabia to make informed decisions about the provision of AT device services. In addition, the Ministry of Education should encourage the universities in Saudi Arabia to integrate AT and its services and applications into their curricula. In addition, rehabilitation professionals must acquire in-depth knowledge of AT options to be able to select and prescribe the most appropriate technology to meet their clients' needs and goals [74]. Moreover, it is necessary to educate clients and families about the importance of AT to enhance quality of life and ensure a means of independence for PWDs [74].

### **3.5 CONCLUSION**

AT devices provide essential means of mobility, communication, and social engagement for older adults and people with different disabilities, if prescribed correctly prescribed to match users' needs and goals. Regardless of the setting or location, a successful AT service delivery model includes the multidisciplinary collaboration of the PWD and the specialists who have knowledge and expertise in the design and application of AT. With strong collaborations between PWDs and healthcare professionals and adherence to quality documentation and ethical and legal standards, the AT service delivery process will positively impact the integration of PWDs into the community and improve quality of life. AT devices improve users' independence, self-confidence, productivity, and social integration in different settings, such as the home, classroom, workplace, and community. Although the Saudi government provides support for the provision of AT, many of the country's rehabilitation professionals lack experience and knowledge of the different technological options that can be prescribed for a person with a disability, which is a stumbling

block to achieving the maximal benefits that AT allows. Therefore, this paper aims to provide clinicians and healthcare providers in Saudi Arabia and perhaps with other countries with the basis for the optimization of the provision of AT devices and methodical decisions regarding AT devices for PWDs by adhering to a user-centered team approach throughout the service delivery process. Users and caregivers should be educated in the importance of AT devices and the positive impact such technologies can have on quality of life, as this knowledge that will help to encourage use of the technology and prevent its abandonment. Healthcare professionals, users, and caregivers should continue to update their knowledge of the new technologies and services.



## **4.0 CROSS-CULTURAL ADAPTATION AND VALIDATION OF CONSUMER PRIORITIES FOR MOBILITY ASSISTIVE TECHNOLOGY SURVEY**

### **4.1 INTRODUCTION**

According to a recent report by the World Health Organization (WHO), more than two billion people with disabilities (PWDs) and older adults are currently in need of AT, of whom only 10% have access to these devices [1]. Consequently, international organizations such as WHO, represented by the Global Cooperation on Assistive Health Technology (GATE), the International Society for Wheelchair Professionals (ISWP), and the United Nations (UN) through the Convention on the Rights of Persons with Disabilities (CRPD), have taken substantial steps toward addressing the global gap in AT device provision by supporting global research and development (R&D) priorities [17],[106]. Their goals are to promote innovation, research, deployment, and education across all the categories of AT devices to keep PWDs and older adults around the world healthy, active, productive, and independent. Achieving these priorities entails increasing the accessibility, acceptability, adaptability, affordability, and availability of high-quality AT devices [17]. A critical first step is to assess the needs, priorities, level of knowledge, and possible solutions to more effectively meet the needs of PWDs and older adults through participatory action research that seeks to capture the baseline knowledge of AT at the national levels, and subsequently at a global level.

In response to the global recall, several research attempts have been made to heed the voice of the consumer (VOC) and recognize the consumers' perceptions of their needs and priorities that are related to MAT. These efforts aim to eventually inform research priorities that could be used

to address gaps in the provision process. For example, in the United States, the Human Engineering Research Laboratories (HERL) team conducted a series of VOC studies to explicitly identify the consumers and providers' opinions about their MAT-related needs and priorities. These studies identified consumer and provider views on their MAT-related needs and priorities. These studies thereby informed R&D priorities when addressing gaps in MAT [40][41][59]. The studies' results revealed several themes that help build a preliminary roadmap for future areas of R&D, including the development of assistive robotics and intelligent systems, smart home technologies, alternative power sources, and human-machine interfaces. Furthermore, these studies identified disparities in the knowledge of new AT products between provider and consumer experiences [40][41][59]. For example, they found that providers believe that information on new products is easy to find; instead, MAT consumers have several gaps in their knowledge of new products and desire to be more included in the process of research, development, and provision process. In addition, they found that the most common barriers to obtaining new technologies included lack of consumer knowledge about existing technology, lack of provider knowledge about the technology or its delivery process, and lack of training and support for proper maintenance [40][41][59]. A recent study was conducted based on these studies to address the gaps in knowledge and training; it assessed the approaches that consumers use to learn about emerging technology, their knowledge of emerging technology, laws and standards, AT assessment tools, and clinical practice guidelines [107]. This study identified specific gaps in the consumer knowledge of MAT, particularly within veteran populations, and helped develop data-driven dissemination and knowledge translation strategies. The survey used in this pilot study was developed by experts in the field of AT at the HERL based on the results of earlier surveys [40][41][59] on the needs of MAT consumers and providers. The content validity of the survey was established by the AT experts at the HERL with

the contribution of the VA Pittsburgh Healthcare System Veteran Engineering Resource Center (VERC). However, the content validity process was not reported on, and the materials from which the survey questions were informed were not reported or explained in the U.S. pilot study.

Understanding the gaps in consumer knowledge, awareness, training, and the preferences on accessing information about AT is the first step toward accessing the proper technology and reducing the abandonment rate; in this regard, the researchers at HERL decided to expand the objectives of the VOC projects on a global level to keep up with the demand for MAT. Saudi Arabia had been decided to be the first country to target. Therefore, the aim of this study was to cross-culturally adapt the English version of the survey that was developed and piloted in one of the U.S VOC studies [107] into Arabic, examine its face validity, and test the pre-final Arabic version among MAT users in Saudi Arabia. Testing the face validity of the adapted survey is a crucial step in ensuring that the translated version retains its equivalence and that the items, instructions, and response options are meaningful and represent their intended use [108]. Several studies have adopted such an approach to support the validity of an assessment tool and to reflect the thought processes of test takers as they respond to the tool, and that can be quantified by face validity index (FVI) [109]–[111]. The raters of face validity may include (1) the person who takes the test, (2) non-professional users who work with the results of the test, and (3) the general public [112].

## **4.2 METHODS**

The study was approved by the University of Pittsburgh Institutional Review Board. In addition, local regulatory approval to conduct the study was obtained through the National

Committee of Bioethics (NCBE) in Saudi Arabia. This study involved two phases: Phase 1 covered the adaptation and validation of the original English survey and Phase 2 entailed the translation and face validation of the Arabic version (see Figure 3).

#### **4.2.1 Phase 1: Modification of the English Survey**

The English version contains some domains that are neither applicable and nor feasible to be included in the Arabic survey. Hence, the English survey was first modified by the main author, a Saudi Arabian citizen, who has extensive experience in AT and is professionally bilingual in English and Arabic (see Appendix A). First, questions about standards and laws, assessment tools, and clinical guidelines were excluded when neither applicable nor comparable to those used in Saudi Arabia. Second, questions such as information sources that Saudi MAT users utilize to find information about MAT were also adjusted based on the available sources in Saudi Arabia. For example, sources such as newsletters, magazines, events, and conferences were adapted to those available in Saudi Arabia or globally. In addition, the new and advanced technology awareness questions were adjusted to include new ATs that may be more familiar to Saudi MAT users. Some demographics were also adjusted for the Saudi culture. However, no changes were made to other questions (i.e., users' level of skills in using MAT) or to open-ended questions. The English survey items were then assessed by the four authors of this papers (i.e., the expert committee) who have experience in AT-related research and clinical expertise. The authors evaluated the content relevance and simplicity of the individual items and the questionnaire as a tool. They agreed that the revised English survey was feasible and relevant in its content.

#### **4.2.2 Phase 2: Translation and Face Validity Process**

Guidelines published by Beaton et al. were used for translating the modified English version in four stages [113]. In the first stage, forward translation from English into Arabic was independently performed by our collaborator in Saudi Arabia who is a bilingual and native Arabic speaker with oral and written proficiency in English. The translator is a physiotherapist with extensive experience in translating and validating some scales into Arabic. A written report of the forward translation was submitted to the expert committee, along with the translator's comments.

In the second phase, the Arabic version of the survey was back-translated into English by a native English speaker with a strong oral and written proficiency in Arabic, and a report was presented to the committee.

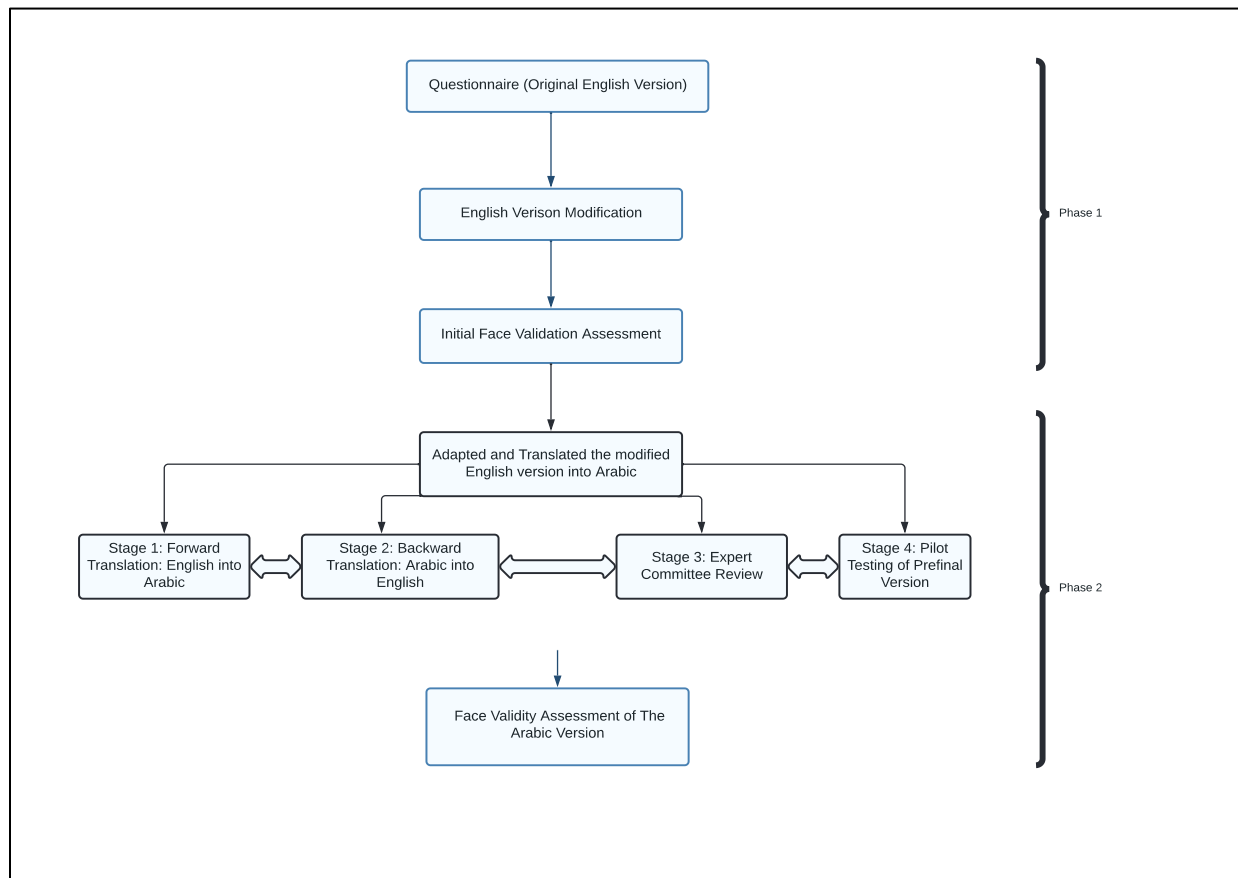
During the third phase, the expert committee evaluated all the translations and reviewed both written reports. After the evaluation and review of the reports sent by the translators, the committee reached a consensus on all the discrepancies, and a pre-draft version in Arabic was formulated. Issues were encountered with wording, clarity, and relevance for cultural understanding; several items were then revised in the translated version. A few changes were made to the Arabic version before conducting the pre-final test. These changes included modifying the unit of height from inches into centimeters and culturally adapting the response options ranging from 4 (critical) to 1 (not important). As direct translation to one of the Likert-scale options (i.e., critical) could cause some confusion in wording in Arabic, this option was replaced with "extremely important." Thus, the options were translated as follows: 5 (extremely important), (very important), 3 (moderately important), 2 (slightly important), and 1 (not at all important) (refer to Appendix B).

In the fourth phase, the survey was tested on a sample of Saudi mobility device users online through the Qualtrics software [114].

The next step was to assess the face validity of the Arabic survey items by a group of participants who had completed the survey. The interested participants were contacted and asked to evaluate the translated version, determine whether the survey items and the instructions were clear and understandable, and ascertain how well the survey items and the instructions were outlined and presented using an online form. An online form was sent to each participant by email; the participants were asked to rate the current draft of the Arabic version, provide feedback, and make recommendations on the important items to include in the final version. Furthermore, the participants were asked to independently rate the level of clarity and comprehension and provide scores for each item in the survey using a four-point Likert rating scale consisting of 1 (not clear and understandable), 2 (somewhat clear and understandable), 3 (clear and understandable), and 4 (very clear and understandable).

The sample was recruited from hospitals, rehabilitation centers, and disability associations in Saudi Arabia. The participants were recruited by AT providers and consumers in person and through flyers. A list of potential participants' emails was obtained through rehabilitation hospitals administrations and disability associations. A collaborator in Saudi Arabia distributed a link to the survey to the interested participants by email. The recruitment materials were also posted on a few social media platforms such as Twitter, Facebook, and WhatsApp groups. Referral sampling was used for recruitment, encouraging participants to distribute recruitment materials to their own networks. The potential participants were instructed to access the survey online in the Arabic version. The inclusion criteria included being 18 years of age or older, a Saudi Arabian citizen, live in Saudi Arabia, and a user of any type of MAT devices. No exclusion criteria were involved.

The participants were required to complete an online informed consent document prior to accessing the survey. For those with cognitive impairments or inability to complete the survey due to the inaccessibility of some questions in the survey, their family members or friends were asked to complete the survey as a proxy for the participant. The active recruitment period for this study covered more than two months (January-March 2022), with a target goal of obtaining 30-40 participants. The respondents were not reimbursed for their participation.



**Figure 3. Flowchart of the cross-cultural adaptation process of the translation and validation of the consumer knowledge sources survey from the English version into Arabic.**

The survey homepage provided an overview and instructions for completing the survey. The survey comprised about 35 questions. The question formats in the survey included forced-

choice questions with open-ended “other” options, Likert rating scales, and open-ended questions. The participants were asked to respond to questions based on their own knowledge and opinions. Information on diagnoses leading to mobility impairment and the prior use of MAT devices was collected in the survey. The survey included questions about the specific information sources that the participants utilize for finding information on MAT, as well as open-ended questions to respond to those queries. The participants were also asked about the key sources for learning about new and advanced MAT and their awareness and skills in using MAT. In addition, they were asked to assess the importance of their providers having knowledge about new MATs. A list of manual wheelchair and power wheelchair skills was presented to the users of these devices to determine their skill level. The participants were similarly asked about their knowledge of and familiarity with new and advanced MATs. At the end of the survey, the participants were asked about the specific type of MAT on which they need further information. In the final part of the survey, the participants were asked to provide their demographic information, such as gender, age, education level, income level, and the city of residence. At the end of the survey, some personal identifiable information was collected to ensure that the responses were not repeated.

### **4.2.3 Statistical Analysis**

#### **4.2.3.1 Face Validity**

Microsoft Excel 2011 (Microsoft Corporation, Redmond, WA) was used for data entry and the calculation of face validity statistics. Two forms of face validity index (i.e., FVI for item, or I-FVI, and FVI for scale, or S-FVI) were computed. The clarity and comprehension ratings by the participants in the “English Survey Modification and Validation” portion of the study were recoded as 1 (the scale of 3 or 4) or 0 (the scale of 1 or 2). The I-FVI is the proportion of raters giving an



item a clarity and comprehension rating of 3 or 4. The S-FVI was calculated based on the average method, which involved adding the I-FVI scores across all items and dividing the total by the number of the items.

For the descriptive analysis of the pilot data, categorical variables were presented using frequency counts, proportions (percentages of the total responses), mean, range, and standard deviation using IBM SPSS (IBM SPSS Statistics, Version 22, Armonk, NY).

### **4.3 RESULTS**

Upon collecting the data, 20 out of the 54 participants expressed their interest in evaluating the face validity of the Arabic version. Therefore, an online form was sent to them by email to fill out and provide scores to each item in the survey. The FVI results are shown in Table 5. For the clarity and comprehension of the survey items, the S-FVI score was 0.85, which is above the threshold according to Marzuki et al. (2018) and Yusoff (2019), whereby the acceptable cut-off score of FVI for over 10 raters is at least .80 in online survey research [115],[112]. Thus, this score indicated a satisfactory level of face validity. However, the item-level indices (I-FVI) for skills in using MAT devices and new and advanced MAT awareness items were below the threshold (i.e., 0.70 and 0.45), respectively, suggesting an unsatisfactory level of face validity. On both items, the participants suggested the revision of both questions. The demographic information of the 20 participants who responded to the online form are presented in Table 6. The average age of the participants was 35 (SD 8.25) years. The majority of the respondents were male ( $n = 15$ , 75%).

**Table 5. Face Validity Index of Clarity and Comprehension of the Arabic version of the survey**

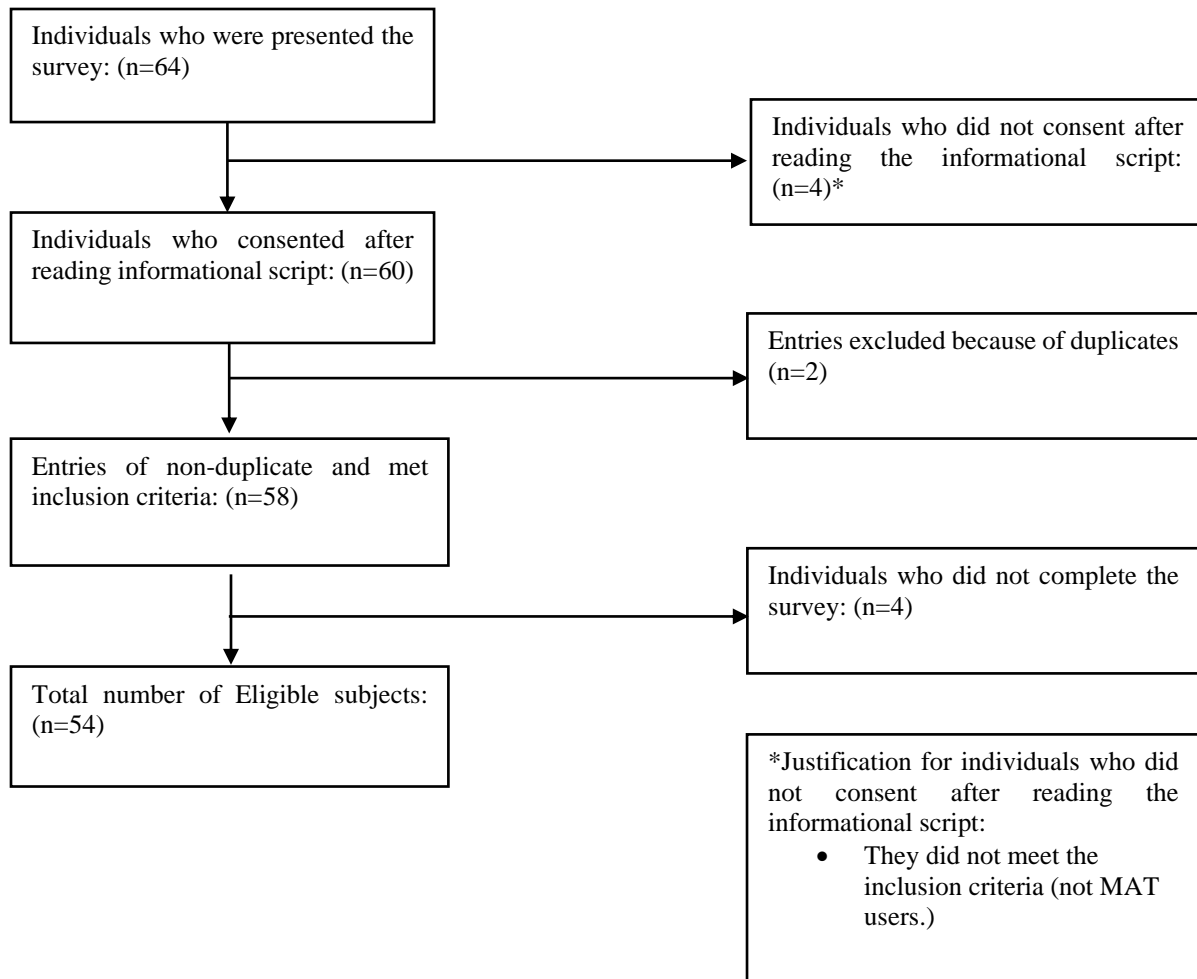
Items	Raters in Agreement	I-FVI
Instruction and informed consent information	19	0.95
Diagnoses		
Type of diagnoses	18	0.9
Type of Traumatic Brain Injury	17	0.85
Level of Spinal Cord Injury	19	0.95
Type of MAT used often	18	0.9
Time using MAT	19	0.95
Information sources		
Type of information sources	16	0.8
Internet sources	16	0.8
Social media sources	17	0.85
Events	16	0.8
Newsletters	16	0.8
Magazines	16	0.8
Conferences	17	0.85
Importance of AT knowledge	20	1
Skills in using MAT devices	14	0.7
New and advanced AT awareness	9	0.45
Type of MAT devices that need more information on	19	0.95
The ways of receiving information	18	0.9
Demographic Information	20	1
S-FVI/Ave		0.85

**Table 6. Participants Demographics (N=20)**

	<b>No. (%) of respondents</b>
<b>Age (years), mean <math>\pm</math> SD</b>	35 $\pm$ 8.23
<b>Gender n (%)</b>	
<b>Male</b>	15 (75)
<b>Female</b>	5 (25)
<b>Highest level of education n (%)</b>	
<b>High school diploma or equivalent (GED)</b>	2 (10)
<b>Associate's degree</b>	10 (50)
<b>Bachelor's degree</b>	8 (40)
<b>City of living n (%)</b>	
<b>Riyadh</b>	13 (65)
<b>Jeddah</b>	3 (15)
<b>Dammam</b>	3 (15)
<b>Abha</b>	1 (5)
<b>Diagnoses</b>	
<b>Spinal Cord Injury</b>	9 (45)
<b>Traumatic Brain Injury</b>	3 (15)
<b>Stroke</b>	2 (10)
<b>Cerebral palsy</b>	3 (15)
<b>Lower extremity amputation/congenital limb deficiency</b>	3 (15)

The participant flow is illustrated in Figure 4. Data from 54 participants were analyzed. Table 7 shows the demographic profile of the survey respondents. The average age of the participants was 40 (SD 9.3; range 22 – 54) years; the participants lived in eight different cities in

Saudi Arabia. Most of the respondents were male (n = 34, 63%). The diagnoses of the participants are shown in Table 8. Participants with a spinal cord injury (SCI) comprised the largest diagnostic group (n = 23, 42.6%), followed by participants with a traumatic brain injury (n = 10, 18.5%). Of the participants with SCI, nine (39.1%) had tetraplegia and 14 (60.9%) had paraplegia. Out of 54 participants, 28 (51.9%) reported being power wheelchair (PWC) users, 13 participants (24.1%) were manual wheelchair (MWC) users, 6 (11.1%) were users of a lower extremity prosthesis, 2 (3.7%) were users of a lower extremity orthosis, and 4 (7.4%) were users of other assistive devices users (e.g., cane, crutch, walker). The majority of participants (n = 30, 55.6%) had been using their MAT devices between two and five years (see Table 9).



**Figure 4. Exclusion Flowchart**

**Table 7. Participants Demographic (N=54)**

	<b>No. of respondents</b>
<b>Age (years), mean <math>\pm</math> SD</b>	39.62 $\pm$ 9.25
<b>Gender n (%)</b>	
Male	34 (63)
Female	20 (37)
<b>Highest level of education n (%)</b>	
High school diploma or equivalent (GED)	13 (24.1)
Associate's degree	22 (40.7)
Bachelor's degree	19 (35.2)
<b>Household income SR n (%)</b>	
Under SR 10,000	3 (5.6)
SR 10,000- SR 15,000	12 (22.2)
SR 15,999- SR 20,000	11 (20.4)
SR 20,999- SR 40,000	1 (1.9)
Prefer not to answer	27 (50)
<b>City of living n (%)</b>	
Riyadh	20 (37)
Jeddah	15 (27.8)
Dammam	8 (14.8)
Abha	3 (5.6)
Hail	2 (3.7)
Tabuk	1(1.9)
Aljof	3 (5.6)
Skaka	2 (3.7)

**Table 8. Participants Diagnoses (N=54)**

	<b>No. (%) of respondents</b>
Stroke	5 (9.3)
Upper extremity amputation/congenital limb deficiency	2 (3.7)
Lower extremity amputation/congenital limb deficiency	4 (7.4)
Multiple sclerosis	-
Amyotrophic lateral sclerosis (ALS)	2 (3.7)
Spina bifida	-
Cerebral palsy	8 (14.8)
Osteo/Rheumatoid arthritis	-
Other	-
Spinal cord injury	23 (42.6)
Tetraplegia or quadriplegia (C1-C8)	9 (39.1)
Paraplegia (T1 and below)	14 (60.9)
Complete	10 (43.5)
Incomplete	13 (56.5)
Traumatic brain injury	10 (18.5)
Was your injury traumatic or non- traumatic?	
Traumatic	5 (50)
Non-traumatic	5 (50)

**Note:** Participants could choose more than one diagnosis.

**Table 9. Primary MAT and length of time using device (N=54)**

	<b>No. (%) of respondents</b>
<b>What assistive mobility device do you use most of the time?</b>	
Manual wheelchair	13 (24.1)
Power wheelchair	28 (51.9)
Scooter	-
Lower extremity prosthesis	6 (11.1)
Lower extremity orthosis (brace)	2 (3.7)
Assistive device (cane, crutch, walker)	4 (7.4)
Other	1 (1.9)
<b>How long have you been using this device?</b>	
< 1 year	11 (20.4)
2-5 years	30 (55.6)
6-10 years	2 (11.1)
> 15 years	7 (13)

When asked to report their sources for finding information on AT, the majority of participants selected the internet (n = 39, 72.2%), social media (n = 34, 63%), physical therapists (PTs) or occupational therapists (OTs) (n = 34, 63%), and physicians (n = 29, 53.7%); for the detailed responses, see Table 10. When presented with specific examples of internet sources, the majority of participants reported Google search as the most frequently used source for finding information about AT (n = 38, 70.4%). Of the social media sources presented, YouTube, Facebook, and Twitter were identified as the most frequently used sources for locating information about AT (see Table 10).

More than half of the participants (n = 33) responded to an open-ended question about the specific information source that they deem important to learn about AT. Their responses included



the internet, social media, and PTs or OTs. The largest number of the participants (n = 18, 54.5%) cited the internet as the key source of information (see Table 11).

**Table 10. Information sources (N = 54)**

<b>Source</b>	<b>Specific source selected; No. (%) of respondents</b>
<b>Internet</b>	39 (72.2)
World Health Organization (WHO)	1 (1.9)
Eastin	14 (25.9)
Disabled-World	26 (48.1)
Wikipedia	8 (14.8)
Google Search	38 (70.4)
Other	-
<b>Social Media</b>	34 (63)
Facebook	19 (35.2)
YouTube	32 (59.3)
Twitter	31 (57.4)
LinkedIn	15 (27.8)
Instagram	5 (9.3)
TikTok	2 (3.7)
Snapchat	16 (29.6)
Other	-
<b>Events</b>	12 (22.2)
Paralympics	10 (18.5)
Adaptive Sports - teams, competitions, gyms, or coaches	10 (18.5)
Local disability fairs	4 (7.4)
International Day of Persons with Disabilities	8 (14.8)
International Day of Physical Therapy	12 (22.2)
Other	-
<b>Newsletters</b>	4 (7.4)
The Authority for the Care of Persons with Disabilities (APD)	4 (7.4)
Children with Disabilities Association	4 (7.4)
Disability Association Motor for Adults Mobility	4 (7.4)
Al-Arabia News	2 (3.7)
Other	-
<b>Magazines</b>	6 (11.1)
Disability Eco	5 (9.3)

**Table 10. (Continued)**

Saudi Disability and Rehabilitation	<b>5 (9.3)</b>
Special Education	3 (5.6)
Disability World	5 (9.3)
Other	-
<b>Conferences</b>	<b>12 (22.2)</b>
International Conference of Experts on Disability and Rehabilitation	11 (20.4)
International Conference on Disability and Rehabilitation	11 (20.4)
Saudi Conference for People with Disabilities	8 (14.8)
International Seating and Wheelchair Symposium (ISS)	4 (7.4)
Other	-
<b>Television</b>	<b>3 (5.6)</b>
<b>Newspapers</b>	<b>1 (1.9)</b>
<b>Physicians</b>	<b>29 (53.7)</b>
<b>Physical or Occupational Therapists</b>	<b>34 (63)</b>
<b>Research Studies</b>	<b>1 (1.9)</b>
<b>Family/Friends using Assistive Technology</b>	<b>10 (18.5)</b>
<b>Other</b>	<b>-</b>

**Table 11. Most important information source (N = 54)**

<b>Source</b>	<b>No. (%) of respondents</b>
Internet	18 (54.5)
Social Media	10 (30.3)
Physical or Occupational Therapists	5 (15.2)

#### 4.4 DISCUSSION

This study presented the cross-cultural adaptation process of a previously developed English-language survey aimed to identify knowledge gaps in clinical skills, emerging technology, and preferred sources to find information about AT into the Arabic-language. Another aim of the study is to examine the face validity of the Arabic pre-final version to ensure that the translated version maintains its equivalence and that the items, instructions, and response options are relevant to meaningful to MAT users within Saudi Arabia. A final aim of this study was to identify the issues that the participants might report (i.e., particularly with regard to wording, clarity, and relevance) to aid the cultural understanding; on the basis of such issues, a final version is prepared, will be used on a large and diverse sample of MAT users within Saudi Arabia.

Similar to other methods employed in other studies [116], [117], the recommended protocol of cross-cultural adaptation adopted in the current study is a useful method for establishing the validity and equivalence of the Arabic version of the survey. During the translation process, the translators reported no difficult experiences despite the non-adoption of Beaton's guideline of using two independent translators at each translation step. We believe that the translators' extensive experience and their background in translating and validating some scales into Arabic, combined with the simple language of the English survey, resulted in the non-emergence of major problems during the translation process. Only a few items were modified due to the cultural background of Saudi Arabia, including the metric units of measurement and one of the Likert-scale options (i.e., critical) that might cause some confusion in wording in Arabic; this option was replaced with "extremely important."

The FVI score for clarity and comprehension was within the satisfactory level of face validity was 0.85 indicating a satisfactory level of face validity. The result indicated that the

translation process was culturally valid to be used within a large sample of MAT users in Saudi Arabia. However, the I-FVI scores for two items in the survey were below the satisfactory level, which we believe was due to the inappropriate formatting of these two items. For example, the question about clinical skills in using MAT devices was confusing as reported by the participants, where the list of MWC and PWC skills was combined and no logic branching was created. The second question about familiarity with new and advanced MATs was unclear, and the description of each technology was lengthy and confusing. The participants, therefore, recommended reformatting the questions and or adding further clarification such as images or weblinks along with the descriptions of the new and advanced MATs. Disclosing the findings of these two items was inappropriate due to their low I-FVI scores. Therefore, reformatting the two items in the final version will facilitate the participants' reporting of meaningful data.

The internet, social media, and PTs or OTs were the participants' most commonly used resources for finding information about AT. Their responses to the open-ended question revealed that these same resources were important for learning about AT. These findings were considered comparable to the findings from the U.S. VOC pilot study, in which the internet and social media platforms were deemed the most frequently utilized resources for locating information about AT [107]. Many of the participants are young, suggesting that this age group may have computer and internet skills in locating AT information. However, having respondents from different regions of Saudi Arabia ensures that the sample is representative of the target population, given the wide cultural and linguistic diversity.

## 4.5 LIMITATIONS

This study has some limitations that worth discussing. First, the survey was disseminated to the participants and the data were collected prior to the assessment of the face validity of the Arabic version of the survey. Two items of questions obtained FVI scores that were lower than the threshold; hence, their data were neither presented nor included in the results section. Second, as the survey was conducted in an online format, we might have oversampled those participants who are technically savvy or have internet access. This factor may partly explain why the internet was identified as a commonly used source of information. In addition, no alternative means of completing the survey were provided, which might result in sample bias. Third, the modification to the English version items was made only by one individual (i.e., the main author, who is a Saudi Arabian citizen with an extensive experience in AT and is professionally bilingual in English and Arabic). This indicates that the modified items or options (e.g., information sources) might not be comprehensive and representative of the ones that are available in Saudi Arabia. However, during the validity process, the participants were informed that they could add any question/option they believe would be highly relevant and beneficial. Fourth, during the translation process, only one independent translator at each translation stage was hired, which was contrary to Beaton's guideline. This limitation might cause some translation issues. However, we believe that the translators' extensive experience and background in translating and validating some scales into Arabic, combined with the simple language of the English survey, resulted in the none-emergence of major problems during the translation process, as reported by the translators and the participants. Fifth, the sample size of this study may be considered small, thereby limiting the generalizability of the findings. However, this study was intended to test the prefinal version of the translated survey and to ensure that it retains its equivalence and that the items, instructions, and response

options are meaningful to MAT users within Saudi Arabia. The final version will be administered to a larger sample of MAT users within Saudi Arabia. Finally, the main form of validity used in this study was face validity, which is considered the weakest form of validity [112]. It is subjective and may only provide the appearance that a survey procedure is valid. In addition, the method used in this study to calculate and report the FVI results was not performed in a standard way. For example, some questions (e.g., demographic ones) were calculated based on the average method, whereby the clarity and comprehension scores on each item within the demographic section were aggregated, and the average score was reported. However, these questions should have been rated individually rather than as a group, and therefore the I-FVI scores of those questions should be interpreted with caution. To help ensure the survey items represent the intended use and to ensure that the translated version of the survey has equivalent properties to the original version, future researchers should assess additional psychometrics properties. For example, upon completing the translation and cross-cultural adaptation processes, a panel of experts should establish the content validity of the translated version in terms of the relevancy and representativeness of each item to a specific domain [118], [119]. This step should be followed by an assessment of the survey's face validity [118], [119]. Another approach to assess the face validity could be a cognitive approach, such as think-aloud sessions where participants can verbalize their thoughts in order to help clarify survey questions [120].

## **4.6 CONCLUSION**

This study reports the translation, cultural adaptation process, and evaluation of the face validity of a previously developed English-language survey; the aim of the survey is to obtain input

from MAT users to identify knowledge gaps in clinical skills and emerging technology and to identify information sources for AT in the Arabic language. The results of the cross-cultural adaptation process reveal that the Arabic version of the survey is simple to understand and culturally relevant to Saudi MAT users. In addition, the face validity results show that the Arabic version demonstrates good face validity. However, the I-FVI scores of two items about MAT users' skill knowledge of and familiarity with the new and advanced ATs were below the threshold. Thus, these two items will be adjusted in the final version by dividing the skill knowledge question into two parts and adding pictures or web links into the question about the familiarity of new and advanced MAT to clarify these technologies. Overall, the translated Arabic version is a valid tool for identifying knowledge gaps in clinical skills and emerging technology and determining the preferred source of information about MAT among MAT users in Saudi Arabia.

## **5.0 THE SAUDI ARABIA VOICE OF THE CONSUMER: A SURVEY OF CONSUMER PRIORITIES TO INFORM KNOWLEDGE TRANSLATION AMONG PEOPLE WITH DISABILITIES WITHIN SAUDI ARABIA WHO USE MOBILITY ASSISTIVE TECHNOLOGY**

### **5.1 INTRODUCTION**

According to a recent report by the World Health Organization (WHO), access to appropriate AT remains a global challenge, as only 10% of more than 2.5 billion people with disabilities (PWDs) and older adults who are currently in need of AT devices can have access to such devices [1]. This number is expected to grow to over 3.5 billion by 2050 due to population ageing and the prevalence of other chronic diseases [1]. Limited access to AT has a significant impact on the education, livelihood, well-being, and health of PWDs, older adults, families, and communities [1].

Several factors influence the need for and access to AT. Absence of knowledge and awareness about the products and services available to AT users, family members, and caregivers is an example of a barrier to the access of the appropriate AT devices [1],[121]. In addition, lack of information about the proper AT might limit awareness, leaving end users with little knowledge about the available products, training, and services. The research consequently found that more than 30% of AT devices were abandoned entirely, and one of the common reasons for abandonment was the users' lack of knowledge about the appropriate AT and inadequate user engagement during the assessment and design process [32],[30]. Martine et al. (2011) established a relationship between awareness of the appropriate AT and user satisfaction, whereby lower



satisfaction was associated with the lack of knowledge and awareness, resulting in the high level of abandonment of AT devices [29]. Therefore, cultivating awareness and being informed about AT are critical steps toward accessing the proper provision and services of such technology [122]. These steps also substantially contribute to the success of AT solutions [123].

The Global Cooperation on Assistive Health Technology (GATE) under the auspices of the WHO, the United Nations (UN), and the International Society for Wheelchair Professionals (ISWP) have undertaken serious actions worldwide to address the gap in AT provision by developing a global priority research agenda. In the 2018 Great Research, Innovation, and Education on Assistive Technology (GREAT) Summit, one of the top five research themes on AT was the assessment of awareness, need, and use of AT [124],[68]. In a recent WHO report, one of the top 10 recommendations for concrete action to improve access to AT is to increase public awareness of the available AT products and services [1]. In response to this global recall, several research attempts have been made to heed the voice of the consumers and the consumers' perceptions of their needs and priorities in relation to MAT; these research efforts are expected to inform research priorities that could be used for addressing the gaps in the provision process. For example, in the U.S., the human engineering research laboratories (HERL) team conducted a series of studies to explicitly identify the consumers and providers' opinions about their MAT-related needs and priorities. The aim of one of these studies was to inform research priorities that could be used for addressing the gaps not only in the provision process but also in skills training, knowledge of laws, standards, clinical practice guidelines, and preferred information sources [40],[41],[59],[107].

Understanding the gaps in consumer knowledge, awareness, training, and the preferences on accessing information about AT is the first step toward accessing the proper technology and

reducing the abandonment rate; in this regard, the researchers at HERL decided to expand the objectives of the VOC projects on a global level to keep up with the demand for MAT. A survey was subsequently developed and piloted in one of the U.S. VOC studies, with the aim of informing research priorities that could be used for addressing the gaps not only in the provision process but also in skills training, knowledge of laws, standards, clinical practice guidelines, and preferred information sources among MAT-using veterans with disabilities; this survey had been used for this purpose [107].

Saudi Arabia was the starting point of our research undertaking. The next step might include several countries around the world based on the interest we might receive from research collaborators. Thus, the English survey used by Quinby et al. (2021) was translated and culturally adapted into the Arabic language [107]. The Arabic version was then assessed among 54 Saudi MAT users. The face validity index (FVI) for the clarity and comprehension of the Arabic version was within the satisfactory level (0.87), indicating that the Arabic version was simple, easy to understand, and culturally relevant to Saudi MAT users. Targeting people with mobility impairments in Saudi Arabia was based on recent findings indicating that mobility impairments in Saudi Arabia were the most frequently reported type of disability; this finding is consistent with the ones from other studies that were conducted in the U.S and India [3]–[5]. Thus, the aim of this study was to empirically identify the level of knowledge on skill training, emerging technology perceptions, and preferred information sources among a large group of Saudi MAT users.

## 5.2 METHODS

The final Arabic version of the survey (see Appendix C) was modified and prepared based on the results of the pre-final test of the survey. The study was approved by the University of Pittsburgh Institutional Review Board (exempt 19100265). Local regulatory approval to conduct the study was also obtained through the National Committee of Bioethics (NCBE) in Saudi Arabia to conduct the study. The survey was administered using the Pitt-licensed version of the Qualtrics software (Qualtrics, Provo, UT, USA) [114]. An email and/or text that has the section in the Arabic language with the link to the survey was created. Thus, the participants completed the survey using the web link.

The participants were recruited from hospitals, rehabilitation centers, and disability associations in Saudi Arabia. They were recruited by AT providers and consumers in person and through flyers. A list of potential participants' emails was obtained through rehabilitation hospitals administrations and disability associations. A collaborator in Saudi Arabia then distributed a link to the survey to interested participants by email. The recruitment materials were also posted on a few social media platforms such as Twitter, Facebook, and WhatsApp groups. Referral sampling was used for recruitment, encouraging participants to distribute recruitment materials to their own networks. The potential participants were instructed to access the survey online in the Arabic version. The inclusion criteria were being 18 years of age or older, a Saudi Arabian citizen, live in Saudi Arabia, and a user of any type of MAT devices. No exclusion criteria were involved. The participants were required to complete an online informed consent document prior to accessing the survey. For those with cognitive impairments or inability to complete the survey due to the inaccessibility of some questions in the survey, their family members or friends were asked to complete the survey as a proxy for the participant. The active recruitment period for this study

covered more than three months (March - June 2022), with a target goal of obtaining 350 responses. The respondents were not reimbursed for their participation.

The survey was designed to take less than 15 minutes to complete and was based on the previously conducted survey [107]. The survey included 35 questions. The survey homepage provided an overview and instructions for completing the survey, followed by an overview of informed consent (number of questions = 3) asking the participants to confirm their consent to participate in the survey. The next part of the survey involved the collection of information on a pre-defined list of diagnoses leading to mobility impairment; other diagnoses that were not in the list were provided under the option “other” (number of questions = 4). The participants were allowed to choose multiple diagnoses. The subsequent question asked the participants about their prior use of MAT devices (number of questions = 2). The survey included questions about the specific information sources that the participants used for finding information on MAT (number of questions = 7), as well as open-ended questions to provide responses to these questions (number of questions = 7). The participants were then asked about the most important sources for learning about new and advanced MAT (number of questions = 2) using open-ended questions. To assess the importance of their providers to have knowledge about new MATs, the participants were instructed to rate such importance on five-point Likert rating scale ranging from 1 = not important at all to 5 = extremely important (number of questions = 1). In addition, they were asked about their awareness of and skills in using MAT (number of questions = 1). Depending on the response to the question about the most frequently used type of MAT device that is being used most, a list of manual wheelchair (MWC) skills was presented to MWC users, and another list of power wheelchair (PWC) skills was presented to those who utilize either PWCs or scooters using a branch logic feature. Additionally, the participants were asked about their knowledge of and familiarity

with new and advanced ATs (number of questions = 1). An image with a description of each MAT was presented, and the participants responded to each question using yes or no options (i.e., whether they were familiar with this type of MAT). At the end of the survey, the participants were asked about the particular type of MAT on which they require further information (number of questions = 1). An open-ended question was provided for those participants who selected another AT device that was not listed (number of questions = 1). Depending on the response to this question, each respondent was led to answer a question about the preferred method of receiving information about the selected device (number of questions = 1). In the final part of the survey, the participants were instructed to provide their demographic information such as gender, age, education level, income level, and the city of residence (number of questions = 4). Question formats in the survey included forced-choice questions with open-ended “other” options, Likert rating scales, “yes or no” dichotomous choices, and open-ended questions. At the end of the survey, some personal identifiable information was collected to ensure that the responses were not repeated.

### **5.2.1 Statistical Analysis**

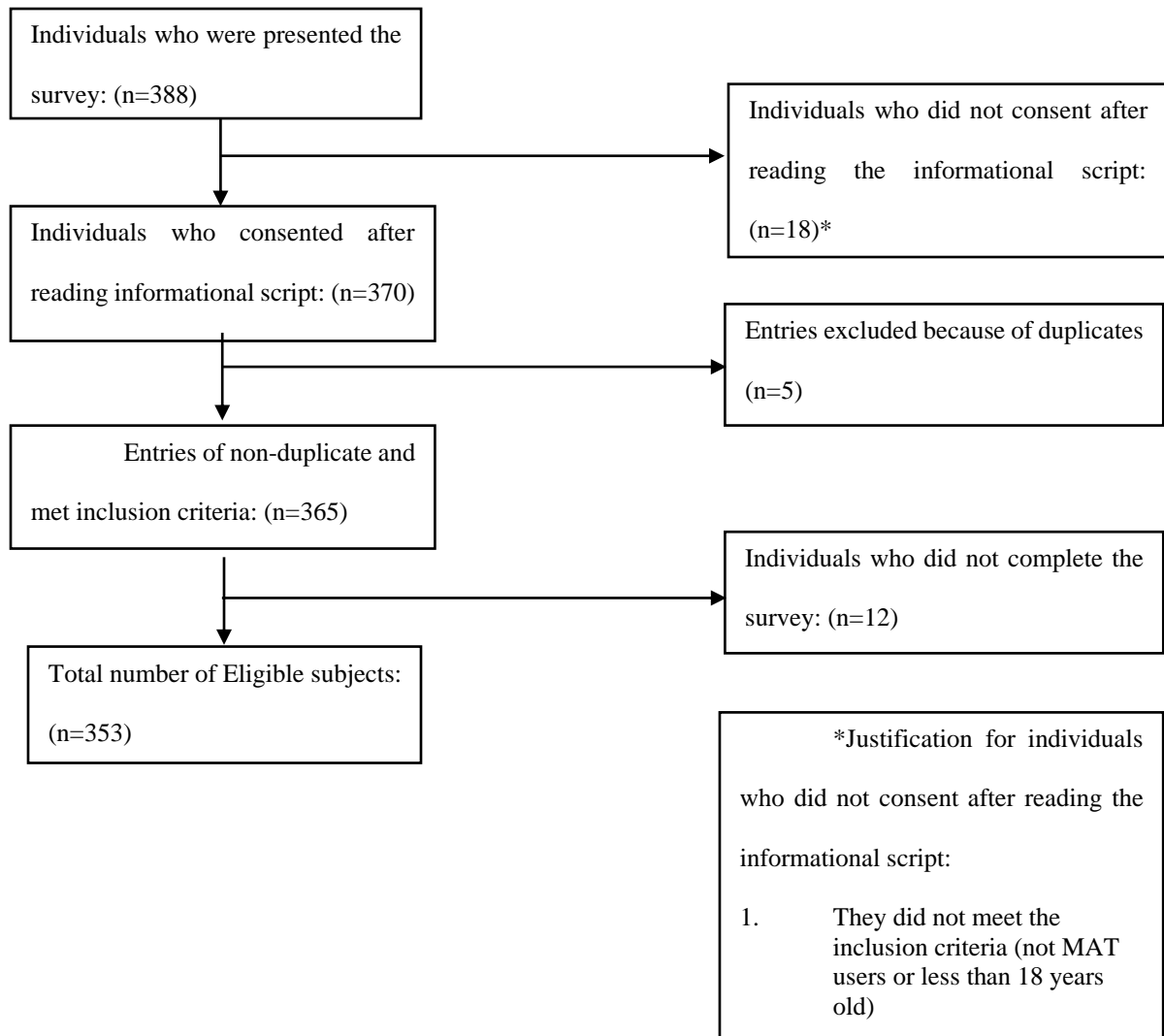
Frequency counts, proportions (percentages of the total responses), mean, range, and standard deviation were used for reporting the descriptive statistics for multiple-choice questions using IBM SPSS (IBM SPSS Statistics, Version 22, Armonk, NY). Open-ended responses were examined in detail to identify patterns and themes. The texts were categorized and their frequencies were reported through Microsoft Excel 2011 (Microsoft Corporation, Redmond, WA).

### 5.3 RESULTS

As shown in Figure 5, a total of 388 individuals responded to the survey, of whom 370 met the inclusion criteria. Other respondents were excluded from the analysis because of duplicates ( $n = 5$ ), non-completion of the survey ( $n = 12$ ), or failure to meet the inclusion criteria ( $n = 18$ ). Thus, data for 353 participants were analyzed.

The demographic profile of the survey respondents is presented in Table 12. The average age of the participants was 39 (SD 9.6; range 18-55) years, and the participants lived in 18 different cities in Saudi Arabia. Most of the respondents were male ( $n = 239$ , 67.7%). The majority of the participants held an associate or a bachelor's degrees ( $n = 134$ , and  $n = 148$ , respectively).

The diagnoses of participants are shown in Table 13. The participants with spinal cord injury (SCI) comprised the largest diagnostic group ( $n = 141$ , 40%) followed by the participants with cerebral palsy (CP) and traumatic brain injury ( $n = 48$ , 13.6% and  $n = 46$ , 13.1%, respectively). Of the participants with SCI, 43 (30.5%) had tetraplegia and 98 (69.5%) had paraplegia. Out of 353 participants, 139 (39.4%) reported being MWC users. Meanwhile, 115 participants (32.6%) were PWC users; 47 (13.3%) were users of other assistive devices users (e.g., canes, crutches, walkers); 25 (7.1%) were users of a lower extremity prosthesis; 11 (3.1%) were users of a lower extremity orthosis; and 16 (4.5%) were users of other assistive devices that were not listed in the question (i.e., upper extremity prostheses and orthoses). The majority of participants ( $n = 164$ , 46.5%) had been using their MAT devices between two and five years (see Table 14).



**Figure 5. Exclusion flowchart**

**Table 12. Participant demographics (N = 353)**

	<b>No. of respondents</b>
<b>Age (years), mean <math>\pm</math> SD</b>	38.92 $\pm$ 9.6
<b>Gender n (%)</b>	
Male	239 (67.7)
Female	114 (32.3)
<b>Highest level of education n (%)</b>	
High school diploma or equivalent (GED)	60 (17)
Associate's degree	134 (38)
Bachelor's degree	148 (41.9)
Doctorate level degree	2 (0.6)
None of the above	3 (0.8)
Prefer not to answer	6 (1.7)
<b>Household income Saudi Riyals (SR) n (%)</b>	
Under SR 10,000	50 (14.2)
SR 10,000- SR 15,000	111 (31.4)
SR 15,999- SR 20,000	70 (19.8)
SR 20,999- SR 40,000	3 (0.9)
Prefer not to answer	119 (33.7)
<b>City of living n (%)</b>	
Riyadh	123 (34.8)
Jeddah	47 (13.3)
Dammam	46 (13)
Abha	16 (4.5)
AlQassim	9 (2.5)
Makkah	14 (4)
Madinah	10 (2.8)
Taif	12 (3.4)
Jazan	9 (2.5)
Najran	7 (2)
Hail	6 (1.7)
Tabuk	13 (3.7)
Aljof	12 (3.4)
Alkobar	11 (3.1)
Buraidah	4 (1.1)
Skaka	7 (2)
Arar	6 (1.7)
Other (Khamis Mushait)	1 (0.3)



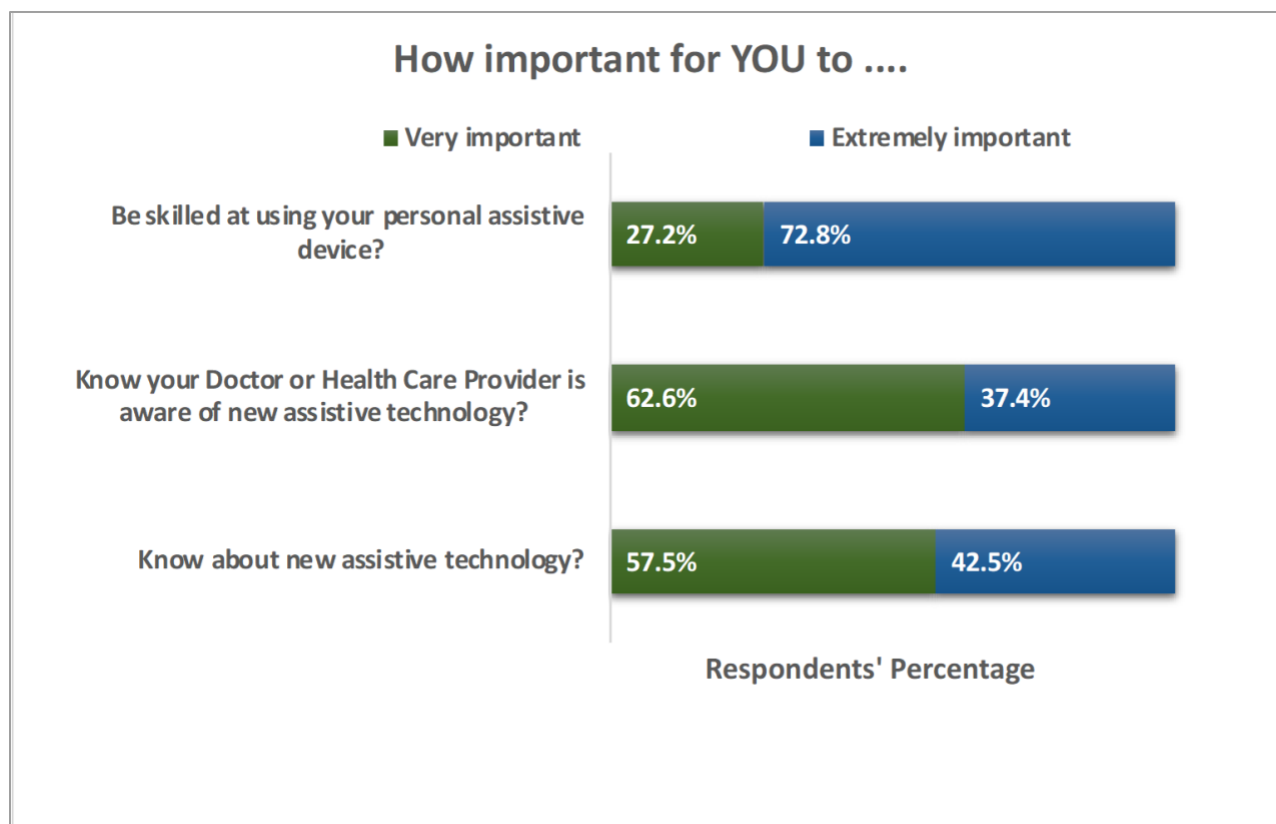
**Table 13. Participants diagnoses (N = 353)**

	<b>No. (%) of respondents</b>
Stroke	30 (8.5)
Upper extremity amputation/congenital limb deficiency	18 (5.1)
Lower extremity amputation/congenital limb deficiency	41 (11.6)
Multiple sclerosis	9 (2.5)
Amyotrophic lateral sclerosis (ALS)	7 (2.0)
Spina bifida	7 (2.0)
Cerebral palsy	48 (13.6)
Osteo/Rheumatoid arthritis	1 (0.3)
Other	5 (1.4)
Spinal cord injury (SCI)	141 (39.9)
Tetraplegia or quadriplegia (C1-C8)	43 (30.5)
Paraplegia (T1 and below)	98 (69.5)
Complete	97 (68.3)
Incomplete	45 (31.7)
Traumatic brain injury	46 (13.1)
Was your injury traumatic or non- traumatic?	
Traumatic	16 (34.8)
Non-traumatic	30 (65.2)

**Table 14. Primary MAT and length of time using device (N = 353)**

	No. (%) of respondents
<b>What assistive mobility device do you use most of the time?</b>	
Manual wheelchair	139 (39.4)
Power wheelchair	115 (32.6)
Scooter	-
Lower extremity prosthesis	25 (7.1)
Lower extremity orthosis (brace)	11 (3.1)
Assistive device (cane, crutch, walker)	47 (13.3)
Other	16 (4.5)
<b>How long have you been using this device?</b>	
< 1 year	59 (16.7)
2-5 years	164 (46.5)
6-10 years	73 (20.7)
11-15 years	15 (4.2)
> 15 years	42 (11.9)

When asked about the importance of personal knowledge of a new MAT, provider knowledge of MAT, and skills in using their MATs, all of the participants reported that skill in using personal MAT devices, healthcare providers' awareness, and knowledgeability about new MATs were either very important or extremely important (see Figure 6). Those participants who reported being MWC, PWC or scooter users were asked to rate their ability to perform various wheelchair skills. For MWC users, performing a 30-second wheelie balancing and climbing up a four-inch curb were the most difficult skills (75.5% and 50.1%, respectively) (see Figure 7). Meanwhile, the majority of PWC users could do every PWC skill, and the skills with which participants reported the most difficulty were operating the battery charger for their PWCs and operating body positioning options (80.9% and 55.7%, respectively) (refer to Figure 8).

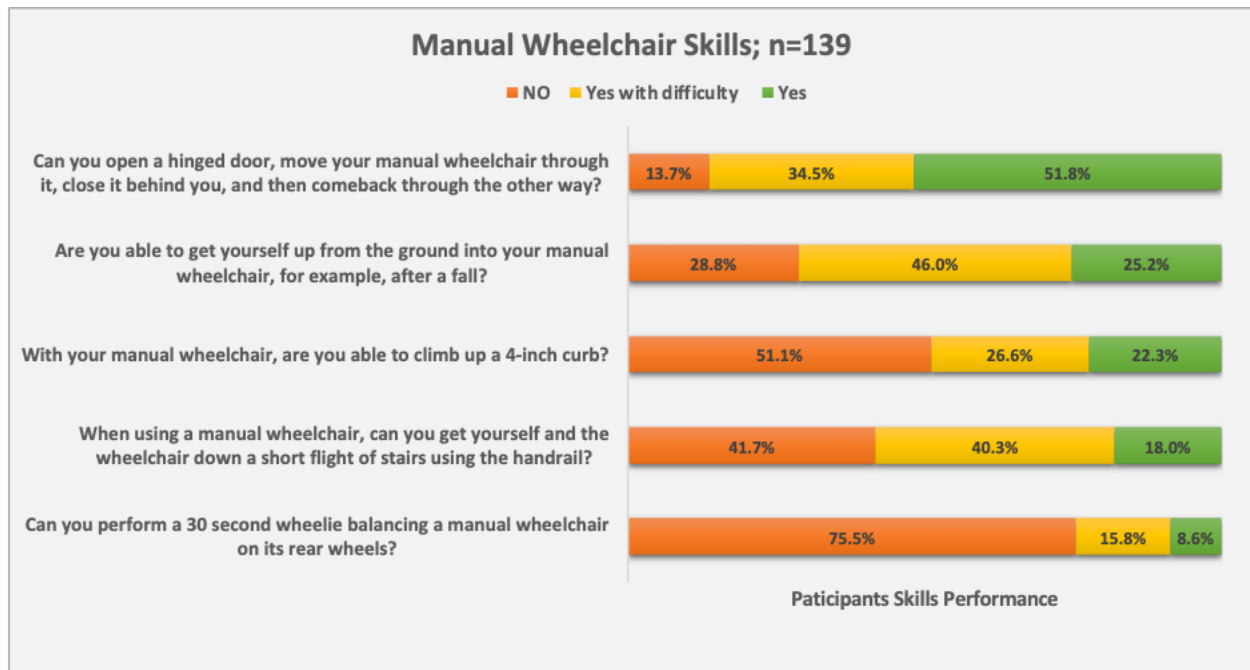


**Figure 6. Importance of consumer and doctor knowledge of mobility assistive technology (MAT)**

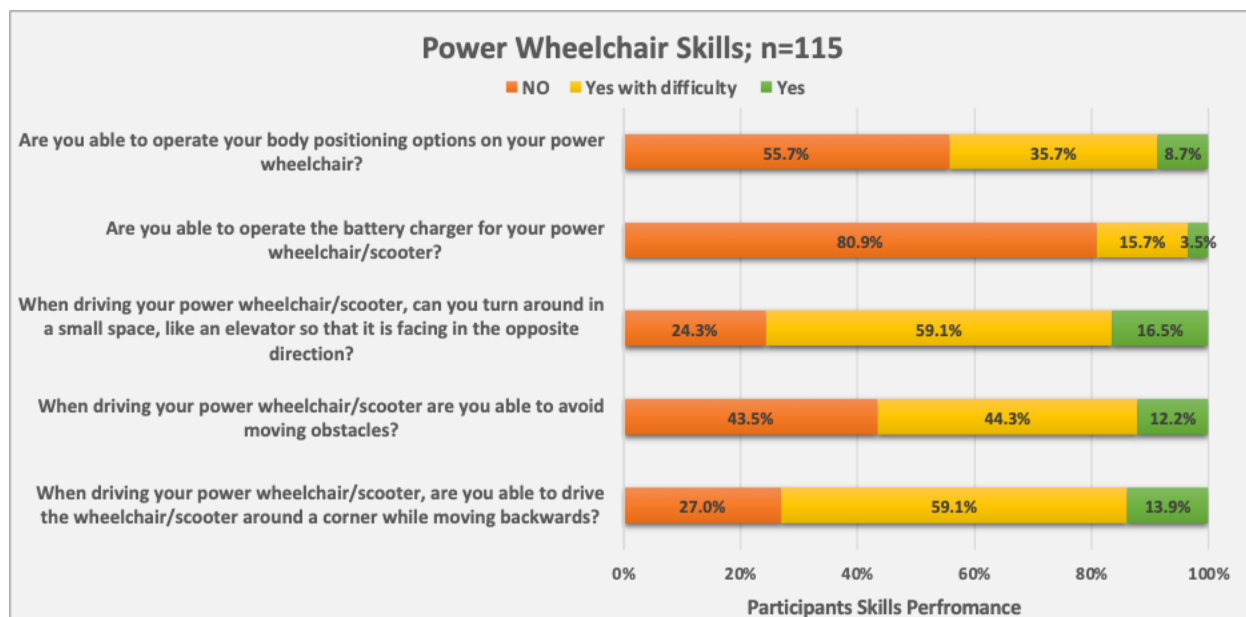
When asked to report the sources used for finding information on MAT, the majority of participants selected PTs or OTs (n = 302, 85.6%); internet (n = 257, 72.8%); social media (n = 213, 60.3%); physicians (n = 170, 48.2%); and family or friends using AT (n = 159, 45%). The other sources included conferences (n = 86, 24.4%); events (n = 77, 21.8%); magazines (n = 16, 4.5%); newsletters (n = 15, 4.2%); newspapers (n = 14, 4%); TV (n = 9, 2.5%); and research studies (n = 4, 1.1%). The detailed responses are outlined in Table 15.

When presented specific examples of internet sources, the majority of participants (n = 252, 71.4%) reported Google search as the most frequently used source for finding information about MAT. Of the social media sources presented, YouTube, Twitter, and Facebook (55.2%,

51.3%, and 28.3%, respectively) were cited as the most commonly utilized sources for locating information about MAT (see Table 15).



**Figure 7. Manual wheelchair skills ability (N = 353)**



**Figure 8. Power wheelchair skills ability (N = 353)**

**Table 15. Information sources (N = 353)**

<b>Source</b>	<b>Specific source selected; No. (%) of respondents</b>
<b>Internet</b>	<b>257 (72.8)</b>
World Health Organization (WHO)	9 (2.5)
Eastin	39 (11)
Disabled-World	79 (22.4)
Wikipedia	62 (17.6)
Google Search	252 (71.4)
Other	-
<b>Social Media</b>	<b>213 (60.3)</b>
Facebook	100 (28.3)
YouTube	195 (55.2)
Twitter	181 (51.3)
LinkedIn	59 (16.7)
Instagram	35 (9.9)
TikTok	36 (10.2)
Snapchat	71 (20.1)
Other (WhatsApp)	1 (0.3)
<b>Events</b>	<b>77 (21.8)</b>
Paralympics	43 (12.2)
Adaptive Sports - teams, competitions, gyms, or coaches	20 (5.7)
Local disability fairs	52 (14.7)
International Day of Persons with Disabilities	75 (21.2)
International Day of Physical Therapy	21 (5.9)
Other	-
<b>Newsletters</b>	<b>15 (4.2)</b>
The Authority for the Care of Persons with Disabilities (APD)	15 (4.2)
Children with Disabilities Association	11 (3.1)
Disability Association Motor for Adults Mobility	15 (4.2)
Al-Arabia News	2 (0.6)
Other	-
<b>Magazines</b>	<b>16 (4.5)</b>
Disability Eco	12 (3.4)

**Table 15. (Continued)**

Saudi Disability and Rehabilitation	<b>15 (4.2)</b>
Special Education	1 (0.3)
Disability World	8 (2.3)
Other	-
<b>Conferences</b>	<b>86 (24.4)</b>
International Conference of Experts on Disability and Rehabilitation	53 (15)
International Conference on Disability and Rehabilitation	50 (14.2)
Saudi Conference for People with Disabilities	68 (19.3)
International Seating and Wheelchair Symposium (ISS)	26 (7.4)
Other	-
<b>Television</b>	<b>9 (2.5)</b>
<b>Newspapers</b>	<b>14 (4)</b>
<b>Physicians</b>	<b>170 (48.2)</b>
<b>Physical or Occupational Therapists</b>	<b>302 (85.6)</b>
<b>Research Studies</b>	<b>4 (1.1)</b>
<b>Family/Friends using Assistive Technology</b>	<b>159 (45)</b>
<b>Other</b>	-

**Note:** Participants could choose more than one option.

About 164 participants (46.5%) responded to an open-ended question about the specific information source that they deem important in learning about MAT. Their responses included healthcare providers (i.e., physicians and PTs or OTs), internet, social media, family or friends using MAT, and rehabilitation centers and disability organizations. Healthcare providers were identified as the most important source of information by the largest number of participants (n = 63, 38.4%), followed by social media (n = 57, 34.8%) and the internet (n = 35, 21.3%) (see Table 16). The participants similarly reported the particular type of MAT on which they require further information (refer to Figure 9). PWC (n = 154, 43.6%) was the most common type of MAT that the participants felt that they need more information on, followed by MWC (n = 113, 32%) and other MAT devices (n = 59, 16.7%) (see Figure 9). Those participants who reported that they

require further information on other MAT devices were directed to answer a follow-up open-ended question. Their responses about the other MAT devices included computer access technology, communication devices, upper limb prostheses, standing wheelchairs, standing frames, and robotic arms. When asked about their preferred mode of receiving information on MAT, the participants primarily cited videos and workshops, followed by social media and websites (see Figure 10).

The participants were also asked to rate their familiarity with new and advanced MATs including wearable or mobile technology, human-machine interface technology, robotic wheelchair/walker, smart home technology, alternative power sources, and exoskeleton. Their responses are shown in Figure 11. Almost all the participants indicated their unfamiliarity with all the presented technologies. However, smart home technology was the most familiar technology for 40% of the participants, followed by wearable or mobile technology (38.7%).

**Table 16. Most important information source (N = 164)**

<b>Source</b>	<b>No.(%) of respondents</b>
<b>Healthcare Provider</b>	63 (38.4)
<b>Social media</b>	57 (34.8)
<b>Internet</b>	35 (21.3)
<b>Family/friends using AT</b>	6 (3.7)
<b>Rehab centers and disability organizations</b>	3 (1.8)



Figure 9. AT Information desired (N=353)

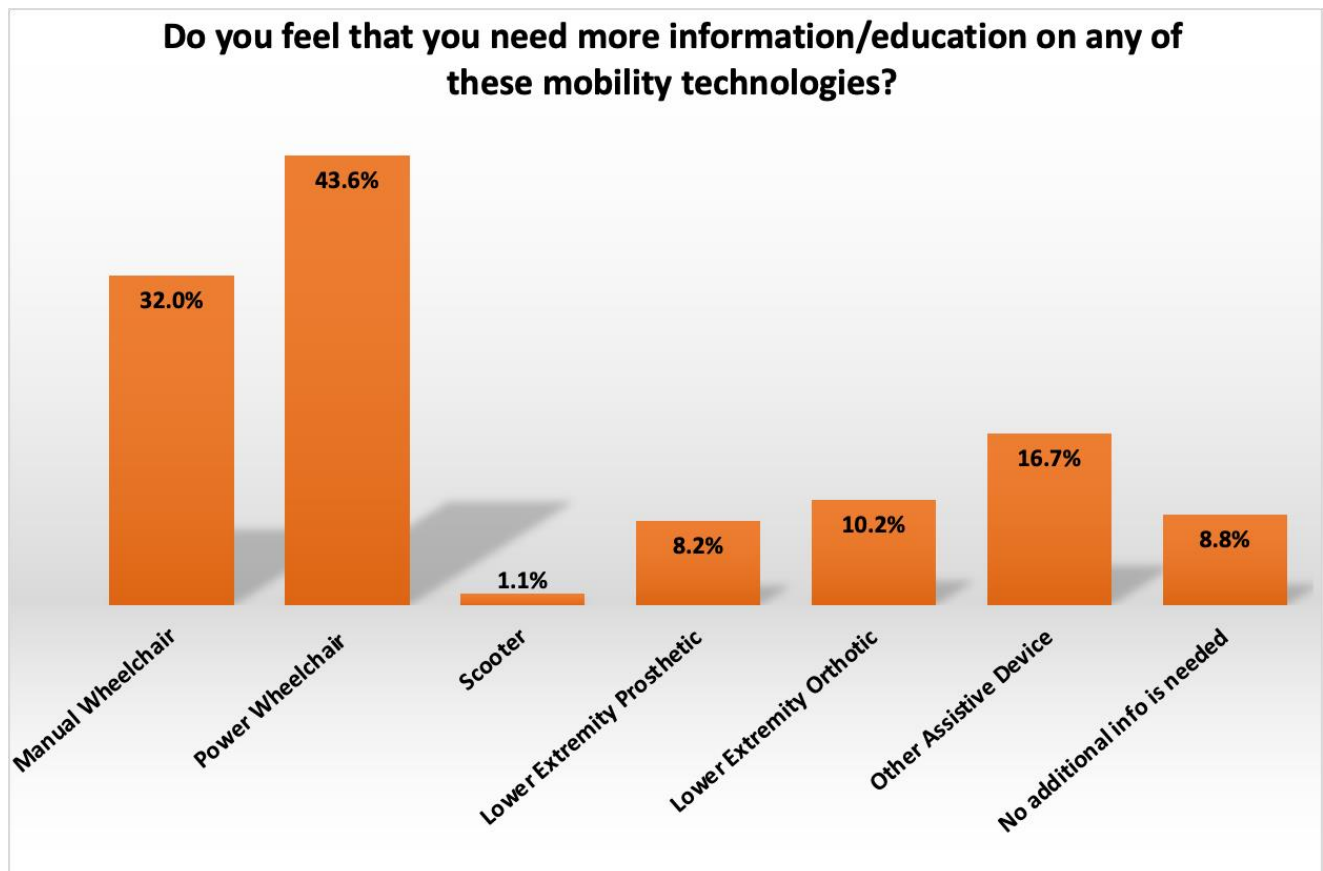
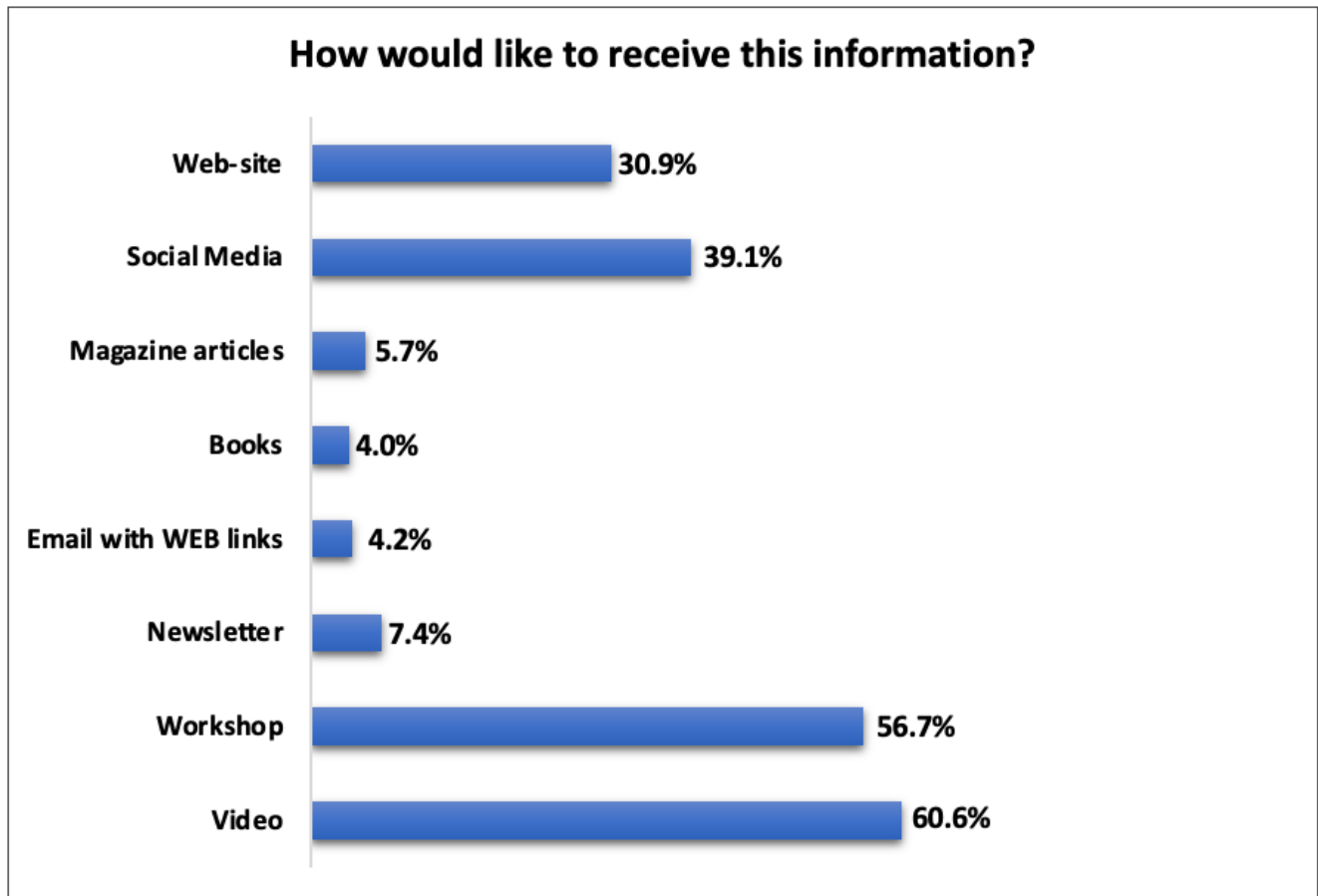
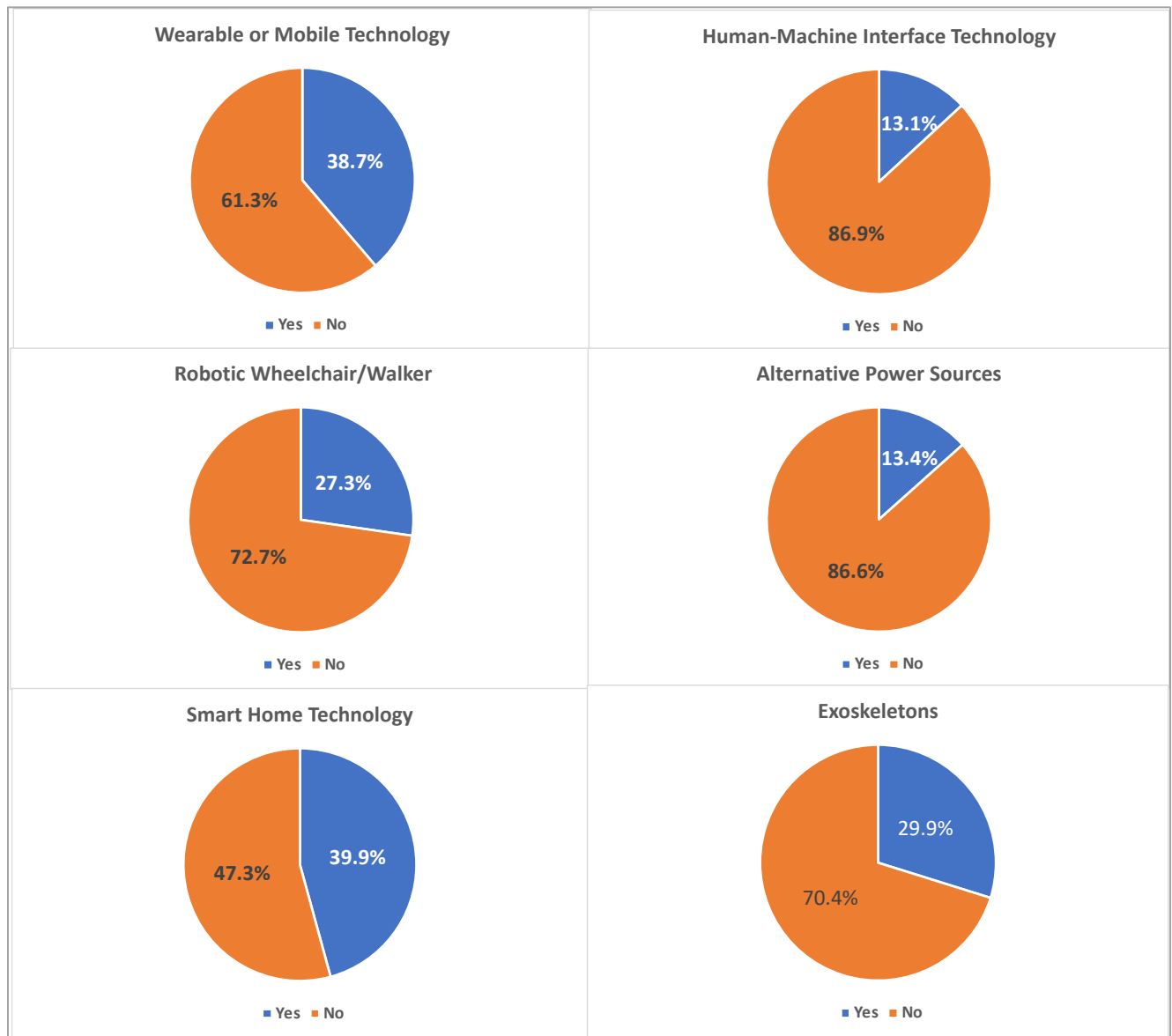


Figure 10. Preferred Methods of Receiving Information (N=353)



**Figure 11. Knowledge of new technology (N = 353)**



## 5.4 DISCUSSION

This exploratory study adds to the existing literature on MAT by providing an example for researchers who are interested in identifying knowledge gaps in clinical skills, emerging technologies, and preferred sources of information about AT in their country. A crucial approach

to inform future dissemination strategies is to understand of the gaps in consumer knowledge and training and the consumer preferences concerning accessing information about AT.

Several interesting findings from this study are worthy of discussion. First, the results show that the participants with SCI comprised the largest diagnostic group. This prevalence rate was aligned with the recent statistical report by the General Authority for Statistics (GASTAT) in Saudi Arabia, which found that SCI is the most frequently reported type of mobility impairments [3],[77]. In addition, the male participation rate in the study was higher than the female participation rate, which is a similar result as the GASTAT's recent statistical report [3],[77]. Second, with regard to MWC and PWC skills when using MAT, the results reveal certain gaps when using MAT devices, especially for clinical skills. For instance, MWC users reported that the most difficult skills were performing a 30-second wheelie balancing and climbing up a four-inch curb (75.5% and 50.1%, respectively). By contrast, PWC users considered the most challenging skills to be operating the battery charger and the body positioning options as the most challenging skills. In the U.S. pilot study, the majority of the American mobility device users also reported that operating the battery charger for PWC or scooter was the most difficult skill. In addition, the majority of the American mobility users reported that another difficult skill was maneuverability. Similarly, while the majority of the Saudi mobility device users (59%) reported that they could perform maneuverability skills, their responses were "yes, with difficulties." Thus, in line with the recommendation of the U.S. pilot study, MWC and PWC users require additional training in nearly all the skills. To learn many of these skills, MAT users in Saudi Arabia must obtain sufficient training either in person or online as recommended by other studies [125],[126]. For example, research is needed on developing chargers that are easy to operate for those who struggle with operating their PWC chargers. The gaps in performing the MWC and PWC skills among Saudi

MAT users are expected as the majority of the participants have been using their current devices for only two to five years (46.5%); thus, it might require some more time to learn how to perform the skills. The results also show that the majority of the participants reported being MWC and PWC users and only a few participants reported being scooter users. Despite the great funding support from the Saudi government for various types of MAT, the fact that there are not many scooter users in Saudi Arabia signals to the providers' unfamiliarity with prescribing such mobility devices and their lack of knowledge concerning when and for whom these devices should be prescribed [127].

The findings about the types of sources that participants use to find information on MAT indicate that the most frequently utilized sources were healthcare providers, the internet, social media, and family or friends using MAT. In the open-ended question about the specific information source that participants deem important for learning about MAT, the majority of participants cite these same resources (i.e., healthcare providers, the internet, and social media). These findings are similar to the findings of the U.S. pilot study, whereby the most frequently utilized sources by the majority of the participants were healthcare providers (i.e., PTs, OTs), the internet, and family or friends using AT (i.e., word of mouth). However, the majority of the American mobility device users reported events as a more common source for finding information about MAT than Saudi mobility device users. This finding can be explained by the lack of the events held in Saudi Arabia compared to the U.S. When it comes to social media resources, the comparison of the studies shows that Saudi mobility device users use social media platforms for locating information about AT more than American mobility device users. The fact that almost 96% of the Saudi population has access to the internet, of whom 79.3% use social media may

partly explain why Saudi mobility device users utilize social media to locate information about MAT more than American mobility device users [128].

Furthermore, the findings about the importance of personal knowledge of new MATs, providers' knowledge of MAT, and skills in using MAT asserted that 100% of the participants recognize that the healthcare providers' knowledge and awareness of AT is very important or extremely important. These findings accordingly suggest the significance of undertaking another study similar to the one that was conducted in the U.S. [41] to obtain the voice of the providers in Saudi Arabia. The focus of such study should be on the evaluation the providers' opinions about the delivery provision process, their awareness of available AT applications and services, and the value of carrying out certain activities by their clients if the technology could accommodate them. Such investigation will help in understanding the providers' current level of knowledge, which presents an opportunity for researchers to boost the providers and users' awareness of the available technologies and their proper use and maintenance, the emerging technologies, and the application of best practices in the provision process by continuously offering education and training programs.

The gaps identified in the participant awareness of emerging technologies (i.e., nearly all the presented examples of emerging technologies were unfamiliar to the participants) underscore for researchers the importance of enhancing research dissemination and knowledge translation in MAT to ultimately increase the awareness of Saudi MAT users. However, such gaps limit the users' ability to access the appropriate MAT that could improve community participation and enhance the quality of life.

This study has some limitations. First, the online survey was the only method used for collecting the data and no other means were provided, which might result in sample bias. Second,

the majority of the survey respondents reside in four large cities, and only a few live in small cities or rural areas, which might limit the generalizability of the findings. This limitation is related to the survey distribution method, which influenced the response diversity and rate. Being unable to travel to Saudi Arabia and collect data from diverse areas, relying on a collaborator to distribute the link to the survey, and using the referral sampling technique to recruit participants similarly affected the acquisition of diverse opinions from those participants residing in rural areas. Third, the participants' average age was approximately 39 (range of 18-55 years old), indicating that the majority of the participants were in the middle age. This result might limit the generalizability due to the limited number of elderly respondents to the survey. In terms of educational level, the majority of the participants have either an associate or a bachelor's degree, thereby increasing the likelihood of responding to the survey as they would be aware of its importance and the impact that the survey results might have on improving the MAT service in Saudi Arabia. This result indicates that the sample is not a comprehensive representation of the population due to the limited number of participants who hold a high school diploma; furthermore, no responses were obtained from those without a formal degree or who have a low level of literacy. Finally, the survey was not fully accessible because this feature is not supported by the Qualtrics software if the survey includes question formats such as Likert scale and questions with graphs. This limitation indicates the lack of clarity regarding the issue of whether those who have severe mobility functions answered the survey by themselves or with the help of their family members, caregivers, or friends, thereby implying the impossibility of generalizing the results.

## 5.5 CONCLUSION

Over all, the study reveals knowledge gaps regarding user perspectives on MAT and underscores the need for further research in this area. Thus, this study of surveying Saudi MAT users can be used for providing an effective model for research dissemination and knowledge translation. Its method can also be adopted as a model for other researchers who are interested in applying it in their home country. The results of this survey highlight for consumers the importance of being skilled in and knowledgeable about using their MAT devices, and for both consumers and healthcare providers the value of being knowledgeable about and aware of new and advanced technologies. Based on the findings of this study, healthcare providers, the internet via search engine, family/friends using MAT, and social media platforms are considered the most preferred sources for Saudi MAT users for finding information about MAT. For healthcare providers, the assessment of their perspectives and level of knowledge of MAT applications, services, and delivery provision process is essential. In the meantime, a national online platform that includes comprehensive information about available technologies (i.e., their use, simple maintenance, and repairs guidelines) and a list of local service providers should be created to be used as a reference for consumers and their families and caregivers. In addition, further study should be conducted to obtain the Saudi policy stakeholders' perspectives about their current level of knowledge about MAT applications and services, standards and laws, and current MAT-related regulations. Such a study will provide a comprehensive view of the MAT services in Saudi Arabia and some recommendations to enhance the MAT service, procurement, and provision regulations.



## **6.0 CONCLUSION, CONTRIBUTION, AND FUTURE RECOMMENDATIONS**

Understanding gaps in knowledge and awareness of available technologies, emerging technologies, clinical skills, delivery provision process, and laws and standards is a critical step toward accessing appropriate devices and informing future development and dissemination strategies. Unfortunately, there is limited global research in this area, where the gaps in knowledge and awareness about MAT are still unknown worldwide. In an effort to keep up with the global demand for accessing appropriate MAT and address this gap in the literature, a series of voice of the consumer studies have been conducted in the U.S. The present study builds upon these studies and aims to expand its objectives at a global level to examine the level of knowledge on skill training, emerging technology perceptions, and preferred information sources among Saudi MAT users (N=353.) In an effort to contribute to the extant literature, the present study: 1) comprehensively reviewed past research on the topic, 2) translated, culturally adapted, and assessed the face validity of a previously developed English survey, 3) and presented empirical data on the level of knowledge in training, emerging technology, and preferred information sources among MAT users in Saudi Arabia.

### **6.1 RECOMMENDATIONS**

The results from this study suggest practices and recommendations for (1) Saudi MAT users, family members, and caregivers; (2) healthcare providers in Saudi Arabia; and (3) policy makers and decision makers in college institution administration and stakeholders in Saudi Arabia.

### **6.1.1 Saudi MAT Users, Family Members, and Caregivers**

#### **6.1.1.1 MAT Users**

The global demand for MAT products has significantly increased the number of different types of MATs designed and developed in the current market. Therefore, Saudi MAT users should be aware that poor knowledge of MAT combined with the absence of trustworthy information on the types and availability of MAT and possible solutions often result in the access of the inappropriate MAT and an increase in the rate of early abandonment. Examples of new and advanced MAT that were presented in the survey indicated the lack of knowledge among Saudi MAT users, whereby the majority of the participants reported their unawareness of the presented technologies. Thus, one of the primary objectives of this work was to raise the level of knowledge and awareness about MAT and its importance in enhancing the quality of life of PWDs and older adults among Saudi MAT users, caregivers, family members, healthcare providers, policy makers, and academic institution decision makers in Saudi Arabia. Knowledge is typically helpful in navigating various steps, setting goals, taking actions, and planning activities. For consumers, becoming informed, demanding, and responsible users of MAT is also essential. This goal can be achieved by initiating support through self-advocacy. In other words, MAT users should educate themselves by finding the most reliable sources of information about MAT. Some specific steps include discussing with healthcare providers the most appropriate and responsible solutions, using trustworthy sites on the internet, and attending conferences, events, workshops, and seminars. In addition, MAT consumers should be empowered end users by advocating their participation and involvement in the provision process - from the assessment and selection of the appropriate MAT device to training.

### **6.1.1.2 Family Members and Caregivers**

For family members and caregivers, they must first know that MAT is vital for the development and participation of children with disabilities in education and playing; the workforce participation of adults; and the older adults' maintenance of independence with dignity. They should also note that circumstances change over time as technologies advance, and needs, preferences and priorities evolve. As the survey results indicated, 45% of the participants obtained information about MAT products based on the information provided by family members and caregivers, or friends using MAT. The use of MAT products becomes acceptable and positively impacts the users' health and quality of life when families and caregivers are knowledgeable about and confident of the MAT products [129]. In addition, the optimistic attitudes of users, family members, and caregivers towards MAT products is critical to the successful adoption of these devices. Therefore, education and raising awareness about MAT products is a key strategy for increasing their level of acceptance. To achieve this level of knowledge, awareness, and positive attitude, families and caregivers should participate in awareness campaigns, consult with healthcare providers about any concerns, and learn and educate themselves about the available MAT products and services that meet the needs and goals of individuals under their care. Family members and caregivers should also be encouraged to learn about and obtain training in simple maintenance, repairs, and necessary adaptations. Furthermore, they must advocate for their participation in MAT provision, service delivery process, monitoring, and evaluation, rather than simply act as passive service recipients.

### **6.1.2 Healthcare Providers in Saudi Arabia**

According to the survey results, healthcare providers were the participants' most preferred source of information about MAT (n = 302, 85.6%). Moreover, nearly 100% of participants revealed that the healthcare providers' awareness of MAT was either very important or extremely important. In addition, the results of the open-ended question indicated that 38.4% of the respondents considered healthcare providers as the most important sources of information about MAT. Identifying the level of knowledge of healthcare providers is beyond the objectives of this study; nonetheless, the fact that trained and knowledgeable professionals are a key component of effective MAT provision should be highlighted. Healthcare providers specifically in Saudi Arabia must primarily know the crucial importance of providing feasible and reliable MAT devices to PWDs and older adults; helping them to regain their social values; and enhancing their participation and interaction with their families, friends, and others. To achieve these goals, healthcare providers must have in-depth knowledge of the MAT options and the service delivery process (i.e., assessment, fitting, user training and follow-up) to select and prescribe the most appropriate technology that meets the needs and goals of their clients. Another necessary approach is to educate clients and families about the importance of MAT in enhancing the quality of life and ensuring a means for independence. In addition, healthcare providers should improve their understanding of the implications of the health conditions of individuals, boost their awareness of environmental barriers and context, and support users in accurately utilizing MAT products to achieve the life goals of these users.

Training end users on the proper use of their MAT devices is crucial to avoid early abandonment, the development of secondary conditions, or even premature death. Based on the survey results, certain gaps exist with respect to both MWC and PWC skills; whereby the majority

of respondents reported that most of skills cannot be performed despite their use of MAT devices for more than two years. Therefore, healthcare providers should provide MAT users with sufficient training in the proper use and maintenance of their AT devices. They also should consider different factors when providing training, such as the users' goals and needs of using the MAT device, their environment and settings in which the MAT device is used, and available services for maintenance and repairs.

Healthcare providers must be aware of several available MAT service delivery models to enable them to promote client-centered decision making when determining the best match between the device, the clients and their lifestyle and environment. The components of the policy, human, activity, assistance, technology, and environment (PHAATE) model are described in Chapter 3. The PHAATE model is the most recent model that offers a broad theoretical framework for MAT research, design, and provision. Healthcare providers and service providers must consider the components of the model both individually and in combination with the other components when contemplating, designing, selecting, implementing, and evaluating an appropriate MAT device. This service delivery model outlines the processes involved in justifying the MAT device selection; obtaining approval for the selected MAT device; delivering the device to the client; setting up, fitting; and customizing the MAT device; and providing follow-up and consultation. In general, before making a comprehensive and accurate assessment to select a new MAT device for an individual with a disability, multidisciplinary team approaches must generally consider not only the users and their families and caregivers but also the qualified healthcare professionals who are involved. The service delivery process should be user-centered, giving users and their caregivers essential roles in the decision-making process.

### **6.1.3 Policy Makers and Academic Institution Decision Makers**

#### **6.1.3.1 Policy Makers**

The goal of the Saudi government is to enable all its citizens, particularly PWDs, to be active in all the areas of life, including social, educational, and economic areas [77]. MAT service is one of the top services that the Saudi government seeks to provide for PWDs and older adults [77]. However, despite the support and funding resources for MAT devices offered by the Saudi government, policy makers and other stakeholders in the governmental and non-governmental sectors continue to have limited knowledge and awareness about MAT application, services, and MAT service delivery models. Thus, these policy makers and other stakeholders must primarily recognize the importance of MAT and its contribution to enabling people to live a healthy life, become productive, be independent to learn, work, and participate in the community. To achieve universal access to MAT, the following recommendations according to the recent WHO report <sup>[1]</sup> for policy makers in the governmental sectors in collaboration with NGOs in Saudi Arabia are suggested:

1. Develop, implement, and strengthen MAT-related policies, regulations, and programs to increase access to MAT and facilitate a barrier-free design.
2. Ensure the availability of sufficient and qualified professionals for the provision and maintenance of assistive products at all levels of the provision of health and social services delivery.
3. Guarantee that users, their families, and caregivers have access to the most appropriate MAT products and have the ability to utilize them safely and effectively.

4. Encourage international and/or regional cooperation for the manufacturing, procurement, and service delivery of priority assistive products, ensuring that these products remain affordable and accessible across borders.
5. Working with healthcare providers; academic institution decision makers; users and their families; and service providers, governmental policy makers should create an essential and unique national MAT product list based on the model WHO Priority Assistive Products List. This list should include MAT products that are affordable, cost-effective, and meets the minimum quality and safety standards.
6. Create a national user platform and database that is utilized as a resource for users, their families, healthcare professionals, and other stakeholders. It should include information about MAT products, service providers, available MAT clinics, maintenance and repair guidelines, and national MAT companies and manufactures.
7. Regularly collecting data using the WHO rapid Assistive Technology Assessment (rATA) tool to understand the needs and the demand, and supply situation. Data on population needs and access, barriers to access and system preparedness for provision are important for stakeholders to design effective interventions, prioritize resources, and raise awareness among the general public. Such data are also key to monitoring the outcomes of interventions and making informed decisions for improvement.
8. Conduct a situational analysis to measure the current MAT gaps and provision gaps and to develop a national roadmap for MAT.
9. Establish a regulatory system by the coordinating with multiple government ministries and departments (e.g., health, education, social welfare) and sectors (e.g., public,

private, non-profit) to promote inclusive barrier-free environments, such that individuals who need MAT can maximize its use and ultimately live independently and safely and fully participate in all the aspects of life.

#### **6.1.3.2 Academic Institution Decision Makers**

Globally, there is a significant need to build a competent workforce to provide AT products and services, including MAT. For example, the United Nations Convention on the Right of Persons with Disabilities (UNCRPD) highlights states' responsibility to increase awareness and access to AT and to provide adequate training for people with disabilities and their family members, service providers, and government officials [130]. To the best of our knowledge, most Saudi universities do not offer academic and professional training programs to prepare MAT professionals. Therefore, Saudi universities should supplement curricula with additional MAT service training materials as this may serve to increase the number of trained professionals in rehabilitation who provide MAT services such as OTs, PTs, and orthotists and prosthetists. A crucial strategy for academic institution decision-makers is to develop, integrate, and mandate new contents on MAT applications and provision processes into the academic curricula across rehabilitation programs, including occupational therapy, physical therapy, physical and rehabilitation medicine, and prosthetics and orthotics programs. However, academic institutions in Saudi Arabia should identify and address challenges and barriers before integrating new MAT content into rehabilitation program curricula. These barriers include time constraints, the instructors' and faculty members' lack of training and expertise, insufficient awareness of basic MAT services and available resources, students' lack of academic preparation, limited funding, course development, and materials' delivery [131],[132]. Several steps are recommended to address these barriers and



challenges [131]. The first step relates to advocacy either within or outside of the institutional organization to integrate new content about MAT education into the curriculum. Such a process would help overcome some of the integration challenges such as the lack of trained faculty and limited awareness of basic MAT applications, services, and available sources. The second step involves planning, including funding and accessing human and physical resources. Some examples of such resources are collaborating and establishing partnerships with external experts who could teach the materials and provide practical demonstrations when needed and preparing laboratory spaces with MAT products and parts, which students need for practice purposes. The next step covers course development and delivery methods. This step can be undertaken by either adapting an existing resource or developing teaching materials that are suitable for the students' contexts. After implementing new content, it is also crucial to measure the students' academic performance and gather students' and faculty members' feedback to assess the efficacy of the course materials' pedagogic approaches and the course in general.

With regard to the integration of wheelchair service provision content into educational programs, several Wheelchair Service Training Packages (WSTP) were developed by the WHO in partnership with the United States Agency for International Development to serve as guides for wheelchair service provision education worldwide. These packages include training at the basic level (WSTP-b), intermediate level (WSTP-I), manager, and stakeholder levels, which contain various components that are available in multiple languages [131]. They also include open-access training materials with different resources, including training manuals, workbooks, presentations, videos, and posters. Furthermore, the recent WHO recommendation of an eight-step wheelchair service provision process has the potential to guide university curriculum development in this area of practice [133]. The eight steps include (1) referral, (2) assessment, (3) prescription, (4) funding

and ordering, (5) product preparation, (6) fitting and adjusting, (7) user training, and (8) maintenance, repairs, and follow-up. These steps have had demonstrable positive impacts and outcomes on users' satisfaction with mobility devices and improved their quality of life [134]. In addition to these resources, the ISWP team recently developed a Seating and Mobility Academic Resource Toolkit (SMART) to facilitate the integration of comprehensive wheelchair provision education into curricula [135]. This toolkit aims to provide educators with open-access wheelchair teaching materials, including case studies, recommendations for resource allocation, advocacy, and policy development. The toolkit resources are also not limited by a context, which is considered a beneficial as the geographic location of the university and the context can be contextual barriers that influence the integration of wheelchair service provision education [131],[135]. A committee that was formed by the ISWP is dedicated to supporting the integration of wheelchair service provision content into educational programs to ensure appropriate wheelchair service provision to any individual in any setting. Achieving this goal entails increasing the number of trained relevant professionals (i.e., rehabilitation professionals) by educating them in academic rehabilitation programs with MAT and its applications and provision processes. Wheelchair service provision is merely one of several content areas of AT that need to be included in university programs. The other areas of AT include assistive robotics and intelligent systems, smart home technologies, augmentative and alternative communication devices, computer access, human-machine interface, cognitive aids, adaptive transportation, hearing aids, and low vision AT. Therefore, academic stakeholders in Saudi Arabia must undertake steps to develop and integrate new content into their rehabilitation academic programs to graduate professionals who have knowledge and training in these areas.

A team of researchers in the Department of Occupational Therapy at the University of Jordan developed a Wheelchair Training Program (WTP) to develop the skills and knowledge of OT students involved in wheelchair service provision and to integrate the program into the rehabilitation curricula and training programs [136]. The WTP was built based on the WHO WSTP, including WSTP-b and WSTP-I and other educational resources. It covers a variety of wheelchair-related topics such as seating biomechanics, postural supports, manual and power wheelchairs, seat functions, wheelchair functional outcomes, clinical implications and special cases, OT role in the wheelchair provision process, accessibility issues, wheelchair skill training, and wheelchair adjustments. This study has three phases; the pre-test phase, the WTP phase, and the post-test phase. The students were asked to complete a paper-based test before and after attending the WTP program to measure the extent to which their knowledge improved and assess the feasibility of integrating such a training program into the curricula. Educational materials such as interactive presentations, handouts, group work, and exercises were provided during the WTP phase. The study results show that the WTP training program significantly improved the students' knowledge. This successful integration endeavor from an Arab country could serve as a good example for Saudi universities that are interested in integrating the WTP or other wheelchair service provision training programs into their rehabilitation program curricula.

## **6.2 FUTURE WORK**

Future studies should continue to sample and heed the voice of other AT users, healthcare providers, academic institutions, and policy makers in Saudi Arabia.

### **6.2.1 Other AT Users**

Despite the large number of respondents to the survey, the majority of them live in urban cities, and only a few participants are from rural areas. Therefore, the recommendation is to repeat the study using both an online survey and a paper-and-pencil method on those who do not have access to the internet. Such study should mainly target MAT users who live in rural areas to examine their level of knowledge and awareness about clinical skills, emerging technologies, and the preferred sources for finding information about AT.

The focus of the current study was mainly focused on MAT users; hence, the expansion of the work and the inclusion other AT users such as those with upper limb amputation, hearing and vision impairments, chronic conditions (e.g., stroke, Alzheimer's disease, diabetes, Parkinson's disease, cardiovascular diseases, cancers, autism) are essential to identify their level of knowledge on clinical skills, emerging technologies, and the preferred sources for finding information about AT. The level of knowledge of families and caregivers about AT services and its application should also be examined. Identifying the gap of knowledge among other AT users and their families and caregivers will provide a comprehensive view about the current situation of AT applications and services in Saudi Arabia. Online surveys together with other means such as paper-and-pencil method help to access a large number of respondents who are geographically dispersed and those who lack technological savvy or seldomly use the internet in a short period.

### **6.2.2 Healthcare Providers**

Healthcare providers play an important role in the AT provision process. Therefore, undertaking a separate study similar to the one conducted in the U.S is crucial [41] to evaluate the

opinions of Saudi AT providers about their knowledge on clinical skills, training, laws and standards, service delivery process, and emerging technologies. Such study will improve the understanding of the providers' current level of knowledge, ultimately enhancing the AT provision and services in Saudi Arabia. Using a mixed-methods approach, including quantitative and qualitative methods, will be the most desirable research methodology to completely understand the current level of knowledge of the healthcare practitioners around the country.

### **6.2.3 Policy Makers and Academic Institution Decision Makers**

A separate exploratory study (i.e., using a qualitative method such as an interview) that is targeted to policy makers in governmental and non-governmental organizations, including the Ministry of Health, Ministry of Social Affairs, Ministry of Municipal and Rural Affairs, private sectors, and non-profit disability organizations, should be conducted. The aim of this study will be to investigate the current level of knowledge about AT applications and services, standards and laws, and current AT-related regulations. Such investigation will provide a comprehensive view about the AT services in Saudi Arabia and some recommendations to enhance the AT service, procurement, and provision regulations. In the educational sector, another study should be undertaken to analyze the current situation in academic programs such as the ones that provide rehabilitation-related subjects and the possibility of integrating new contents of AT into these academic programs. The adoption of a mixed-methods research approach (i.e., an online survey and an interview) is recommended, which targets academic stakeholders, including senior leaders in educational institutions, program directors, and faculty members. The survey and the interview questions should be developed based on the other successful trials of integrating AT curricula into academic programs in other countries.

## Appendix A MODIFIED ENGLISH VERSION OF THE SURVEY

Q1 Before indicating your consent to participate in this study, please answer the following two questions: Are you 18 years of age or older?

☐ Yes

☐ No

*Skip To: End of Survey If "Before indicating your consent to participate in this study, please answer the following two questions: Are you 18 years of age or older?" = No*

---

Q2 Are you a mobility assistive device user (e.g., manual wheelchair, power wheelchair, scooter, walker, cane, crutches, and/or prosthetic or orthotic devices)?

☐ Yes

☐ No

*Skip To: End of Survey If "Are you a mobility assistive device user?" = No*

---

Q3 If you read and understand the above information, please indicate your consent to participate in this study  
Do you agree to participate?

☐ Yes

☐ No

*Skip To: End of Survey If "If you read and understand the above information, please indicate your consent to participate in this study "Do you agree to participate?" = No*

Q4 Please answer each question for yourself only. Do not try to guess what family or friends might want you to say.

Please indicate your diagnosis.

- ☐ Spinal Cord Injury
- ☐ Traumatic Brain Injury
- ☐ Stroke
- ☐ Upper Extremity Amputation or Congenital Limb loss
- ☐ Lower Extremity Amputation or Congenital Limb loss
- ☐ Multiple Sclerosis
- ☐ Amyotrophic Lateral Sclerosis (ALS)
- ☐ Spina Bifida
- ☐ Cerebral Palsy
- ☐ Osteo/Rheumatoid Arthritis
- ☐ Other (please specify) \_\_\_\_\_

---

*Display This Question:*

*If "Please indicate your diagnosis" = Traumatic Brain Injury*

Q5 Was your injury considered traumatic or non-traumatic?

- ☐ Traumatic
- ☐ Non-traumatic

---

*Display This Question:*

*If "Please indicate your diagnosis"= Spinal Cord Injury*

Q6 Since you have indicated that you have a spinal cord injury, please tell us if it is classified as

- ☐ Paraplegia (T1 and below)
- ☐ Tetraplegia or Quadriplegia (C1-C8)

---

*Display This Question:*

*If "Please indicate your diagnosis"= Spinal Cord Injury*

Q7 Since you have indicated that you have a spinal cord injury, please tell us if it is considered

- ☐ Incomplete
- ☐ Complete

---

Page Break



Q8 What assistive mobility device do you use most of the time?

- ☐ Manual Wheelchair
  - ☐ Power Wheelchair
  - ☐ Scooter
  - ☐ Lower Extremity Prosthetic
  - ☐ Lower Extremity Orthotic (brace)
  - ☐ Assistive Device (cane, crutch, walker)
  - ☐ Other (please specify) \_\_\_\_\_
- 

Q9 How long have you been using the device listed above?

- ☐ 1 year or less
  - ☐ 2 to 5 years
  - ☐ 6 to 10 years
  - ☐ 11 to 15 years
  - ☐ More than 15 years
- 

Page Break

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Q10 Where do you find information about Assistive Technology?

Please check all that apply.

- ☐ Internet
- ☐ Social Media
- ☐ Events
- ☐ Television
- ☐ Newspapers
- ☐ Newsletters
- ☐ Magazines
- ☐ Physicians
- ☐ Physical or Occupational Therapists
- ☐ Conferences
- ☐ Research Studies
- ☐ Family/Friends using Assistive Technology
- ☐ Other (please specify) \_\_\_\_\_

*Display This Question:*

*If "Where do you find information about Assistive Technology? Please check all that apply." = Internet*

### Q11 Internet Sources

Please check all that apply.

- ☐ WHO - World Health Organization
- ☐ Eastin
- ☐ Disabled-World
- ☐ Wikipedia
- ☐ Google Search
- ☐ Other (please specify below)

---

*Display This Question:*

*If "Internet Sources Please check all that apply." = Other (please specify below)*

### Q12 What other internet sources do you use to get information about assistive technology?

---

---

*Display This Question:*

*If "Where do you find information about Assistive Technology? Please check all that apply." = Social Media*

### Q13 Social Media

Please check all that apply.

- ☐ Facebook
- ☐ YouTube
- ☐ Twitter
- ☐ LinkedIn
- ☐ Instagram
- ☐ TikTok
- ☐ Snapchat
- ☐ Other (please specify below)

---

*Display This Question:*

*If "Social Media Please check all that apply." = Other (please specify below)*

Q14 What other social media sources do you use to get information about assistive technology?

---

---

*Display This Question:*

*If "Where do you find information about Assistive Technology? Please check all that apply." = Events*

Q15 Events

Please check all that apply.

- ☐ Paralympics
- ☐ Adaptive Sports - teams, competitions, gyms, or coaches
- ☐ Local disability fairs
- ☐ International Day of Persons with Disabilities
- ☐ International Day of Physical Therapy
- ☐ Other (please specify below)

---

*Display This Question:*

*If "Events Please check all that apply." = Other (please specify below)*

Q16 What events do you attend to get information about assistive technology?

---

---

*Display This Question:*

*If "Where do you find information about Assistive Technology? Please check all that apply." = Newsletters*

Q17 Newsletters

Please check all that apply.

- ☐ The Authority for the Care of Persons with Disabilities (APD)
- ☐ Children with Disabilities Association
- ☐ Disability Association Motor for Adults Mobility
- ☐ Al-Arabia News
- ☐ Other (please specify below)

---

*Display This Question:*

*If "Newsletters Please check all that apply." = Other (please specify below)*

Q18 What other newsletters do you read to get information about assistive technology?

---

---

*Display This Question:*

*If "Where do you find information about Assistive Technology? Please check all that apply." = Magazines*

Q19 Magazines

Please check all that apply.

- ☐ Disability Eco
- ☐ Saudi Disability and Rehabilitation
- ☐ Special Education
- ☐ Disability World
- ☐ Other (please specify below)

---

*Display This Question:*

*If "Magazines Please check all that apply." = Other (please specify below)*

Q20 What other magazines do you read to get information about assistive technology?

---

---

*Display This Question:*

*If "Where do you find information about Assistive Technology? Please check all that apply." = Conferences*

Q21 Conferences

Please check all that apply.

- ☐ International Conference of Experts on Disability and Rehabilitation
- ☐ International Conference on Disability and Rehabilitation
- ☐ Saudi Conference for People with Disabilities
- ☐ ISS-International Seating and Wheelchair Symposium
- ☐ Other (please specify below)

---

*Display This Question:*

*If "Conferences Please check all that apply." = Other (please specify below)*



Q22 What conferences do you attend to get information about assistive technology?

---

Q23 Are there any other sources that you use to obtain information about assistive technology?

---

Q24 What do you feel is your most important source for finding out about new Assistive Technology?

---

Q25 How important is it for YOU to...

	Not at all important	Slightly important	Moderately important	Very important	Extremely important
Know about new assistive technology?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Know your Doctor or Health Care Provider is aware of new assistive technology?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Be skilled at using your personal assistive device?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

*Display This Question:*

*If "What assistive mobility device do you use most of the time?" = Manual Wheelchair*

*And "What assistive mobility device do you use most of the time?" = Power Wheelchair*

*And "What assistive mobility device do you use most of the time?" = Scooter*

**Q26 What is YOUR ability to complete various manual/power wheelchair (including scooter) skills... Answer only those that apply.**

---

	Yes	Yes with difficulty	No	Not applicable
Can you perform a 30-second wheelie, balancing a manual wheelchair on its rear wheels?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When using a manual wheelchair, can you get yourself and the wheelchair down a short flight of stairs that has a handrail?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
With your manual wheelchair are you able to climb up a 4-inch curb?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Are you able to get yourself up from the ground into your manual wheelchair, for example, after a fall?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Can you open a hinged door, move your manual wheelchair through it, close it behind you, and then come back through the other way?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When driving your power wheelchair/scooter, are you able to drive the wheelchair/scooter around a corner while moving backwards?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

When driving your power wheelchair/scooter are you able to avoid moving obstacles?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When driving your power wheelchair/scooter, can you turn around in a small space, like an elevator, so that it is facing in the opposite direction?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Are you able to operate the battery charger for your power wheelchair/scooter?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Are you able to operate your body positioning options on your power wheelchair?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q28 New technologies are always being created.

Before proceeding to answer the following questions, please read the descriptions below about the proposed areas of technology

(1). Wearable or Mobile Technology is a kind of technology that can be worn by a user and is often designed for tracking information related to health and fitness such as walking running and biking. For wheelchair users, these kinds of technologies use smartphone apps that monitor daily physical activity through estimating energy expenditure, distance traveled, number of propulsions, propulsion efficiency, time spent at different intensity levels, and other relevant information.

(2). Human-Machine Interface Technology is a component of certain devices that allow user inputs to be translated as signals that, in turn, provide the required results to the users. Also known as “alternative controls,” this technology may assist users with limited arm or hand movement to control wheelchairs and other environmental devices. Examples of these alternative technologies include eye/face tracking, head/chin joysticks voice command, sip-n-puff activation, and tongue drive systems (the newest wheelchair alternative control.)

(3). Robotic Wheelchair/Walkers are mobility devices designed to enable people with various disabilities, particularly those who find it difficult to use a wheelchair or walker independently, to achieve safe and independent mobility through assisting with obstacles or collision detection, navigation, barrier negotiation, performing specific tasks such as passing through doors way. Some smart wheelchairs and walkers are designed to be operated autonomously with no user intervention, while others are designed to be operated using alternative controls.

(4). Alternative Power Sources in mobility assistive technology means integrating other sources of energy other than batteries in powered mobility devices.

(5) Smart Home Technology allows users to control and monitor their home devices remotely through smart home apps, smartphones, or other network devices. For example, users can monitor and control lights, doors, windows, shades, fans, entertainment systems, and their health with voice commands or online.

(6). Exoskeletons are robotic lower limb orthoses that can be placed on the user to amplify, reinforce, or restore human performance, but not as a replacement for an original body part.

**How familiar are you with these areas of advanced assistive technology?**

	Not familiar at all	Slightly familiar	Moderately familiar	Very familiar	Extremely familiar
Wearable or Mobile Technologies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Human-Machine Interfaces	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Robotic Wheelchair/Walker Design	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Alternative Power Sources	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Smart home technology	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Exoskeleton technology	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

-----

Q27. Do you feel that you need more information/education on any of these mobility technologies?

Please check all that apply.

- ☐ Manual Wheelchair
- ☐ Power Wheelchair
- ☐ Scooter
- ☐ Lower Extremity Prosthetic
- ☐ Lower Extremity Orthotic
- ☐ Other Assistive Device (Please specify below)
- ☐ I do not feel that I need any additional information.

-----

Q29 What other assistive technology devices do you feel you need information on?

\_\_\_\_\_

-----

Q30 How would you like to receive this information?

- ☐ Video
- ☐ Workshop
- ☐ Newsletter
- ☐ Email with WEB links
- ☐ Books
- ☐ Magazine articles
- ☐ Social Media
- ☐ Web-site

End of Block: Default Question Block

---

Start of Block: Demographic Information

Q31 To allow us to determine if we are reaching a diverse group of respondents who represent all types of mobility device users, we would like to know some information about you . . .

What is your gender?

- ☐ Male
- ☐ Female

-----



Q32 What is your age?

---

Q33 What is the highest level of education you have completed?

☐ High school diploma or equivalent (GED)

☐ Associate's degree

☐ Bachelor's degree

☐ Master's degree

☐ Doctorate level degree- MD, DO, PhD

☐ Other advanced degree

☐ None of the above

☐ prefer not to answer

Q34 What is your household income?

- ☐ Under SR 5,000
- ☐ SR 5,000 – SR 10,000
- ☐ SR 10,999 – SR 20,000
- ☐ SR 20,999 – SR 30,000
- ☐ SR 30,999 – SR 50,000
- ☐ Over SR 50,000
- ☐ I don't know
- ☐ I prefer not to answer

Q35 Where do you live?

- ☐ Riyadh
- ☐ Jeddah
- ☐ Dammam
- ☐ Makkah
- ☐ Madina
- ☐ Taif
- ☐ Abha
- ☐ Jazan
- ☐ Najran
- ☐ Hail
- ☐ Tabuk
- ☐ Aljof
- ☐ Alkobar
- ☐ AlQassim
- ☐ Buraidah
- ☐ Skaka
- ☐ Arar
- ☐ Other (please specify) \_\_\_\_\_

Q36 To ensure that each participant completes the questionnaire only once, please fill in the following questions

First and last name \_\_\_\_\_

Date of birth \_\_\_\_\_

Email address \_\_\_\_\_

Phone number \_\_\_\_\_

End of Block: Demographic Information

---

We thank you for your time spent taking this survey. Your response has been recorded.  
If you would like to learn more about our lab go to: [www.herl.pitt.edu](http://www.herl.pitt.edu)

## Appendix B ARABIC VERSION OF THE SURVEY



قبل الإشارة إلى موافقتك على المشاركة في هذه الدراسة ، يرجى الإجابة على السؤالين التاليين  
هل تبلغ/تبلغين من العمر ١٨ عامًا أو أكثر؟

نعم ☐

لا ☐

*Skip To: End of Survey If Before indicating your consent to participate in this study, please answer the following two ques... = No*

هل أنت/انتي من مستخدمي الأجهزة المساعدة على الحركة والتنقل على سبيل المثال ، كرسي متحرك يدوي ، كرسي متحرك كهربائي  
سكوتر كهربائي، عصا ، عكازات ، مشاية ، أو أجهزة تقويمية أو اطراف صناعية؟

نعم ☐

لا ☐

*Skip To: End of Survey If Are you a mobility assistive device user (e.g., manual wheelchair, power wheelchair, scooter, can... = No*

إذا قرأت/قرأت وفهمتي/فهمتي المعلومات الواردة أعلاه ، فيرجى الإشارة إلى موافقتك على المشاركة في هذه الدراسة  
هل توافق/توافقين على المشاركة؟

نعم ☐

لا ☐

*Skip To: End of Survey If If you read and understand the above information, please indicate your consent to participate in... = No*

الرجاء الإجابة على كل سؤال بفهمك فقط. لا تحاول/تحاولين تخمين ما قد يفسر من قبل العائلة أو الأصدقاء أو غيرهم من إيضاح  
للسؤال.

قبل الإشارة إلى موافقتك على المشاركة في هذه الدراسة ، يرجى الإجابة على السؤالين التاليين  
هل تبلغ/تبلغين من العمر ١٨ عامًا أو أكثر؟

نعم ☐

لا ☐

*Skip To: End of Survey If Before indicating your consent to participate in this study, please answer the following two ques... = No*

هل أنت/انتي من مستخدمي الأجهزة المساعدة على الحركة والتنقل على سبيل المثال ، كرسي متحرك يدوي ، كرسي متحرك كهربائي  
سكوتر كهربائي، عصا ، عكازات ، مشاية ، أو أجهزة تقويمية أو اطراف صناعية؟ ،

نعم ☐

لا ☐

*Skip To: End of Survey If Are you a mobility assistive device user (e.g., manual wheelchair, power wheelchair, scooter, can... = No*

إذا قرأت/قرأتي وفهمت/فهمتي المعلومات الواردة أعلاه ، فيرجى الإشارة إلى موافقتك على المشاركة في هذه الدراسة  
هل توافق/توافقين على المشاركة؟ .

نعم ☐

لا ☐

*Skip To: End of Survey If If you read and understand the above information, please indicate your consent to participate in... = No*

الرجاء الإجابة على كل سؤال بفهمك فقط . لا تحاول/تحاولين تخمين ما قد يفسر من قبل العائلة أو الأصدقاء أو غيرهم من ايضاح  
السؤال.

يرجى الإشارة إلى التشخيص الخاص بك

- ☐ إصابة الحبل الشوكي
- ☐ إصابات في الدماغ
- ☐ السكتة الدماغية
- ☐ بتر الأطراف العلوية أو فقدان الأطراف الخلقى
- ☐ بتر الأطراف السفلية أو فقدان الأطراف الخلقى
- ☐ تصلب متعدد
- ☐ التصلب الجانبي الضموري (ALS)
- ☐ السنسنة المشقوقة أو الصلب المشقوق
- ☐ الشلل الدماغي
- ☐ هشاشة العظام /التهاب المفاصل الروماتويدي
- ☐ غير ذلك. يرجى التحديد \_\_\_\_\_

Display This Question:

Please answer each question for yourself only. Do not try to guess what family, friends or others... =  
Traumatic Brain Injury If

هل كانت إصابتك حاده أم غير حاده؟

حاده ☐

غير حاده ☐

Display This Question:

Please answer each question for yourself only. Do not try to guess what family, friends or others... =  
Spinal Cord Injury If

بما أنك أشرت/أشرتي إلى أن لديك إصابة في الحبل الشوكي ، فيرجى إخبارنا إذا كانت مصنفة على أنها

الشلل النصفي (الفقره الصدرية الاولى وأدناه) ☐

الشلل الرباعي (من الفقره العنقيه ١ الى ٨) ☐

Display This Question:

Please answer each question for yourself only. Do not try to guess what family, friends or others... =  
Spinal Cord Injury If

نظراً لأنك أشرت/أشرتي إلى أن لديك إصابة في النخاع الشوكي ، فيرجى إخبارنا إذا تم تصنيف الإصابه ب...

☐ قطع غير كامل

☐ قطع كامل

ما هو جهاز التنقل المساعد على الحركة الذي تستخدمه/تستخدمينه معظم الوقت؟

☐ كرسي متحرك يدوي

☐ كرسي متحرك كهربائي

☐ سكوتر كهربائي

☐ طرف صناعي سفلي

☐ جهاز تعويضي سفلي(دعامه)

☐ جهاز مساعد (عصا ، عكاز ، مشاية)

☐ غير ذلك (يرجى التحديد) \_\_\_\_\_

منذ متى وأنت/انتي تستخدم/تستخدمين الجهاز المذكور أعلاه؟

☐ سنة أو أقل

☐ من سنتين إلى ٥ سنوات

☐ من ٦ إلى ١٠ سنوات

☐ ١١ إلى ١٥ سنة

☐ أكثر من ١٥ سنة



أين تجد/تجددين المعلومات حول التكنولوجيا المساعدة؟

يرجى اختيار كل ما ينطبق. بالامكان الاشارة على اكثر من خيار

- ☐ إنترنت
- ☐ وسائل التواصل الاجتماعي
- ☐ المناسبات
- ☐ التلفاز
- ☐ الصحف
- ☐ النشرات الإخبارية
- ☐ المجلات
- ☐ الأطباء
- ☐ اخصائي العلاج الطبيعي او الوظيفي
- ☐ المؤتمرات
- ☐ دراسات بحثية
- ☐ الأسرة /الأصدقاء الذين يستخدمون التكنولوجيا المساعدة
- ☐ غير ذلك (يرجى التحديد) \_\_\_\_\_

Display This Question:

Where do you find information about Assistive Technology? Please check all that apply. = Internet If

مصادر الإنترنت

يرجى اختيار كل ما ينطبق. بالامكان الاشارة على اكثر من خيار

- ☐ ايسنن (1)
- ☐ عالم المعوقين (3)
- ☐ منظمة الصحة العالمية (4) (WHO)
- ☐ ويكيبيديا (5)
- ☐ بحث جوجل (6)
- ☐ أخرى (يرجى التحديد أدناه) (7)

Display This Question:

Internet Sources Please check all that apply. = Other (please specify below) If

ما هي مصادر الإنترنت الأخرى التي تستخدمها/تستخدمينها للحصول على معلومات حول التكنولوجيا المساعدة؟

---

Display This Question:

Where do you find information about Assistive Technology? Please check all that apply. = Social Media If

وسائل التواصل الاجتماعي  
يرجى اختيار كل ما ينطبق. بالامكان الاشارة على اكثر من خيار

- ☐ الفيسبوك
- ☐ موقع يوتيوب
- ☐ تويتر
- ☐ تيك توك
- ☐ انستغرام
- ☐ لينكدن
- ☐ سناب شات
- ☐ أخرى (يرجى التحديد أدناه)

Display This Question:

Social Media Please check all that apply. = Other (please specify below) If

ما هي مصادر التواصل الاجتماعي الأخرى التي تستخدمها/تستخدمينها للحصول على معلومات حول التكنولوجيا المساعدة؟

---

Display This Question:

Where do you find information about Assistive Technology? Please check all that apply. = Events If

#### المناسبات

يرجى اختيار كل ما ينطبق. بالامكان الاشارة على اكثر من خيار

- ☐ الألعاب البارالمبية
- ☐ الرياضات التكميلية - فرق أو مسابقات أو صالات رياضية أو مدربون
- ☐ معارض الإعاقة المحلية
- ☐ اليوم العالمي للأشخاص ذوي الإعاقة
- ☐ اليوم العالمي للعلاج الطبيعي
- ☐ أخرى (يرجى التحديد أدناه)

Display This Question:

Events Please check all that apply. = Other (please specify below) If

ما المناسبات الاخرى التي تحضرها/تحضرينها للحصول على معلومات حول التكنولوجيا المساعدة

Display This Question:

Where do you find information about Assistive Technology? Please check all that apply. = Newsletters If

#### النشرات الإخبارية

يرجى اختيار كل ما ينطبق. بالامكان الاشارة على اكثر من خيار

- ☐ هيئة رعاية الأشخاص ذوي الإعاقة
- ☐ جمعية الأطفال المعوقين
- ☐ جمعية الإعاقة الحركية للكبار (حركية)
- ☐ العربية نيوز
- ☐ أخرى (يرجى التحديد أدناه)

Display This Question:

Newsletters Please check all that apply. = Other (please specify below) If

ما هي النشرات الإخبارية الأخرى التي تقرأها/تقرأينها للحصول على معلومات حول التكنولوجيا المساعدة؟

Display This Question:

Where do you find information about Assistive Technology? Please check all that apply. =  
Magazines If

المجلات

يرجى اختيار كل ما ينطبق. بالامكان الاشارة على اكثر من خيار

- ☐ صدق الإعاقة
- ☐ المجلة السعودية للإعاقة والتأهيل
- ☐ التريبيه الخاصه
- ☐ عالم الإعاقة
- ☐ أخرى (يرجى التحديد أدناه)

Display This Question:

Magazines Please check all that apply. = Other (please specify below) If

ما المجلات الأخرى التي تقرأها/تقرأينها للحصول على معلومات حول التكنولوجيا المساعدة؟

Display This Question:

Where do you find information about Assistive Technology? Please check all that apply. =  
Conferences If

#### المؤتمرات

يرجى اختيار كل ما ينطبق. بالامكان الاشارة على اكثر من خيار

- ☐ المؤتمر الدولي للخبراء حول الإعاقة والتأهيل
- ☐ المؤتمر الدولي للإعاقة والتأهيل
- ☐ المؤتمر السعودي لذوي الإعاقة
- ☐ المؤتمر الدولي للجلوس والكراسي المتحركة (ISS)
- ☐ أخرى (يرجى التحديد أدناه)

Display This Question:

Conferences Please check all that apply. = Other (please specify below) If

ما المؤتمرات الاخرى التي تحضرها/تتضمنها للحصول على معلومات حول التكنولوجيا المساعدة؟

---

هل هناك أي مصادر أخرى تستخدمها/تستخدمينها للحصول على معلومات حول التكنولوجيا المساعدة؟

---

برأيك، ما هو اهم مصدر للحصول على معلومات حول التكنولوجيا المساعدة الجديدة؟

---

ما مدى أهمية التالي بالنسبة لك.....

ليس مهما على الإطلاق	مهم نوعاً ما	مهم بدرجة معقولة	مهم جداً	مهم للغاية	
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	التعرف على تكنولوجيا مساعدة جديدة؟
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	معرفة أن طبيبك أو مقدم الرعاية الصحية على علم بالتكنولوجيا المساعدة الجديدة؟
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	ان تكون/تكوني متمكن/متمكنة من مهارات استخدام جهازك المساعد الشخصي؟

Display This Question:

What assistive mobility device do you use most of the time? = Manual Wheelchair If  
And What assistive mobility device do you use most of the time? = Power Wheelchair  
And What assistive mobility device do you use most of the time? = Scooter

ما هي قدرتك على إكمال العديد من مهارات الكراسي المتحركة اليدوية /الكهربائية بما في ذلك السكوتر الكهربائي ... (أجب/اجيبي فقط على المهارات التي تنطبق عليك

نعم (1)	نعم بصعوبة (2)	لا (3)	لا ينطبق (4)
<p>هل يمكنك أداء حركة بهلوانية بالكرسي المتحرك اليدوي لمدة ٣٠ ثانية ، موازنة الكرسي المتحرك اليدوي على عجلاته الخلفية؟</p> <p>عند استخدام كرسي متحرك يدوي ، هل يمكنك النزول بنفسك والكرسي المتحرك على مسافة قصيرة من السلالم المزودة بدرابزين؟</p> <p>باستخدام كرسيك المتحرك اليدوي ، هل أنت/انتي قادر/قادره على تجاوز عقبة او عائق ارتفاعه ما يقارب ١٠ سنتيمتر؟</p> <p>هل أنت قادر/قادره على النهوض من الأرض إلى الكرسي المتحرك اليدوي ، على سبيل المثال ، بعد السقوط؟</p> <p>هل يمكنك فتح مفصله الباب، وتحريك الكرسي المتحرك ، اليدوي من خلاله وإغلاقه خلفك ، ثم العودة من خلال الطريق الآخر؟</p> <p>عند قيادة الكرسي المتحرك الكهربائي او السكوتر ، هل أنت قادر/قادره على قيادة الكرسي المتحرك او السكوتر عند الزاوية أثناء التحرك للخلف؟</p> <p>عند قيادة الكرسي المتحرك الكهربائي او السكوتر ، هل أنت قادر/قادره على تجنب العوائق المتحركة؟</p>	<input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>	<input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>	<input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>

عند قيادة الكرسي  
/ المتحرك الكهربائي  
السكوتر ، هل يمكنك  
الالتفاف في مساحة  
صغيرة ، مثل المصعد  
بحيث تواجه الاتجاه ،  
المعكس؟

هل أنت قادر/قادره  
على تشغيل شاحن  
البطارية لكرسيك  
المتحرك او سكوترك  
الكهربائي؟

هل أنت قادر/قادره  
على تشغيل خيارات  
تعديل وضع الجسم  
الموجوده في جهاز  
القيادة في الكرسي  
المتحرك الكهربائي؟



صناعة وتطوير تقنيات جديدة  
قبل المتابعة للإجابة على الأسئلة التالية ، يرجى قراءة الأوصاف أدناه حول مجالات التكنولوجيا المساعدة الحديثه

١) (التكنولوجيا القابلة للارتداء وهي نوع من التكنولوجيا التي يمكن أن يرتديها المستخدم وغالبًا ما تكون مصممة لتتبع المعلومات المتعلقة بالصحة واللياقة البدنية مثل المشي والجري وركوب الدراجات .بالنسبة لمستخدمي الكراسي المتحركة ، تستخدم هذه الأنواع من التقنيات تطبيقات الهواتف الذكية التي تراقب النشاط البدني اليومي من خلال تقدير الطاقة المستهلكة، والمسافة المقطوعة ، وعدد مرات دفع عجلات الكرسي المتحرك اليدوي ، وكفاءة الدفع ، والوقت الذي يقضيه في تجاوز مستويات واسطح مختلفة، وغيرها من المعلومات ذات الصلة.

٢) (تعد تقنية الإنسان والآلة أحد مكونات بعض الأجهزة التي تسمح بترجمة مدخلات المستخدم كإشارات توفر بدورها النتائج المطلوبة للمستخدمين .تُعرف هذه التقنية أيضًا باسم "المتحكمات البديلة" ، وقد تساعد المستخدمين الذين لديهم حركة محدودة للذراع أو اليد للتحكم في الكراسي المتحركة والأجهزة البيئية الأخرى .تتضمن أمثلة هذه التقنيات البديلة تتبع حركة العين أو الوجه ، والأمر الصوتي لعصا التحكم في الرأس والذقن ، التحكم عن طريق الشهيقي والزفير ، وأنظمة التحكم باللسان )أحدث تحكم بديل للكرسي المتحرك .)

٣) (الكرسي المتحرك أو المشابيات الآلية وهي أجهزة تنقل مصممة لتمكين الأشخاص ذوي الإعاقات المختلفة ، لا سيما أولئك الذين يجدون صعوبة في استخدام الكرسي المتحرك أو المشي بشكل مستقل ، لتحقيق تنقل آمن ومستقل من خلال المساعدة في اكتشاف العوائق أو الاصطدام ، والملاحة ، وتخطي العقبات والحواجز ، وأداء مهام معينة مثل المرور عبر الأبواب .تم تصميم بعض الكراسي المتحركة والمشابيات الذكية ليتم تشغيلها بشكل مستقل دون تدخل المستخدم ، بينما تم تصميم البعض الآخر ليتم تشغيله باستخدام أدوات تحكم بديلة.

٤) (مصادر الطاقة البديلة في التكنولوجيا المساعدة للتنقل وتعني دمج مصادر أخرى للطاقة بخلاف البطاريات في الأجهزة المساعدة .على التنقل والحركة التي تعمل بالطاقة

٥) (تقنية البيت الذكي والتي تتيح للمستخدمين التحكم في أجهزتهم المنزلية ومراقبتها عن بُعد من خلال تطبيقات المنزل الذكي أو الهواتف الذكية أو أجهزة الشبكة الأخرى .على سبيل المثال ، يمكن للمستخدمين مراقبة الأضواء والأبواب والنوافذ والمظلات والمراوح وأنظمة الترفيه وايضا مراقبه ما يتعلق بالصحة والتحكم فيها من خلال الأوامر الصوتية أو عبر الإنترنت

٦) (الهياكل الخارجية هي أجهزة تقويمية اليه للأطراف السفلية يمكن وضعها على المستخدم لتعزيز أداء الاعضاء السفلية أو تقويتها أو استعادة حركتها، ولكن لا تعتبر كبديل لوظيفة الجزء الأصلي من الجسم

ما مدى معرفتك بهذه المجالات من التكنولوجيا المساعدة المتقدمة؟

غير مألوف على الإطلاق	مألوف بعض الشيء	مألوف إلى حد ما	مألوف جدا	مألوف للغاية	
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	التقنيات القابلة للارتداء
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	تقنية الإنسان والآلة
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	كرسي متحرك أو مشايه آليه
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	مصادر الطاقة البديلة
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	تقنية المنزل الذكي
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	تكنولوجيا الهيكل الخارجي

هل تشعر/تشعرين أنك بحاجة إلى مزيد من المعلومات أو التعلم حول أي من هذه التقنيات المساعدة على التنقل والحركة؟  
يرجى اختيار كل ما ينطبق. بالامكان الإشارة على أكثر من خيار

- ☐ كرسي متحرك يدوي
- ☐ كرسي متحرك كهربائي
- ☐ سكوتر
- ☐ الأطراف الصناعية السفلية
- ☐ اجهزه التقويم السفلية
- ☐ جهاز مساعد آخر (يرجى التحديد أدناه)
- ☐ لا أشعر أنني بحاجة إلى أي معلومات إضافية

ما هي الأجهزة التقنية المساعدة الأخرى التي تشعر/تشعرين أنك بحاجة إلى معلومات عنها

كيف ترى/ترين افضل آلية لتلقي هذه المعلومات؟

- ☐ فيديو (1)
- ☐ ورشة عمل (2)
- ☐ النشرة الإخبارية (3)
- ☐ WEB بريد إلكتروني مع روابط (4)
- ☐ كتب (5)
- ☐ مقالات المجلات (6)
- ☐ وسائل التواصل الاجتماعي (7)
- ☐ موقع إلكتروني (8)

للسماح لنا بتحديد ما إذا كنا نصل إلى مجموعة متنوعة من المشاركين الذين يمثلون جميع أنواع مستخدمي أجهزة التنقل والحركة في . . . السعودية ، نود معرفة بعض المعلومات عنك

ما هو جنسك؟

☐ ذكر

☐ أنثى

ما هو عمرك؟

ما هو أعلى مستوى تعليمي أكملته؟

☐ شهادة الثانوية العامة أو ما يعادلها

☐ دبلوم

☐ بكالوريوس

☐ ماجستير

☐ دكتوراه

☐ لا شيء مما بالأعلى

☐ أفضل عدم الاجابة

ما هو دخلك الشهري؟

- ☐ أقل من ١٠٠٠٠ ريال سعودي
- ☐ ١٠٠٠٠ ريال سعودي إلى ١٥٠٠٠ ريال سعودي
- ☐ ١٥٩٩٩ ريال سعودي إلى ٢٠٠٠٠ ريال سعودي
- ☐ ٢٠٩٩٩ ريال سعودي إلى ٤٠٠٠٠ ريال سعودي
- ☐ ٤٠٩٩٩ ريال سعودي إلى ٧٠٠٠٠ ألف ريال سعودي
- ☐ ٧٠٩٩٩ ريال سعودي إلى ١٠٠٠٠٠ ريال سعودي
- ☐ أكثر من مائه ألف ريال سعودي
- ☐ أفضل عدم الإجابة

أين تقيم؟

☐ الرياض

☐ جدة

☐ الدمام

☐ مكة

☐ المدينة المنورة

☐ الطائف

☐ أبها

☐ جازان

☐ نجران

☐ حائل

☐ تبوك

☐ الجوف

☐ الخبر

☐ القصيم

☐ بريدة

☐ سكاكا

☐ عرعر

☐ غير ذلك (يرجى التحديد)

للتأكد من أن كل مشارك يكمل الاستبيان مرة واحدة فقط ، يرجى ملء الأسئلة التالية

○ الاسم الأول والاسم الأخير \_\_\_\_\_

○ تاريخ الولادة \_\_\_\_\_

○ عنوان البريد الإلكتروني \_\_\_\_\_

○ رقم الهاتف \_\_\_\_\_

#### End of Block: Demographic Information

نشكرك على الوقت الذي امضيته في تعبئه هذا الاستبيان. لقد تم تسجيل اجوبتك. اذا كنت ترغب في الحصول على معلومات اكثر حول  
المعمل الرجاء الضغط على الرابط التالي [www.herl.pitt.edu](http://www.herl.pitt.edu)

نهاية الاستبيان!

## Appendix C ARABIC VERSION OF THE SURVEY\_FINAL



قبل الإشارة إلى موافقتك على المشاركة في هذه الدراسة ، يرجى الإجابة على السؤالين التاليين  
هل تبلغ/تبلغين من العمر ١٨ عامًا أو أكثر؟

نعم ☐

لا ☐

*Skip To: End of Survey If Before indicating your consent to participate in this study, please answer the following two ques... = No*

هل أنت/انتي من مستخدمي الأجهزة المساعدة على الحركة والتنقل على سبيل المثال ، كرسي متحرك يدوي ، كرسي متحرك كهربائي  
سكوتر كهربائي، عصا ، عكازات ، مشاية ، أو أجهزة تقويمية أو اطراف صناعية؟

نعم ☐

لا ☐

*Skip To: End of Survey If Are you a mobility assistive device user (e.g., manual wheelchair, power wheelchair, scooter, can... = No*

إذا قرأت/قرأت وفهمتي/فهمتي المعلومات الواردة أعلاه ، فيرجى الإشارة إلى موافقتك على المشاركة في هذه الدراسة  
هل توافق/توافقين على المشاركة؟

نعم ☐

لا ☐

*Skip To: End of Survey If If you read and understand the above information, please indicate your consent to participate in... = No*

الرجاء الإجابة على كل سؤال بفهمك فقط. لا تحاول/تحاولين تخمين ما قد يفسر من قبل العائلة أو الأصدقاء أو غيرهم من ايضاح  
للسؤال.



يرجى الإشارة إلى التشخيص الخاص بك

- ☐ إصابة الحبل الشوكي
- ☐ إصابات في الدماغ
- ☐ السكتة الدماغية
- ☐ بتر الأطراف العلوية أو فقدان الأطراف الخلفي
- ☐ بتر الأطراف السفلية أو فقدان الأطراف الخلفي
- ☐ تصلب متعدد
- ☐ التصلب الجانبي الضموري (ALS)
- ☐ السنسنة المشقوقة أو الصلب المشقوق
- ☐ الشلل الدماغي
- ☐ هشاشة العظام /التهاب المفاصل الروماتويدي
- ☐ غير ذلك .يرجى التحديد \_\_\_\_\_

Display This Question:

Please answer each question for yourself only. Do not try to guess what family, friends or others... =  
Traumatic Brain Injury If

هل كانت إصابتك حاده أم غير حاده؟

☐ حاده

☐ غير حاده

Display This Question:

Please answer each question for yourself only. Do not try to guess what family, friends or others... =  
Spinal Cord Injury If

بما أنك أشرت/أشرتي إلى أن لديك إصابة في الحبل الشوكي ، فيرجى إخبارنا إذا كانت مصنفة على أنها

☐ الشلل النصفي (الفقره الصدرية الاولى وأدناه)

☐ الشلل الرباعي (من الفقره العنقيه ١ الى ٨)

Display This Question:

Please answer each question for yourself only. Do not try to guess what family, friends or others... =  
Spinal Cord Injury If

نظراً لأنك أشرت/أشرتي إلى أن لديك إصابة في النخاع الشوكي ، فيرجى إخبارنا إذا تم تصنيف الإصابه ب...

☐ قطع غير كامل

☐ قطع كامل

ما هو جهاز التنقل المساعد على الحركة الذي تستخدمه/تستخدمينه معظم الوقت؟

☐ كرسي متحرك يدوي

☐ كرسي متحرك كهربائي

☐ سكوتر كهربائي

☐ طرف صناعي سفلي

☐ جهاز تعويضي سفلي(دعامه)

☐ جهاز مساعد (عصا ، عكاز ، مشاية)

☐ غير ذلك (يرجى التحديد) \_\_\_\_\_

منذ متى وأنت/انتي تستخدم/تستخدمين الجهاز المذكور أعلاه؟

☐ سنة أو أقل

☐ من سنتين إلى ٥ سنوات

☐ من ٦ إلى ١٠ سنوات

☐ ١١ إلى ١٥ سنة

☐ أكثر من ١٥ سنة

أين تجد/تجدين المعلومات حول التكنولوجيا المساعدة؟

يرجى اختيار كل ما ينطبق. بالامكان الاشارة على اكثر من خيار

- ☐ إنترنت
- ☐ وسائل التواصل الاجتماعي
- ☐ المناسبات
- ☐ التلفاز
- ☐ الصحف
- ☐ النشرات الإخبارية
- ☐ المجلات
- ☐ الأطباء
- ☐ اخصائي العلاج الطبيعي او الوظيفي
- ☐ المؤتمرات
- ☐ دراسات بحثية
- ☐ الأسرة /الأصدقاء الذين يستخدمون التكنولوجيا المساعدة
- ☐ غير ذلك (يرجى التحديد) \_\_\_\_\_

Display This Question:

Where do you find information about Assistive Technology? Please check all that apply. = Internet If

مصادر الإنترنت

يرجى اختيار كل ما ينطبق. بالامكان الاشارة على اكثر من خيار

- ☐ ايسن (1)
- ☐ عالم المعوقين (3)
- ☐ منظمة الصحة العالمية (4) (WHO)
- ☐ ويكيبيديا (5)
- ☐ بحث جوجل (6)
- ☐ أخرى (يرجى التحديد أدناه) (7)



Display This Question:

Internet Sources Please check all that apply. = Other (please specify below) If

ما هي مصادر الإنترنت الأخرى التي تستخدمها/تستخدمينها للحصول على معلومات حول التكنولوجيا المساعدة؟

---

Display This Question:

Where do you find information about Assistive Technology? Please check all that apply. = Social Media If

وسائل التواصل الاجتماعي  
يرجى اختيار كل ما ينطبق. بالامكان الاشارة على اكثر من خيار

- ☐ الفيسبوك
- ☐ موقع يوتيوب
- ☐ تويتر
- ☐ تيك توك
- ☐ انستغرام
- ☐ لينكدن
- ☐ سناب شات
- ☐ أخرى (يرجى التحديد أدناه)

Display This Question:

Social Media Please check all that apply. = Other (please specify below) If

ما هي مصادر التواصل الاجتماعي الأخرى التي تستخدمها/تستخدمينها للحصول على معلومات حول التكنولوجيا المساعدة؟

---

Display This Question:

Where do you find information about Assistive Technology? Please check all that apply. = Events If

المناسبات

يرجى اختيار كل ما ينطبق. بالامكان الاشارة على اكثر من خيار

- ☐ الألعاب البارالمبية
- ☐ الرياضات التكميلية - فرق أو مسابقات أو صالات رياضية أو مدربين
- ☐ معارض الإعاقة المحلية
- ☐ اليوم العالمي للأشخاص ذوي الإعاقة
- ☐ اليوم العالمي للعلاج الطبيعي
- ☐ أخرى (يرجى التحديد أدناه)

Display This Question:

Events Please check all that apply. = Other (please specify below) If

ما المناسبات الاخرى التي تحضرها/تحضرينها للحصول على معلومات حول التكنولوجيا المساعدة

Display This Question:

Where do you find information about Assistive Technology? Please check all that apply. = Newsletters If

النشرات الإخبارية

يرجى اختيار كل ما ينطبق. بالامكان الاشارة على اكثر من خيار

- ☐ هيئة رعاية الأشخاص ذوي الإعاقة
- ☐ جمعية الأطفال المعوقين
- ☐ جمعية الإعاقة الحركية للكبار (حركية)
- ☐ العربية نيوز
- ☐ أخرى (يرجى التحديد أدناه)

Display This Question:

Newsletters Please check all that apply. = Other (please specify below) If

ما هي النشرات الإخبارية الأخرى التي تقرأها/تقرأينها للحصول على معلومات حول التكنولوجيا المساعدة؟

---

Display This Question:

Where do you find information about Assistive Technology? Please check all that apply. =  
Magazines If

المجلات

يرجى اختيار كل ما ينطبق. بالامكان الاشارة على اكثر من خيار

- ☐ صدى الإعاقة
- ☐ المجلة السعودية للإعاقة والتأهيل
- ☐ التربيـه الخاصـه
- ☐ عالم الإعاقة
- ☐ أخرى (يرجى التحديد أدناه)

Display This Question:

Magazines Please check all that apply. = Other (please specify below) If

ما المجلات الأخرى التي تقرأها/تقرأينها للحصول على معلومات حول التكنولوجيا المساعدة؟

---

Display This Question:

Where do you find information about Assistive Technology? Please check all that apply. =  
Conferences If

## المؤتمرات

يرجى اختيار كل ما ينطبق. بالامكان الاشارة على اكثر من خيار

- ☐ المؤتمر الدولي للخبراء حول الإعاقة والتأهيل
- ☐ المؤتمر الدولي للإعاقة والتأهيل
- ☐ المؤتمر السعودي لذوي الإعاقة
- ☐ المؤتمر الدولي للجلوس والكراسي المتحركة (ISS)
- ☐ أخرى (يرجى التحديد أدناه)

Display This Question:

Conferences Please check all that apply. = Other (please specify below) If

ما المؤتمرات الأخرى التي تحضرها/تتضمنها للحصول على معلومات حول التكنولوجيا المساعدة؟

---

هل هناك أي مصادر أخرى تستخدمها/تستخدمينها للحصول على معلومات حول التكنولوجيا المساعدة؟

---

برأيك، ما هو أهم مصدر للحصول على معلومات حول التكنولوجيا المساعدة الجديدة؟

---



ما مدى أهمية التالي بالنسبة لك.....

ليس مهما على الإطلاق	مهم نوعاً ما	مهم بدرجة معقولة	مهم جداً	مهم للغاية
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

التعرف على تكنولوجيا مساعدة جديدة؟

معرفة أن طبيبك أو مقدم الرعاية الصحية على علم بالتكنولوجيا المساعدة الجديدة؟

ان تكون/تكوني متمكن/متمكنة من مهارات استخدام جهازك المساعد الشخصي؟

Display This Question:

What assistive mobility device do you use most of the time? = Manual Wheelchair If  
And What assistive mobility device do you use most of the time? = Power Wheelchair  
And What assistive mobility device do you use most of the time? = Scooter

Display This Question:

What assistive mobility device do you use most of the time? = Manual Wheelchair If

ما هي قدرتك على إكمال العديد من مهارات الكراسي المتحركة اليدوية ... أجب/اجيبي فقط على المهارات التي تنطبق عليك

لا ينطبق	لا	نعم بصعوبة	نعم	
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	هل يمكنك أداء حركة بهلوانية بالكرسي المتحرك اليدوي لمدة ٣٠ ثانية ، اي موازنة الكرسي المتحرك اليدوي على عجلاته الخلفية؟
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	عند استخدام كرسي متحرك يدوي ، هل يمكنك النزول بنفسك والكرسي المتحرك على مسافة قصيرة من السلالم المزودة بدرابزين؟
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	باستخدام كرسيك المتحرك اليدوي ، هل أنت/انتي قادر/قادره على تجاوز عقبه او عائق ارتفاعه ما يقارب ١٠ سنتيمتر؟
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	هل أنت/انتي قادر/قادره على النهوض من الأرض إلى الكرسي المتحرك اليدوي ، على سبيل المثال ، بعد السقوط؟
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	هل يمكنك فتح مفصله الباب، وتحريك الكرسي المتحرك اليدوي من خلاله ، وإغلاقه خلفك ، ثم العودة من خلال الطريق الآخر؟



Display This Question:

What assistive mobility device do you use most of the time? = Power Wheelchair If  
Or What assistive mobility device do you use most of the time? = Scooter

ما هي قدرتك على إكمال العديد من مهارات الكراسي الكهربائية (بما في ذلك السكوتر الكهربائي ... (أجب/اجيبي فقط على المهارات التي تنطبق عليك

لا ينطبق	لا	نعم بصعوبة	نعم
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

عند قيادة الكرسي المتحرك الكهربائي أو السكوتر ، هل أنت/انتي قادر/قادره على قيادة الكرسي المتحرك أو السكوتر عند الزاوية أثناء التحرك للخلف؟

عند قيادة الكرسي المتحرك الكهربائي أو السكوتر ، هل أنت/انتي قادر/قادره على تجنب العوائق المتحركة؟

عند قيادة الكرسي المتحرك الكهربائي / السكوتر ، هل يمكنك الالتفاف في مساحة صغيرة ، مثل المصعد ، بحيث تواجه/تواجهين الاتجاه المعاكس؟

هل أنت/انتي قادر/قادره على تشغيل شاحن البطارية لكرسيك المتحرك الكهربائي؟

هل أنت/انتي قادر/قادره على تشغيل خيارات تعديل وضع الجسم الموجودة في جهاز القيادة في الكرسي المتحرك الكهربائي؟

Page Break

**Display This Question:**

**What assistive mobility device do you use most of the time? = Manual Wheelchair If**

يتم دائما إنشاء تقنيات جديدة. قبل المتابعة للإجابة على الأسئلة التالية ، يرجى قراءة الأوصاف أدناه حول مجالات التكنولوجيا المقترحة

هل أنت/أنتي على علم بما يلي؟ ملاحظة: إذا كنت تواجه/تواجهين مشكلة في عرض الصور ضمن هذا الاستطلاع ، فهي متوفرة أيضا على: <http://herl.pitt.edu/tech-survey/>

١. التكنولوجيا القابلة للارتداء أو الهاتف المحمول هي نوع من التكنولوجيا التي يمكن أن يرتديها المستخدم وغالبًا ما تكون مصممة لتتبع المعلومات المتعلقة بالصحة واللياقة البدنية مثل المشي والجري وركوب الدراجات. بالنسبة لمستخدمي الكراسي المتحركة ، تستخدم هذه الأنواع من التقنيات تطبيقات الهواتف الذكية التي تراقب النشاط البدني اليومي من خلال تقدير نفقات الطاقة ، والمسافة المقطوعة ، وعدد مرات الدفع ، وكفاءة الدفع ، والوقت الذي يقضيه في مستويات كثافة مختلفة ، وغيرها من المعلومات ذات الصلة



هل أنت/أنتي على معرفة بهذه التقنية ؟

نعم ☐

لا ☐

**Display This Question:**

**What assistive mobility device do you use most of the time? = Power Wheelchair If**

**Or What assistive mobility device do you use most of the time? = Scooter**

٢. تعد تقنية واجهة الإنسان والآلة أحد مكونات بعض الأجهزة التي تسمح بترجمة مدخلات المستخدم كإشارات توفر بدورها النتائج المطلوبة للمستخدمين. تُعرف هذه التقنية أيضًا باسم "أجهزة التحكم البديلة"، وقد تساعد المستخدمين الذين لديهم حركة محدودة للذراع أو اليد للتحكم في الكراسي المتحركة والأجهزة البينية الأخرى. تتضمن أمثلة هذه التقنيات البديلة تتبع حركة العين أو الوجه، والأمر الصوتي لعصا التحكم في الرأس أو الذقن، التحكم عن طريق الشهيقي والزفير، وأنظمة التحكم باللسان (أحدث تحكم بديل للكرسي المتحرك).



هل أنت/انتي على معرفة بهذه التقنية ؟

نعم ☐

لا ☐



Display This Question:

What assistive mobility device do you use most of the time? = Power Wheelchair If

Or What assistive mobility device do you use most of the time? = Scooter

٣. الكرسي المتحرك او المشايه الالية وهي أجهزة تنقل مصممة لتمكين الأشخاص ذوي الإعاقات المختلفة ، لا سيما أولئك الذين يجدون صعوبة في استخدام الكرسي المتحرك أو المشي بشكل مستقل ، لتحقيق تنقل آمن ومستقل من خلال المساعدة في اكتشاف العوائق أو الاصطدام ، والملاحة ، وتخطي العقبات والحواجز ، وأداء مهام معينة مثل المرور عبر الأبواب. تم تصميم بعض الكراسي المتحركة والمشايات الذكية ليتم تشغيلها بشكل مستقل دون تدخل المستخدم ، بينما تم تصميم البعض الآخر ليتم تشغيله باستخدام أدوات تحكم بديلة.



هل أنت/انتي على معرفة بهذه التقنية ؟

نعم ☐

لا ☐



Display This Question:

What assistive mobility device do you use most of the time? = Manual Wheelchair If

Or What assistive mobility device do you use most of the time? = Power Wheelchair

Or What assistive mobility device do you use most of the time? = Scooter

Or What assistive mobility device do you use most of the time? = Lower Extremity Prosthetic

Or What assistive mobility device do you use most of the time? = Lower Extremity Orthotic (brace)

Or What assistive mobility device do you use most of the time? = Assistive Device (cane, crutch, walker) Or What assistive mobility device do you use most of the time? = Other (please specify)

٤. مصادر الطاقة البديلة في التكنولوجيا المساعدة على الحركة وتعني دمج مصادر أخرى للطاقة بخلاف البطاريات في الأجهزة المساعدة على الحركة التي تعمل بالطاقة مثل استخدام إسطوانات غاز الهواء كما هو مبين في الصورة



هل أنت/انتي على معرفة بهذه التقنية ؟

نعم ☐

لا ☐

Display This Question:

What assistive mobility device do you use most of the time? = Manual Wheelchair If  
Or What assistive mobility device do you use most of the time? = Power Wheelchair  
Or What assistive mobility device do you use most of the time? = Scooter  
Or What assistive mobility device do you use most of the time? = Lower Extremity Prosthetic  
Or What assistive mobility device do you use most of the time? = Lower Extremity Orthotic (brace)  
Or What assistive mobility device do you use most of the time? = Assistive Device (cane, crutch, walker) Or What assistive mobility device do you use most of the time? = Other (please specify)

٥. تقنية البيت الذكي والتي تتيح للمستخدمين التحكم في أجهزتهم المنزلية ومراقبتها عن بُعد من خلال تطبيقات المنزل الذكي أو الهواتف الذكية أو أجهزة الشبكة الأخرى. على سبيل المثال ، يمكن للمستخدمين مراقبة الأضواء والأبواب والنوافذ والمظلات والمراوح وأنظمة الترفيه وإيضاً مراقبه ما يتعلق بالصحة والتحكم فيها من خلال الأوامر الصوتية أو عبر الإنترنت



هل أنت/انتي على معرفة بهذه التقنية ؟

نعم ☐

لا ☐

٦. الهياكل الخارجية هي أجهزة تقويمية اليه للأطراف السفلية يمكن وضعها على المستخدم لتعزيز أداء الاعضاء السفلية أو تقويتها أو استعادة حركتها، ولكن لا تعتبر كبديل لوظيفة الجزء الأصلي من الجسم



هل أنت/انتي على معرفة بهذه التقنية ؟

نعم ☐

لا ☐

Page Break

هل تشعر/تشعرين أنك بحاجة إلى مزيد من المعلومات أو التعلم حول أي من هذه التقنيات المساعدة على التنقل والحركة؟  
يرجى اختيار كل ما ينطبق. بالامكان الإشارة على أكثر من خيار

- ☐ كرسي متحرك يدوي
- ☐ كرسي متحرك كهربائي
- ☐ سكوتر
- ☐ الأطراف الصناعية السفلية
- ☐ اجهزه التقويم السفلية
- ☐ جهاز مساعد آخر (يرجى التحديد أدناه)
- ☐ لا أشعر أنني بحاجة إلى أي معلومات إضافية

ما هي الأجهزة التقنية المساعدة الأخرى التي تشعر/تشعرين أنك بحاجة إلى معلومات عنها

كيف ترى/ترين أفضل آلية لتلقي هذه المعلومات؟

- ☐ فيديو (1)
- ☐ ورشة عمل (2)
- ☐ النشرة الإخبارية (3)
- ☐ WEB بريد إلكتروني مع روابط (4)
- ☐ كتب (5)
- ☐ مقالات المجلات (6)
- ☐ وسائل التواصل الاجتماعي (7)
- ☐ موقع إلكتروني (8)

للسماح لنا بتحديد ما إذا كنا نصل إلى مجموعة متنوعة من المشاركين الذين يمثلون جميع أنواع مستخدمي أجهزة التنقل والحركة في . . . السعودية ، نود معرفة بعض المعلومات عنك

ما هو جنسك؟

☐ ذكر

☐ أنثى

ما هو عمرك؟

ما هو أعلى مستوى تعليمي أكملته؟

☐ شهادة الثانوية العامة أو ما يعادلها

☐ دبلوم

☐ بكالوريوس

☐ ماجستير

☐ دكتوراه

☐ لا شيء مما بالأعلى

☐ أفضل عدم الاجابة

ما هو دخلك الشهري؟

- ☐ أقل من ١٠٠٠٠ ريال سعودي
- ☐ ١٠٠٠٠ ريال سعودي إلى ١٥٠٠٠ ريال سعودي
- ☐ ١٥٩٩٩ ريال سعودي إلى ٢٠٠٠٠ ريال سعودي
- ☐ ٢٠٩٩٩ ريال سعودي إلى ٤٠٠٠٠ ريال سعودي
- ☐ ٤٠٩٩٩ ريال سعودي إلى ٧٠٠٠٠ ألف ريال سعودي
- ☐ ٧٠٩٩٩ ريال سعودي إلى ١٠٠٠٠٠ ريال سعودي
- ☐ أكثر من مائه الف ريال سعودي
- ☐ أفضل عدم الاجابة

أين نقيم؟

☐ الرياض

☐ جدة

☐ الدمام

☐ مكة

☐ المدينة المنورة

☐ الطائف

☐ أبها

☐ جازان

☐ نجران

☐ حائل

☐ تبوك

☐ الجوف

☐ الخبر

☐ القصيم

☐ بريدة

☐ سكاكا

☐ عرعر

☐ غير ذلك (يرجى التحديد) \_\_\_\_\_

للتأكد من أن كل مشارك يكمل الاستبيان مرة واحدة فقط ، يرجى ملء الأسئلة التالية

○ الاسم الأول والاسم الأخير \_\_\_\_\_

○ تاريخ الولادة \_\_\_\_\_

○ عنوان البريد الإلكتروني \_\_\_\_\_

○ رقم الهاتف \_\_\_\_\_

#### End of Block: Demographic Information

نشكرك على الوقت الذي أمضيتَه في تعبئه هذا الاستبيان. لقد تم تسجيل اجوبتك. اذا كنت ترغب في الحصول على معلومات أكثر حول  
المعمل الرجاء الضغط على الرابط التالي [www.herl.pitt.edu](http://www.herl.pitt.edu)

نهاية الاستبيان!



## Appendix D SURVEY CONSENT FORMS



### تحديد مصادر الوعي والمعرفة للتكنولوجيا المساعدة على الحركة والتنقل

#### Start of Block: Default Question Block

تحديد مصادر الوعي والمعرفة للتكنولوجيا المساعدة على الحركة والتنقل

هذه الدراسة هي امتداد لمجموعه من الدراسات الاستطلاعية لمعرفة اراء مستخدمي التكنولوجيا المساعدة على الحركة والتنقل التي أجريت في الولايات المتحدة. تهدف هذه الدراسة إلى جمع المعلومات والآراء مباشرة من الأفراد الذين يستخدمون التكنولوجيا المساعدة المتعلقة بالحركة والتنقل والذين يعيشون في المملكة العربية السعودية. في هذا الاستطلاع، نسعى إلى معرفة مختلف التقنيات المساعدة المستخدمة حالياً وأين يمكن للمستخدمين الحصول على معلومات تخص التكنولوجيا المساعدة على الحركة والتنقل

في حال موافقه على المشاركة في هذا الاستطلاع، فعليك إكمال استبيان قصير يسألك عن نوع الاعاقه وأنواع الأجهزة المساعدة على الحركة والتنقل التي تستخدمها/تستخدمينها حالياً. كذلك نود مشاركتك معرفتك حول المصادر الذي تحصل/تحصلين فيها على المعلومات المتعلقة بالتكنولوجيا المساعدة على الحركة والتنقل. أخيراً، سيكون هناك بعض الأسئلة العامة عن المشارك في الاستطلاع مثل الجنس (ذكر، أنثى)، العمر، مستوى الدخل المعيشي، والمدينة المقيم فيها

تستطيع/تستطيعين المشاركة في هذه الدراسة اذا تبلغ/تبليغين من العمر ١٨ عاماً أو أكثر وتستخدم/تستخدمين التكنولوجيا المساعدة المتعلقة بالتنقل والحركة (مثل الكراسي المتحركة، السكوتر الكهربائي، والاطراف الصناعية والأجهزة التعويضية وما إلى ذلك). (لا توجد مخاطر فعلية مرتبطة بالموافقة على المشاركة في هذه الدراسة. سنجمع الحد الأدنى من المعلومات التي يمكن تحديدها) مثال: الاسم الأول واسم العائلة وتاريخ الميلاد (المحاولة التأكد من أن كل مشارك يكمل الاستبيان مرة واحدة فقط. سيطلب منك تقديم عنوان بريدك الإلكتروني إذا كنت ترغب/ترغبين في الاتصال بك للمشاركة في الاستطلاعات المستقبلية في هذه المجموعه الاستطلاعية. لذلك، من المحتمل وجود خرق في سرية المعلومات المقدمة، مع التأكيد بان الفريق البحثي المسنول عن الدراسة سيبدل قصارى جهده لمنع حدوث مثل هذه الاختراقات

سيستغرق استكمال الاستبيان حوالي ١٥ دقيقة. لن تستفيد/تستفيدين بشكل مباشر من المشاركة في هذا البحث، ومع ذلك، قد تساعد المعلومات التي سيتم جمعها من فريق البحث في تقييم أو تحسين طرق نشر المعرفة بالتقنيات المساعدة التي قد تفيد مستخدمي هذه الأجهزة ومقدمي الرعاية الصحية والأطباء في المستقبل. مشاركتك في هذا البحث تطوعية وليست الزامية، كما انه لن يترتب على رفضك للمشاركة أي عقوبة أو فقدان الحقوق التي يحق لك الحصول عليها. يمكنك الانسحاب من هذه الدراسة في أي وقت. بعد الانتهاء من هذا الاستبيان، يمكنك اختيار الدخول في السحب للفوز بـ ٢٠٠ ريال سعودي. وللمشاركة في هذا السحب، يرجى إدخال رقم هاتف حتى تتمكن من الوصول إليك والاتصال بك إذا حالفك الحظ بالفوز. إذا كان لديك أي أسئلة حول هذه الدراسة، يمكنك الاتصال اما على ا.صالح القحطاني على جوال 0562444293 او التواصل مع المشرف الأكاديمي د. روري كوبر من خلال الايميل [rcooper@pitt.edu](mailto:rcooper@pitt.edu)

شاكرين سلفاً مشاركتك في تعبئه هذا الاستبيان !1

# Identifying Awareness and Knowledge Sources of Mobility-Assistive Technology

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Start of Block: Default Question Block

## 1 Identifying Awareness and Knowledge Sources of Mobility-Assistive Technology

This research study is an extension of a series of surveys for the Voice of the Consumer research study that has been conducted in the United States in which we aim to collect information and opinions directly from individuals living in Saudi Arabia who use mobility-related assistive technology. In this survey, we want to see what is known about various assistive technologies and where people get their knowledge of technology.

If you agree to participate, you will be asked to complete a short questionnaire that will ask you about your disability and the types of assistive mobility devices that you use. We will also ask you to share your thoughts on where you get information related to assistive mobility technology. Finally, we will ask some general questions about you such as your gender, ethnicity, and the type of community setting in which you live.

You are being asked to take part in this study because you are 18 years of age or older and use mobility-related assistive technology (e.g. wheelchair, scooter, prosthesis, etc.). There are no physical risks associated with agreeing to participate in this study. We will collect a minimal amount of identifiable information (first name, last name, & date of birth) to try to ensure that each participant completes the questionnaire only once. You will be asked to provide your email address if you would like to be contacted to participate in future surveys in this series. Therefore, there is a slight risk of breach of confidentiality, but the research team will do everything possible to prevent this risk. The questionnaire will take approximately 15 minutes to complete. You will not directly benefit from participating in this research, however, the information collected may help the research team evaluate and/or improve ways to spread knowledge of assistive technologies which may in turn benefit users of these devices, caregivers, and clinicians in the future. Your participation in this research is voluntary. You do not have to take part in this study, and your refusal to participate will involve no penalty or loss of rights to which you are entitled. You may withdraw from this study at any time. Following completion of this questionnaire, you may choose to be entered into a drawing to win SR200. To participate in this drawing please enter a phone number where you can be reached in the space provided so we can contact you if you win. If you have any questions about this study, please contact Mr. Saleh Alqahtani at 0562444293 or Dr. Rory Cooper at [rcooper@pitt.edu](mailto:rcooper@pitt.edu).

Thanks in advance for your participation!

## Appendix E IRB APPROVAL



### EXEMPT DETERMINATION

Date:	February 17, 2022
IRB:	STUDY19100265
PI:	Rory Cooper
Title:	Identifying Awareness and Knowledge Sources of Mobility-Assistive Technology
Funding:	Name: Saudi Arabian Cultural Mission

The Institutional Review Board reviewed and determined the above referenced study meets the regulatory requirements for exempt research under 45 CFR 46.104.

#### Determination Documentation

Determination Date:	2/17/2022
Exempt Category:	(2)(iii) Tests, surveys, interviews, or observation (identifiable); and for which limited IRB review was conducted via expedited review

Approved Documents:	<ul style="list-style-type: none"><li>• Translator certification_Version_0.01.pdf, Category: Translator;</li><li>• English Version of the Survey, Category: Data Collection;</li><li>• Arabic Version of the Survey, Category: Data Collection;</li><li>• Acknowledgment of Unregulated Research Activities, Category: External Site Permission Letter;</li><li>• Consent Form.docx, Category: Recruitment Materials;</li><li>• Exempt Application Form, Category: IRB Protocol;</li></ul>
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If you have any questions, please contact the University of Pittsburgh IRB Coordinator, [Larry Ivancd](#).

Please take a moment to complete our [Satisfaction Survey](#) as we appreciate your feedback.

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