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Barriers to the Provision of Mobility Assistive Technology in Saudi Arabian Healthcare: A Mixed-Methods Study Using the Consolidated Framework for Implementation Research

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Abstract

Purpose: Mobility-related disabilities are the most prevalent disabilities in Saudi Arabia, significantly affecting quality of life. While mobility-assistive technologies (MATs) help mitigate impairments, unmet needs persist with a critical knowledge gap regarding barriers to their provision. This study investigated the barriers to the provision of MAT in the healthcare system of Saudi Arabia.

Materials and Methods: This mixed methods study combined a cross-sectional survey with a qualitative embedded multiple case study across three public hospitals in two Saudi regions. The survey assessed MAT availability among 67 stakeholders and facilitated recruitment for the qualitative investigation. Semi-structured interviews were conducted with 33 participants (healthcare professionals, managers, and leaders), and six policy documents were analysed. The Consolidated Framework for Implementation Research (CFIR) guided data collection and analysis.

Results: The survey demonstrated that, while basic MATs were generally accessible, advanced devices were not and there were substantial regional disparities. The qualitative analysis identified 52 barriers across all CFIR domains, including dependence on imported devices, high costs and procurement delays, restrictive policies and regulatory ambiguities, insufficient professional healthcare training, inadequate strategic planning and clinical leadership, infrastructural constraints, and sociocultural factors that influence patient acceptance.

Conclusion: This study is the first comprehensive investigation of barriers to MAT provision in Saudi Arabia. These findings provide policymakers and practitioners with an evidence-based foundation for designing contextually relevant implementation strategies to enhance equitable MAT provision.

Keywords: Mobility, assistive technology; Assistive devices; Implementation science; Consolidated Framework for Implementation Research; Barriers; Healthcare access

Introduction

Mobility impairments resulting from neurological conditions, musculoskeletal disorders, aging, and injuries diminish the quality of life (QoL) [1–3], limit social participation [3,4], restrict employment opportunities [5], and increase dependency and caregiver burden [6]. Mobility-assistive technologies (MATs), including wheelchairs, walking aids, prosthetics, and orthoses, are essential for addressing these challenges [5]. Clinical evidence supports effectiveness of MAT in promoting independence, enhancing QoL, and reducing the burden across individuals, families, and communities [5–7]. International recognition by the United Nations and World Health Organisation establishes MATs as a fundamental tool for equity and inclusion [5,8].

Despite this, access to MATs remains limited worldwide, with significant gaps between those who require MAT devices and those who receive appropriate provisions [5,9]. Global barriers to access include lack of national policies, insufficiently trained personnel, high costs, fragmented supply chains, and limited awareness among providers and users [5]. The WHO has identified six key principles essential for equitable MAT access: accessibility, affordability, availability, adaptability, acceptability, and quality. Failure to meet these principles contributes to persistent inequality in provisions [5].

In Saudi Arabia, evidence regarding the provision of MAT, barriers, and unmet needs is scarce [10]. As of 2022, Saudi Arabia's population was approximately 32.2 million, with approximately 5.9% (over 1.3 million people) with disabilities: mobility impairment being the most prevalent type [11]. Despite this substantial need, service delivery varies across institutions with no national monitoring system to track MAT provisions or outcomes [10]. The Saudi healthcare system comprises three main sectors: the Ministry of Health as the primary provider, other government agencies (including the Ministry of Defense, Ministry of Interior, National Guard, and university hospitals), and the private sector, with MAT services integrated within rehabilitation services at specialised and advanced hospitals [12,13].

Understanding the contextual factors contributing to suboptimal MAT uptake, where significant gaps persist between those who require devices and those who receive appropriate provision [5,9], is crucial for the development of effective implementation strategies [14,15]. The healthcare context is influenced by factors at multiple levels, including individuals, such as healthcare professionals (HCP), patients, and organisations. Implementation science

frameworks provide structured approaches to understanding this multilevel context and the interactions among stakeholders in healthcare delivery [16]. The Consolidated Framework for Implementation Research (CFIR) can help examine facilitators and barriers to implementation by providing structured approaches for understanding phenomena at multiple levels, including individuals such as HCPs, patients, and organisations [17,18]. The CFIR was developed by synthesising constructs from 19 implementation theories [19] and is now one of the most highly cited frameworks in implementation science [18]. The updated 2022 version comprises 48 constructs across five domains: innovation, outer setting, inner setting, individuals, and implementation processes [18]. This study aimed to identify barriers to the provision of MAT in Saudi Arabia's public healthcare system using the CFIR.

Materials and Methods

Study Design and Setting

This mixed-methods study employed an explanatory sequential design with equal priority (QUAN→QUAL) combining a cross-sectional online survey with a qualitative embedded multiple-case study design [20]. Systematic measurement of availability gaps (quantitative) and in-depth understanding of why these gaps existed (qualitative) – had equal priority for developing actionable policy recommendations. Integration occurred at three levels: design level (survey results informing interview guide development), methods level (survey responses facilitating maximum variation sampling for case selection), and interpretation level (joint displays synthesising equally-weighted evidence from both components). Integration of both methods provided a comprehensive understanding that neither could achieve independently.

The survey served two purposes: (1) providing a descriptive overview of MAT availability across Saudi hospitals and (2) facilitating maximum variation sampling for interview recruitment. For example, the survey findings on low device awareness informed the development of targeted interview prompts. The qualitative component employed a multiple case study design across three purposively selected public hospitals in Saudi Arabia, incorporating semi-structured interviews and document analyses.

Implementation science research prioritises data collection from individuals with authority over implementation decisions, as they provide insights into system-level barriers and have

the power to implement changes [18,21]. Each hospital served as an individual case, with three embedded units of analysis representing different stakeholder groups: frontline healthcare professionals providing MAT services, managers responsible for oversight and administration, and leaders with decision-making authority.

The three hospitals represent diverse governance structures and geographical regions: two Ministry of Health hospitals (one in the central region and one in the eastern region) and one hospital under an alternative government agency (central region, Riyadh). The specific agency is not reported to maintain organisational anonymity. This purposive selection approach maximises variation across organisational contexts [20]. The data were collected between January 2023 and March 2024.

Participants and Recruitment

Survey Participants

The eligible participants included HCPs, managers, and leaders involved in MAT provision. No exclusion criteria were applied. Survey sampling aimed for complete enumeration of eligible staff at three sites (estimated population: 150 staff across rehabilitation, administrative and leadership roles). A total of 67 participants completed the survey, representing a response rate of approximately 45% from an estimated eligible population of 150 staff. As the survey was designed to provide a descriptive overview of MAT availability and to support recruitment for the qualitative phase, rather than for hypothesis testing, no formal power calculation was undertaken. Instead, the sample size was determined by the study aim and the number of eligible staff available across the three participating hospitals, consistent with guidance for survey research [22].

The rehabilitation management offices at each site were contacted to explain the purpose of the study and to obtain recruitment permission. Invitation emails containing information sheets, estimated completion times, data management details, and survey links were distributed to eligible participants. Leaders and administrative managers received additional direct contact to ensure awareness of the study. A follow-up reminder email was sent two–four weeks after initial contact. The participants were not reimbursed for their participation in the survey.

Qualitative Study Participants

Of the 67 survey participants, 51 indicated willingness to participate in the follow-up interviews, while 16 declined. From the 51 willing participants, 33 were purposively selected using maximum variation sampling to ensure diverse representation across roles, sites, and characteristics. Interview sampling quotas targeted minimum 2 participants per stakeholder group per hospital. Invitation emails offering a choice between face-to-face and online interviews were sent to willing participants, with two reminder emails at four-week intervals. Additional participants were identified through snowball sampling, in which interviewees recommended colleagues who could provide further insights.

Data saturation was achieved following Francis et al.'s [23] principles: After the initial 10 interviews, the stopping criterion was assessed after each subsequent interview until no new themes emerged in three consecutive interviews. In total, 33 interviews were conducted across the three hospitals to ensure the representation of at least six individuals from each stakeholder subgroup [24]. Saturation was observed after the 29th interview, with the final four interviews reinforcing and validating existing themes. After each interview, reflective memos were written to capture immediate observations, aiding both the saturation assessment and the refinement of subsequent interviews [25].

Data Collection

Survey

The online questionnaire was administered using the Qualtrics software (Qualtrics, Provo, UT, USA) under the University of Sheffield licence (Supplementary File 1). As no previously validated tools were available, the questionnaire was developed based on the WHO Priority Assistive Products List (APL) and the literature on MAT benefits [5,26]. The WHO APL document provides a list of priority ATs that can improve the QoL of people with disabilities [26]. The questionnaire was piloted by an experienced physiotherapist, after which response options were modified to enhance clarity. Items employing a 3-point Likert scale were refined by explicitly defining options ('Accessible' = patients can access; 'Not accessible' = patients cannot access), and an 'Unaware' category was added to capture uncertainty in participant knowledge.

The questionnaire was organised across four sections and designed to take less than five minutes to complete: (1) informed consent (Q1); (2) participant demographics, including hospital affiliation, gender, age, educational level, years of experience, and professional role (Q2–Q7); (3) MAT availability ratings for 15 devices using a 3-point Likert scale (accessible, not accessible, unaware) (Q8); and (4) willingness to participate in follow-up interviews, with email address requested from those who consented (Q11–Q11.1). Two additional conditional questions regarding professional designation and clinical speciality were presented solely to respondents identifying as HCPs (Q7.1–Q7.2). The questionnaire displayed one question per page and allowed the respondents to review and return to their previous responses.

Semi-structured Interviews

The interview guide (Supplementary File 2) was developed using all five CFIR domains and integrated the findings from the survey. After a pilot test with a physiotherapist, the questions were refined for clarity and translated into Arabic. The same semi-structured interview guide was employed for all stakeholders to ensure consistency, with preliminary questions assessing the participants' knowledge relevant to each section.

The one-to-one interviews were conducted in quiet private settings. Overall, 24 interviews were held face-to-face within the hospitals and nine were conducted online using Google Meet. All interviews were audio recorded with an encrypted device and transcribed verbatim, ranging from 38 to 57 minutes in duration. Field notes were systematically recorded during and immediately after each interview and subsequently integrated into the MAXQDA as analytical memos. Participants were asked to recommend additional potential interviewees and identify relevant documents for analysis.

Document Collection

Documents, including hospital reports, guidelines, and policies related to MAT provision, were identified by interviewing the participants and accessed through their facilitation. Six documents were analysed: three hospital-specific guidelines and three general government documents outlining the policies and regulations governing MAT provision in Saudi Arabia.

Data Analysis

Survey Analysis

Survey results were analysed using descriptive statistics within the Qualtrics software, calculated as frequency counts and percentages of participants responding to each question. Data were cross-tabulated to investigate the differences between hospitals and question responses regarding MAT availability. The data were exported to Microsoft Excel 2022 (Redmond, WA, US) for further review.

Qualitative Data Analysis

Interview transcripts and field notes were uploaded to the MAXQDA software (version 2022) for management and analysis. Documents were uploaded to the same software and analysed using the same CFIR coding framework applied to the interview transcripts, to enable data triangulation [27]. Documents served two primary purposes: first, to provide data on the context, aiding in the identification of issues that contribute to the barriers to the provision of MATs, and as a means to verify the findings from interviews, thereby enhancing the credibility of the findings [27]. The analysis was conducted in Arabic to maintain contextual accuracy [28], with quotations translated into English only after the completion of the analysis. The analysis began after the first interview and continued concurrently with data collection, enabling the systematic assessment of data saturation.

The National Centre for Social Research's framework analysis approach was employed, following a five-step process: (1) familiarisation, (2) identifying a thematic framework, (3) indexing, (4) charting, and (5) mapping and interpretation [29]. In Step one, the data were reviewed through immersion in transcripts, annotation, and memo writing. In step two, a thematic framework was established using a priori codes derived from the CFIR coding guidelines (https://cfirguide.org/) (Supplementary File 3), which were iteratively refined throughout the data collection to reflect participant descriptions. In step three, data were indexed and organised using Excel spreadsheets structured by hospitals and stakeholder groups (managers, leaders, and HCPs), with links maintained to MAXQDA, which facilitated returning to the data as necessary. In step four (charting), within-case analysis, triangulating data from the three stakeholder groups and documents using joint display tables, and cross-case analysis across hospitals were conducted (Supplementary Files 4, 5). Finally, convergence and divergence within and across cases were identified through matrix

comparison to determine the factors influencing MAT provision (Supplementary File 6). Integration was conducted by AA with validation from co-authors DH, BF and SR during team discussions at key integration points to ensure interpretive rigour.

Trustworthiness

Study trustworthiness was ensured by following Lincoln and Guba's (1985) criteria [30]. Credibility was systematically addressed through multiple strategies. The CFIR provided a robust theoretical framework underpinning all stages of data collection and analysis [18]. Concurrent data collection and analysis were conducted from the first interview onwards, enabling ongoing saturation assessment following Francis et al.'s [23] principles, with saturation achieved at interview 29. Data triangulation further strengthened credibility through the convergence of evidence from semi-structured interviews and document analysis, across three hospitals and three stakeholder groups (HCPs, managers, and leaders) [20,31]. Member checking with 15 participants confirmed the accuracy of interpretations [32]. Transferability was facilitated through comprehensive descriptions of the participants, settings, and methods [31]. Dependability was maintained through detailed audit trials using the MAXQDA. Confirmability was achieved through triangulation and reflexivity, ensuring that the findings reflected participants' experiences rather than the researcher's interpretation [31,33].

Ethical Considerations

Ethical approval was obtained from all participating hospitals. Written informed consent was obtained from the interviewees and electronic consent was required for survey participation. Confidentiality was maintained by removing identifiers and assigning unique participant codes. All data were stored securely in the University of Sheffield Filestore, a secure institutional research server with restricted access limited to the research team.

Results

Survey Response

We received 67 completed survey responses (Table 1). The survey respondents comprised HCPs (70%, n=47) and leaders and managers (28%, n=19), with an even gender distribution (51% male, 49% female). Most respondents were aged 31-40 years (48%) and held a bachelor's degree (66%). Occupational and physical therapists represent the largest professional groups, with significant representation in neurology specialties.

Survey Findings

Provision of MATs across participant hospitals

The results demonstrated differences in accessibility between the different MATs (Figure 1). Basic MATs were reported by respondents as widely available to patients in all participating hospitals. These included manual wheelchairs (85%, n = 57), ankle-foot orthoses (AFO) (87%, n = 58), canes/sticks (91%, n = 61), elbow and axillary crutches (93%, n = 62), and walkers (96%, n = 64). However, the availability of advanced or specialised devices for patients was limited. Sixty-one percent of participants reported that electrically powered wheelchairs were accessible to patients (n = 41). Seven percent (n = 5) of the participants reported that manual power-assisted wheelchairs were available to patients, whereas only 1.0% (n = 1) indicated that mobility scooters were accessible. Additionally, only 31% (n = 21) of the participants reported that their patients had access to reclining power wheelchairs, and 25% (n = 17) indicated that customised manual wheelchairs were available to their patients. Traditional lower-limb prostheses were reported to be accessible to patients by 58% of the participants (n = 39), and 13% (n = 9) reported that microprocessor-controlled lower-limb prostheses were available.

Several participants were unaware of the availability of different MAT devices in their hospitals (Figure 1). Specifically, 28% of the respondents (n = 19) were uncertain about carbon-fibre AFOs and microprocessor-controlled lower-limb prostheses, 33% (n = 22) about wearable powered exoskeletons, 31% (n = 21) about manual power-assisted wheelchairs, and 18% (n = 12) about manual wheelchairs with postural support.

Provision of MATs in each hospital

The provision differs considerably between hospitals. This was particularly evident in devices such as electrically powered wheelchairs, lower limb prostheses, reclining power wheelchairs, carbon fibre AFOs, and manual wheelchairs with postural support (Figure 2). Respondents from Hospitals A and B in the central region reported relatively high accessibility of electrically powered wheelchairs (79% and 92% respectively). The reported availability of the same device was notably lower in Hospital C (eastern region), with only 13% of respondents indicating accessibility (Figure 2 [a]). Reported availability of traditional lower limb prostheses showed noticeable differences between hospitals. Respondents indicated accessibility rates of 80% and 84% for Hospitals B and A in the central region, respectively. However, Hospital C (eastern region) respondents reported notably lower accessibility (13%) (Figure 2 [b]).

Respondents from Hospitals A and B in the central region reported high accessibility for carbon fibre AFO, at 68% and 48 %, respectively. However, Hospital C respondents indicated lower accessibility of 21% (Figure 2 [c]). Reported availability of reclining power wheelchairs was relatively high in hospitals A and B in the central region, at 37% and 48%, respectively. Hospital C respondents reported notably lower availability of 8.7% (Figure 2 [d]).

Qualitative Findings

Interview Participants

Interviews were conducted with a sample of survey respondents. In total, 33 participants were interviewed, including six leaders, 10 clinical and administrative managers, and 17 HCPs (Table 1).

Document characteristics

Six documents were analysed (Supplementary File 7). These comprised two categories: three hospital-level documents (D1–D3) and three national-level policy documents (D4–D6). The hospital-level documents included one document from each participating hospital describing local processes or guidance related to MAT provision. Specifically, Hospital A had a formal policy outlining MAT eligibility criteria (Document 1), Hospital B had locally developed

practice guidance prepared by rehabilitation staff (Document 2), and Hospital C had no formal MAT guidelines, though a local document outlining basic device provision was available for analysis (Document 3). The three national-level documents comprised a Ministry of Human Resources and Social Development document on financial assistance procedures (Document 4), Ministry of Finance procurement regulations (Document 5), and a national policy report on assistive technology from the Authority for the Care of People with Disabilities (Document 6).

Factors influencing the provision of MATs in Saudi Arabia: CFIR Analysis

Analysis of the interview and document data, organised according to the CFIR, identified barriers across all five domains affecting MAT provision (Figure 3). The findings of the cross-case analysis and documents are integrated throughout the results section, as detailed in Supplementary File 5.

Innovation domain

Most participants indicated significant reliance on imported devices owing to a lack of local manufacturing, raising concerns about the sustainability and reliability of supply chains (Innovation Source) (Table 2). The cost of the devices often exceeds the allocated budget, with import duties leading to the purchase of lower-quality alternatives (Innovation Cost). Customising advanced devices for patient-specific needs is complex, time-consuming, and resource-intensive, hindering their rapid provision (Innovation Complexity). Regulatory complexity and strict procurement procedures further challenge this process (innovative design). Although HCPs emphasised the importance of MATs to patient recovery and QoL, administrative managers focused on financial implications, such as reduced hospital stays (Innovation Relative Advantage). A lack of contextual data on comparative studies and prevalence and cost-effectiveness analyses (Innovation Evidence Bases) exists in Saudi Arabia.

Outer setting domain

Participants reported constraints imposed by the National Unified Procurement Company (NUPCO), which limited purchases to pre-approved devices (Partnerships and Connections). The introduction of new devices requires a thorough evaluation, with strict rules that

complicate purchases and cause delays. Collaboration with MHRSD often leads to delays and the provision of generic devices that do not meet patient needs (Partnerships and Connections). Inconsistent policies between inpatient and outpatient services led to confusion, with patients without employment or insurance being excluded from services (Policies and Laws). The lack of clear regulations regarding provision, maintenance, and follow-up compromises comprehensive delivery (Policies and Laws). Financial constraints imposed by the Ministry of Finance's budget approval result in procurement delays (Financing). Limited MAT access in rural areas forces patients to travel to major hospitals, while environmental inadequacies lead to device refusal due to incompatible living conditions (Local Conditions).

Inner setting domain

The type of healthcare environment (acute vs. rehabilitative) and hospital classification directly influenced the service range (Physical Infrastructure). The absence of effective management systems and reliance on manual processes hinders tracking (Information Technology infrastructure). Uncertainty regarding responsibility for assessing needs and authorising provision causes miscommunication and delays (Work Infrastructure). HCPs remained unaware of the quality of devices provided to their patients (Communications). Differing institutional focuses result in uneven resource allocation (Mission Alignment), with higher priority placed on acute care overshadowing rehabilitation needs (Relative Priority). Insufficient internal funds necessitate external sponsorships (Funding). Space constraints hinder storage and training (Available Resources; Space). The lack of standardised assessment tools, MAT specialist shortages, and training gaps were prominent (Available Resources; Access to Knowledge and Information). Heavy workloads leave little time for patient interactions (Compatibility).

Implementation process domain

Leaders stressed annual needs estimation based on historical data (Planning), but HCPs criticised one-size-fits-all approaches, which fail to meet individual needs (Assessing Needs). Despite these complaints, actionable solutions remained unimplemented, particularly at Site C (Assessing Needs). There is a notable lack of engagement at the hospital and national levels, with rehabilitation frequently neglected (Engagement). The lack of local clinical leaders in advanced rehabilitation has contributed to these challenges (Engaging).

Individual domain

Patient health condition complexity influenced MAT adoption requirements (Needs; patients). Cultural preferences for family-based care over independence-promoting technologies affected acceptance (Motivation; Patients). Complex healthcare systems impede their use, with patients being lost in processes (Opportunity; Patients). HCPs expressed concerns about limited autonomy, inadequate role recognition, and insufficient device knowledge (Opportunity; Capability; HCPs). Training inadequacies and a reliance on experience rather than certification were prominent (Capabilities; HCPs). Administrative managers emphasised strategic planning needs (Need; Managers) but showed unawareness of MAT benefits (Capability; Managers). The clinical managers reported overlooked improvements (Opportunities; Managers). Leaders identified the need for specialised expertise (Need; Leaders) but lacked complete autonomy as department leaders (Opportunity; Leaders). A summary of these barriers is presented in Supplementary file 8.

Discussion

This mixed-method study is the first comprehensive investigation of the factors influencing MAT provision in Saudi Arabia. A survey of 67 stakeholders across three hospitals showed that while basic MAT devices were generally accessible, advanced devices (electrically powered wheelchairs, prostheses, and specialised seating) showed limited availability, with regional disparities and substantial unawareness among respondents. Qualitative analysis of 33 interviews and six policy documents identified 52 barriers across five CFIR domains.

The key barriers identified in this study, including dependence on imported devices, high costs and procurement delays, insufficient HCP training, and sociocultural factors influencing patient acceptance, align with global observations from WHO and UNICEF [5] and Mishra et al. [34], who reported similar challenges including lack of awareness, high costs, procurement challenges, and workforce capacity gaps. The observed adoption rates aligned with Danemayer et al.'s (2022) [9] global review, which showed that MAT use ranged from 0.9% for prosthetics and electrically powered wheelchairs to 18% for manual wheelchairs. However, this study also highlights critical context-specific challenges. The heavy reliance on imported MAT, owing to weak local manufacturing, was reported by participants across

all three hospitals, leading to extended waiting times both to receive devices and to obtain repairs, consistent with broader evidence of supply chain vulnerabilities within Saudi Arabia's healthcare system [35]. The observed regional variations advance our understanding beyond previous local research [10] by identifying specific disparities that may indicate systemic variations in health care resource distribution, particularly given that regions such as Madinah, Jizan, and Al-Bahah report a higher prevalence of severe mobility limitations [36].

The substantial proportion of HCPs who were unaware of advanced device availability supports previous findings that HCPs lack a comprehensive understanding of AT options [10], potentially due to limited exposure, insufficient training, and a lack of clear communication channels. Cultural barriers identified parallel findings from Kenya and South Africa [37,38], where elderly patients' perception of MAT as dependency created adoption barriers, emphasising the need for culturally appropriate services [39]. The divergence between HCP needs and management decisions—where HCPs criticized 'one-size-fits-all' approaches while managers prioritized cost containment under NUPCO rules—reflects broader resource allocation tensions. Rey-Matias et al. (2019) [40] offer a bridging perspective, arguing that governments should view MAT as a strategic investment to enhance productivity and employability while generating long-term savings.

These findings have significant implications for healthcare practices and policies in Saudi Arabia. First, the substantial unawareness of advanced device availability and reported training gaps indicate the need for comprehensive education programs targeting HCPs with strategic university collaboration to integrate MAT competencies into curricula and continue professional development. This should address both technical assessment skills and the knowledge of available devices. Second, the quality-cost tensions reported between HCPs and administrators, coupled with procurement delays through NUPCO, necessitate the implementation of rigorous quality standards and streamlined vendor management systems to ensure both device quality and timely delivery.

Policy development requires addressing three critical areas identified in this study: regulatory ambiguities in procurement and service delivery, sustainable funding mechanisms, and culturally appropriate provision practices. The reported regulatory ambiguities and inconsistent policies between inpatient and outpatient services necessitate clear regulations for procurement processes and service delivery. As suggested by Rey-Matias et al. (2019), sustainable funding mechanisms must view MAT as a strategic investment rather than an

expense [40], potentially enhancing long-term productivity while reducing support costs. Finally, culturally appropriate provision practices are essential given the identified barriers to family-based care preferences and stigma. The WHO Guidelines on the Provision of Wheelchairs [41] provide a practical model that establishes essential principles while allowing contextual tailoring.

The main strength of this study is its comprehensive methodological approach that combines survey data, qualitative interviews with diverse stakeholders, and documentary analyses across multiple sites. Integration revealed insights unavailable from either method alone. For instance, the survey found 28-33% unawareness about device availability; interviews revealed this stemmed not from individual knowledge gaps but from systemic communication failures between procurement and clinical departments. Similarly, quantitative regional disparities (e.g., 13% vs 92% electric wheelchair availability) were explained through qualitative data showing different NUPCO contract implementations and budget allocations across regions. The CFIR provided a robust theoretical framework for systematic barrier identification, whereas data triangulation and member checking with 15 participants strengthened its credibility [20,31,42]. Maximum variation sampling ensured representation, with data saturation achieved by following established principles [23].

This study had several limitations. First, the survey was exploratory and descriptive, and developed in this context without formal psychometric validation or cultural adaptation. Second, the study was restricted to three public hospitals across two of Saudi Arabia's 13 administrative regions, limiting its transferability across a diverse healthcare landscape. The focus on public hospitals excludes private facilities and underrepresents other government healthcare agencies. Third, the absence of MAT users and their families represents a limitation, as they could have provided valuable insights into the personal and environmental barriers to access and acceptance. Sequential mixed-methods design are prone to certain limitations, especially around temporal trends; for instance, it is possible that we are unaware of contextual changes that took place in the time lag between survey and interviews (up to 14 months).

The barriers identified through the CFIR can be systematically linked to implementation strategies using the Expert Recommendations for Implementing Change (ERIC) matching tool [43,44], which provides 73 evidence-based strategies to address the identified barriers. This approach enables the development of targeted, context-specific solutions for enhancing

MAT provision, aligned with WHO's six principles: accessibility, affordability, availability, adaptability, acceptability, and quality [5]. Future research should also investigate barriers in other Saudi regions, particularly remote areas where mobility limitations are more prevalent [36], and examine the specific funding and policy challenges faced by the NUPCO and MHRSD in procurement and distribution.

Conclusion

This study is the first comprehensive investigation of barriers to MAT provision in Saudi Arabia's public healthcare system using the CFIR. The findings identified substantial gaps in advanced MAT accessibility and regional disparities, with 52 barriers identified across all five CFIR domains. These findings provide policymakers and practitioners with an evidence-based foundation for designing contextually relevant strategies to enhance equitable MAT provision in Saudi Arabia.

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Declaration of interest statement

The authors declare no conflicts of interest.

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Data availability statement

All analysed data supporting the findings are included in the article and supplementary

materials.

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Table 1 Demographic characteristics of survey respondents and interview participants

Characteristic	Survey Respondents (n=67) n (%)	Interview Participants (n=33) n (%)
Hospital Leaders	8 (12%)	6 (18%)
Director of Rehabilitation Services	2 (3.0%)	1 (3.0%)
Chairperson, Department of Physical Therapy	2 (3.0%)	1 (3.0%)
Chairperson, Department of Occupational Therapy	1 (1.0%)	1 (3.0%)
Chairperson, Department of Prosthetics and Orthotics	1 (1.0%)	1 (3.0%)
Chairperson, Department of Rehabilitation Technology	1 (1.0%)	1 (3.0%)
Chief Executive Officer, Rehabilitation	1 (1.0%)	1 (3.0%)
Clinical and Administrative Managers	11 (16%)	10 (30%)
Clinical Supervisors	7 (10%)	6 (18%)
Rehabilitation Services Coordinator	1 (1.0%)	1 (3.0%)
Medical Equipment Coordinator	1 (1.0%)	1 (3.0%)
Director of Budget Administration	1 (1.0%)	1 (3.0%)
Supply Chain Management	1 (1.0%)	1 (3.0%)
Healthcare Professionals	47 (70%)	17 (52%)
Occupational Therapist	25 (37%)	12 (36%)
Physical Therapist	19 (28%)	3 (9.0%)
Speech and Language Therapist	2 (3.0%)	0 (0.0%)
Assistive Technology Specialist	2 (3.0%)	2 (6.0%)
Specialty Area (HCPs only)	(n=47)	(n=17)
Neurology	13 (19%)	6 (18%)
Paediatrics	8 (12%)	1 (3.0%)
Orthopaedics	5 (7.0%)	3 (9.0%)
No Specific Speciality	5 (7.0%)	1 (3.0%)
Geriatrics	3 (4.0%)	1 (3.0%)
Cardiovascular and Pulmonary	2 (3.0%)	1 (3.0%)

Adult Rehabilitation	2 (3.0%)	0 (0.0%)
Lymphedema	2 (3.0%)	0 (0.0%)
Acute Care	2 (3.0%)	2 (6.0%)
Musculoskeletal	1 (1.0%)	0 (0.0%)
Burn Unit	1 (1.0%)	0 (0.0%)
Assistive Technology	1 (1.0%)	2 (6.0%)
Amputation and Neurology	1 (1.0%)	0 (0.0%)
Paediatrics and Orthopaedics	1 (1.0%)	0 (0.0%)
Gender		
Male	34 (51%)	22 (67%)
Female	33 (49%)	11 (33%)
Age Group (years)		
21-30	22 (33%)	10 (30%)
31-40	32 (48%)	18 (55%)
41-50	11 (16%)	4 (12%)
51-60	2 (3.0%)	1 (3.0%)
Years of Experience		
<5	18 (27%)	7 (21%)
5-10	23 (34%)	10 (30%)
11-20	21 (31%)	13 (39%)
>20	5 (7.0%)	3 (9.0%)
Academic Qualifications		
Bachelor's	44 (66%)	15 (45%)
Master's	21 (31%)	16 (49%)
PhD	2 (3.0%)	2 (6.0%)
Healthcare Setting		
Hospital A (central region)	19 (28%)	10 (30%)

Hospital B (central region)	25 (37%)	14 (42%)
Hospital C (eastern region)	23 (34%)	9 (27%)
Geographical Area		
Central region	54 (80%)	24 (73%)
Eastern region	23 (34%)	9 (27%)

Table 2 Key Barriers to MAT Provision in Saudi Arabia by CFIR Domain

CFIR Domain & Construct	Key Theme	Illustrative Quotations (Interviews/Documents)
Innovation domain		
Innovation Source	Dependence on foreign suppliers; Lack of reliable local providers	"These are Saudi companies that don't manufacture but only import" (P3, HCP);"Most are not locally available; companies order them from abroad" (P24, Manager)
Innovation Cost	High cost of devices and spare parts	"We're talking about a wheelchair that costs a hundred thousand riyals... It incurs a very high budget on the department" (P20, Leader)
Innovation Complexity	Customisation and production constraints; Complex procedures and delays in provision; Procurement regulations	"Wheelchairs or some devices now need customisation, which I expect takes a long time" (P6, Leader);"The process takes a very long time because there are codes, approval steps and several parties involved" (P2, HCP);"Specifications should not specify a particular brand unless they apply only to a specific product" (D5, p.13)
Innovation Design	Quality-cost balance in MAT provision	"Quality matters, but it's more important to balance it with cost... It's about meeting what's needed in a way that's affordable and works well" (P10, Administrative Manager)
Innovation Relative Advantage	Different perceived value and benefits of MAT	"Of course, it makes the person more functionally independent and can facilitate their quality of life. It's highly needed" (P29, Clinical Manager);"These costs add up over four or five days, sometimes exceeding the value of the devices provided to the patient... it preserves the budget" (P23, Administrative Manager)
Innovation Evidence Base	Insufficient data and research; Data accessibility gaps	"Because we need to be evidence based, and if you have research, we can make an argument" (P4, HCP);"How many people use a wheelchair regularly? I don't know, honestly; I've searched everywhere. There isn't [any information]" (P11, HCP)
Outer setting domain		
Partnerships and Connections	Challenges in rigid administrative partnerships; Collaboration across sectors	"National Unified Procurement Company (NUPCO) is like a mediator... All these processes take about six months to a year until the competition is approved" (P8, Administrative Manager);"The issue has become that introducing a new product into NUPCO is very difficult" (P20, Leader);"The AT Unit will facilitate the provision of the required device either through

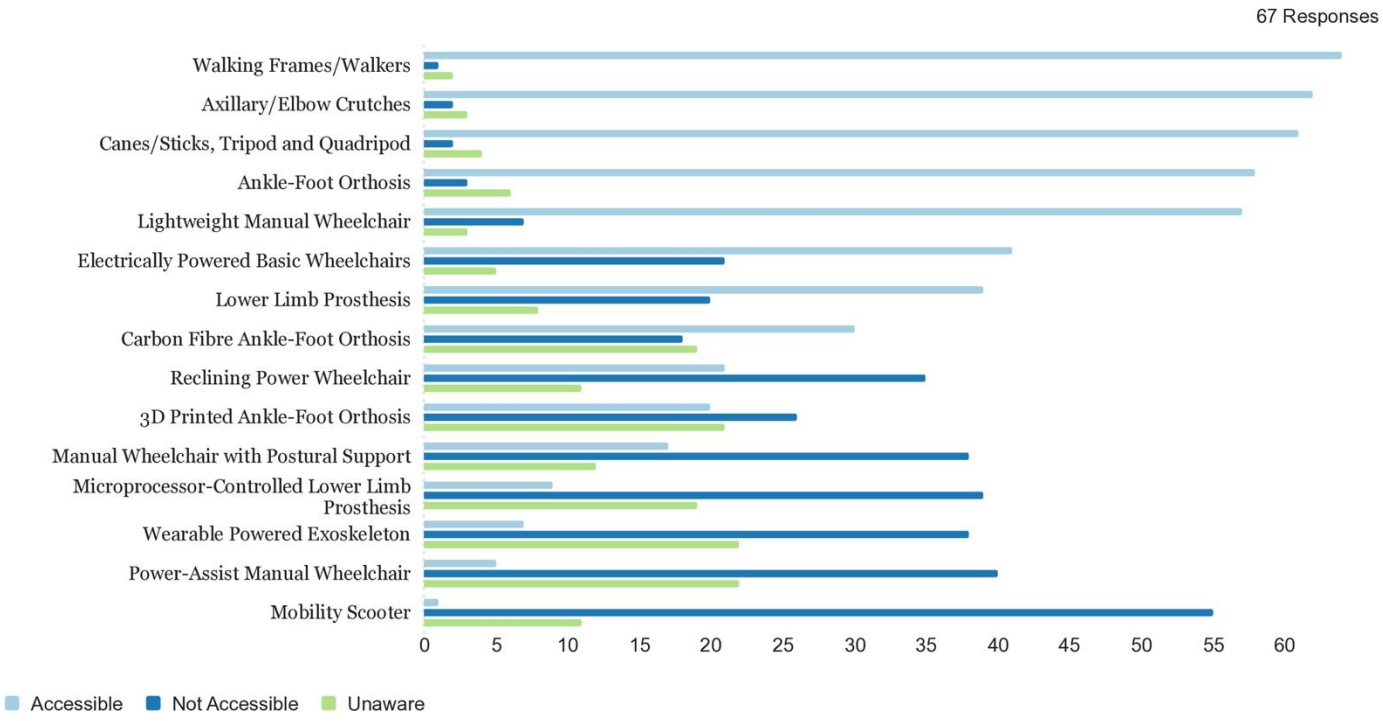
		the Ministry of Social Affairs or through [hospital name]'s self-finance fund" (D2, p.2)
Policies and Laws	Restrictive and inflexible policies; Absence of clear system and regulations; Regulatory ambiguity	"We can't always ensure that the patient receives the device that they should receive. This policy comes from the hospital according to the budget capabilities" (P5, HCP);"There is no protocol or clear system. Sometimes, the delay in providing the device delays the patient's discharge" (P12, HCP);"Assistive devices will be provided and sponsored by the Rehabilitation Hospital for patients admitted for a comprehensive rehabilitation programme for the first time following an injury/illness (i.e. their first experience)" (D2, p.2)
Financing	Inadequate and unstable governmental financing mechanisms; Financial and feasibility constraints	"Generally speaking, we are talking about the second health cluster and a budget from the cluster's budget, which may not be sufficient" (P7, Leader);"The governmental entity shall present a study of feasibility and cost in cases where the preliminary cost of works and purchases exceeds twenty-five million Riyals" (D5, p.4)
Local Conditions	Geographical concentration and inequities; Inadequate environmental and infrastructure adaptability	"Some patients are transferred to major cities to receive appropriate treatment because the major rehabilitation hospitals are located in the main cities" (P31, Clinical Manager);"My home itself is not prepared. The basics at my home are not ready... If I brought it to my house in such-and-such village, I wouldn't benefit from it at all" (P1, HCP);"Requirements for prescription: The patient's living environment must provide adequate access between rooms, manoeuvring space, and surfaces suitable for the use of the power wheelchair" (D1, p.7)
Inner setting domain		
Physical Infrastructure	Characteristics of healthcare setting; Type of facility and admission criteria	"The type of hospital affects the services it offers and what it provides... how many beds it serves, these things have an impact, plus the location of the hospital" (P23, Administrative Manager)
Information Technology Infrastructure	Outdated IT infrastructure and manual processes	"We need to use technology. There must be a system... we're doing a lot of Excel sheets... in the end, things still turn out wrong... there's no system synchronising things together" (P33, Leader)

Work Infrastructure	Undefined role boundaries in prescriptive authority	"We don't have the authority to prescribe, although we tried since 2013... when the patient is transferred to physical therapy, occupational therapy, we do an assessment, we give recommendations, but then the matter is transferred to physical medicine" (P31, Clinical Manager);"The Wheelchair Seating and Mobility Assessment Form is within physical medicine" (D3, p.1)
Communications	Inadequate coordination and communication among departments; Challenges in tracking patient care	"The reasons, I expect, are miscommunication between the departments" (P33, Leader);"We don't always know what type of quality they received" (P5, HCP)
Mission Alignment	Focus and scope of healthcare settings; Commitment to inclusive development	"Currently in the 2030 vision, we are working on prevention more than treatment, and prevention means a high quality of life" (P11, HCP);"There might be a priority... the priority is not rehabilitation at the moment... They serve things related to emergencies and urgent surgeries, but they don't serve what is related to the final stage of rehabilitation" (P3, HCP)
Funding	Availability of internal funding for MAT; Dependency on external funding	"The department has a certain budget... in case they are not available and we can't provide them to the patient, we always advise the patient to look for them elsewhere" (P13, HCP);"Communicate with the Ministry of Social Affairs or [hospital name]'s self-finance fund to facilitate the provision of the required equipment" (D2, p.3)
Available Resources	Scarcity of trained professionals; Storage and space constraints; Lack of assessment tools and materials	"We have few assistive specialists, so no one knows exactly what we are talking about" (P1, HCP);"A small room, you might say its size is three by five meters... There is actually no place for devices, just storing boxes and a bit of chaos" (P14, HCP);"We don't have a follow-up, so we don't have an official form to see the outcome and the satisfaction. It's just prescriptions only" (P5, HCP)
Access to Knowledge and Information	Professional development and training gaps; Poorly designed educational programmes	"I was not trained on them. For example, sport wheelchairs, lightweight wheelchairs, specific measurements and these things, no, I was not trained on them at the university, only through experience" (P19, HCP);"Most of the specialists are not certified, they just have experience" (P22, Clinical Manager)

Process domain		
Planning	Challenges in strategic planning and coordination for device needs; Procurement planning requirements	"When the hospital plans properly for the demand for these devices, the planning won't be effective without the presence of a budget" (P23, Administrative Manager);"Article Three: According to paragraph (1) of Article Two (10) - The entity's plan for its works and purchases shall be published, including the following information during the first quarter of each financial year as per the system" (D5, p.2)
Engaging	Lack of engagement and recognition from high-level leadership; Absence of specialised local clinical leadership	"In reality, it will end up in the higher management. I feel, no, they are not interested – but if they knew the importance of assistive devices, they would definitely provide them" (P18, HCP);"As staff, sometimes they ask us, but there is nothing official, like 'not a committee'... they send us an email asking whether we use a certain device or not" (P13, HCP)
Assessing Needs	Lack of effective response to feedback and complaints	"If the physicians started to advocate for us to have a seating clinic, and we insisted on it, and we raised a proposal and requested to have a wheelchair clinic and set a budget for it and did a full study – but it's gone with the wind" (P33, Leader)
Individual domain		
Patients (Need, Motivation, Capability, Opportunity)	Type of functional difficulty; Cultural and social influences; Inadequate patient education; Socioeconomic barriers; Patient autonomy and consent	"There is a stigma around it in society; patients want to appear to be normal" (P5, HCP);"Most of the patients and their families are not well educated. So, when they are informed, yes, some parents come to you and discuss... but they are rare" (P27, HCP);"The patient gets lost between the departments, between home care, social services, or rehabilitation" (P1, HCP);"The patient has not expressed any unwillingness to use a power wheelchair in the home" (D1, p.7)
HCPs (Capability, Opportunity)	Awareness and knowledge gaps; Limitations in expertise; Autonomy and recognition issues	"Difficult cases that have core mobility issues, those I don't know how to work with... they become difficult for me to do an assessment for them" (P18, HCP);"My role ends after I do the device prescription only, but the decision-making is done by the higher management" (P17, HCP)
Managers (Need, Capability, Opportunity)	Strategic planning needs; Advocacy and awareness gaps; Limited authority	"The delay sometimes is due to planning, that the requests were not made early enough... there must be early planning" (P8, Administrative Manager);"They don't feel aware; I mean, they don't feel it's important" (P32, Clinical Manager)

Leaders (Need, Opportunity)	Building expert networks; Empowering rehabilitation with autonomy	"We need experts from all over the kingdom, representatives of course. If the tenders are related to chairs, they request experts specialised in chairs" (P7, Leader);"Rehabilitation does not have full autonomy for this entire process. Autonomy is the main issue" (P20, Leader)

Figure 1


67 Responses
Walking Frames/Walkers
Axillary/Elbow Crutches
Canes/Sticks, Tripod and Quadripod
Ankle-Foot Orthosis
Lightweight Manual Wheelchair
Electrically Powered Basic Wheelchairs
Lower Limb Prosthesis
Carbon Fibre Ankle-Foot Orthosis
Reclining Power Wheelchair
3D Printed Ankle-Foot Orthosis
Manual Wheelchair with Postural Support
Microprocessor-Controlled Lower Limb Prosthesis
Wearable Powered Exoskeleton
Power-Assist Manual Wheelchair
Mobility Scooter
0
5
10
15
20
25
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40
45
50
55
60
Accessible
Not Accessible
Unaware

Figure 2

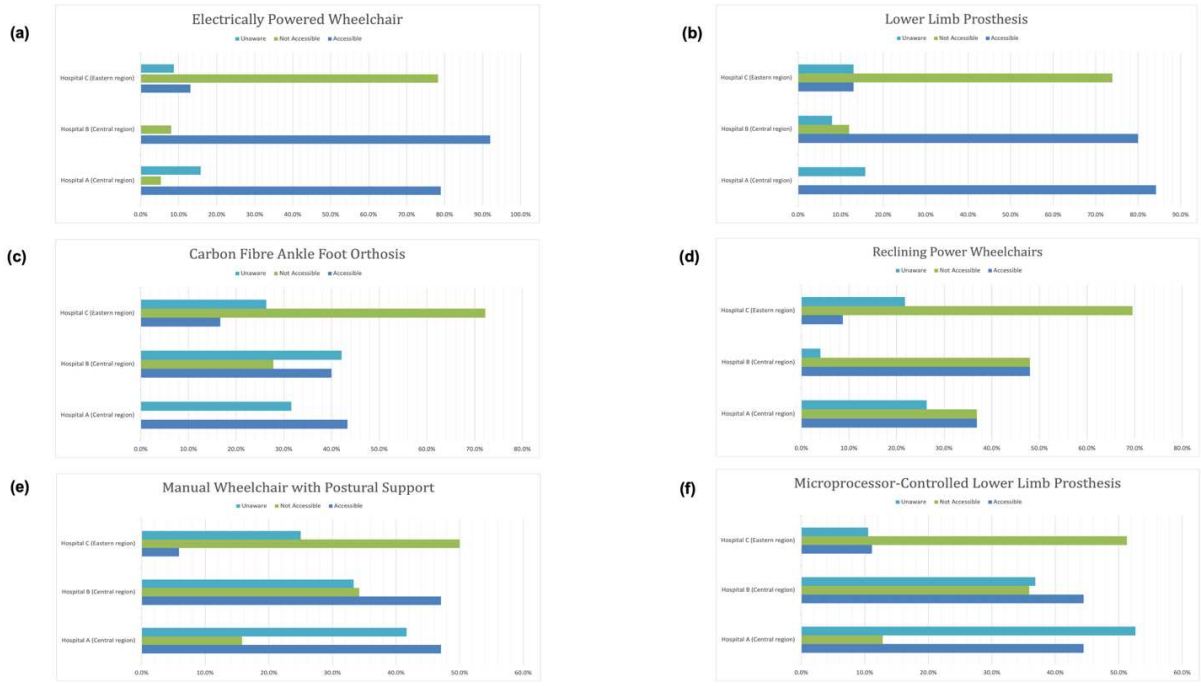
(a)
Electrically Powered Wheelchair
Unaware
Not Accessible
Accessible
Hospital C (Eastern region)
Hospital B (Central region)
Hospital A (Central region)
0.0% 10.0% 20.0% 30.0% 40.0% 50.0% 60.0% 70.0% 80.0% 90.0% 100.0%
(b)
Lower Limb Prosthesis
Unaware
Not Accessible
Accessible
Hospital C (Eastern region)
Hospital B (Central region)
Hospital A (Central region)
0.0% 10.0% 20.0% 30.0% 40.0% 50.0% 60.0% 70.0% 80.0% 90.0%
(c)
Carbon Fibre Ankle Foot Orthosis
Unaware
Not Accessible
Accessible
Hospital C (Eastern region)
Hospital B (Central region)
Hospital A (Central region)
0.0% 10.0% 20.0% 30.0% 40.0% 50.0% 60.0% 70.0% 80.0%
(d)
Reclining Power Wheelchairs
Unaware
Not Accessible
Accessible
Hospital C (Eastern region)
Hospital B (Central region)
Hospital A (Central region)
0.0% 10.0% 20.0% 30.0% 40.0% 50.0% 60.0% 70.0% 80.0%
(e)
Manual Wheelchair with Postural Support
Unaware
Not Accessible
Accessible
Hospital C (Eastern region)
Hospital B (Central region)
Hospital A (Central region)
0.0% 10.0% 20.0% 30.0% 40.0% 50.0% 60.0%
(f)
Microprocessor-Controlled Lower Limb Prosthesis
Unaware
Not Accessible
Accessible
Hospital C (Eastern region)
Hospital B (Central region)
Hospital A (Central region)
0.0% 10.0% 20.0% 30.0% 40.0% 50.0% 60.0%

Figure 3

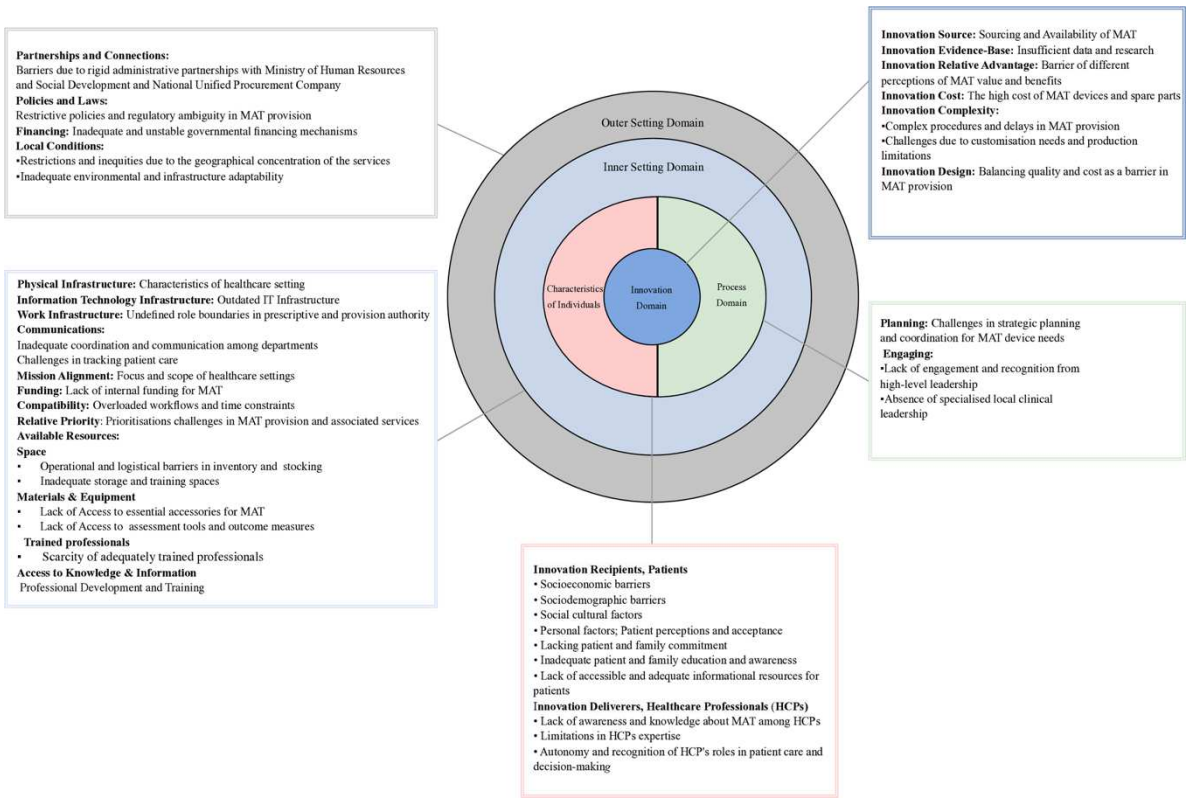
Partnerships and Connections:
Barriers due to rigid administrative partnerships with Ministry of Human Resources and Social Development and National Unified Procurement Company
Policies and Laws:
Restrictive policies and regulatory ambiguity in MAT provision
Financing: Inadequate and unstable governmental financing mechanisms
Local Conditions:
•Restrictions and inequities due to the geographical concentration of the services
•Inadequate environmental and infrastructure adaptability
Innovation Source: Sourcing and Availability of MAT
Innovation Evidence-Base: Insufficient data and research
Innovation Relative Advantage: Barrier of different perceptions of MAT value and benefits
Innovation Cost: The high cost of MAT devices and spare parts
Innovation Complexity:
•Complex procedures and delays in MAT provision
•Challenges due to customisation needs and production limitations
Innovation Design: Balancing quality and cost as a barrier in MAT provision
Outer Setting Domain
Inner Setting Domain
Characteristics of Individuals
Innovation Domain
Process Domain
Physical Infrastructure: Characteristics of healthcare setting
Information Technology Infrastructure: Outdated IT Infrastructure
Work Infrastructure: Undefined role boundaries in prescriptive and provision authority
Communications:
Inadequate coordination and communication among departments
Challenges in tracking patient care
Mission Alignment: Focus and scope of healthcare settings
Funding: Lack of internal funding for MAT
Compatibility: Overloaded workflows and time constraints
Relative Priority: Prioritisations challenges in MAT provision and associated services
Available Resources:
Space
▪ Operational and logistical barriers in inventory and stocking
▪ Inadequate storage and training spaces
Materials & Equipment
▪ Lack of Access to essential accessories for MAT
▪ Lack of Access to assessment tools and outcome measures
Trained professionals
▪ Scarcity of adequately trained professionals
Access to Knowledge & Information
Professional Development and Training
Planning: Challenges in strategic planning and coordination for MAT device needs
Engaging:
•Lack of engagement and recognition from high-level leadership
•Absence of specialised local clinical leadership
Innovation Recipients, Patients
• Socioeconomic barriers
• Sociodemographic barriers
• Social cultural factors
• Personal factors; Patient perceptions and acceptance
• Lacking patient and family commitment
• Inadequate patient and family education and awareness
• Lack of accessible and adequate informational resources for patients
Innovation Deliverers, Healthcare Professionals (HCPs)
• Lack of awareness and knowledge about MAT among HCPs
• Limitations in HCPs expertise
• Autonomy and recognition of HCP's roles in patient care and decision-making

Figure captions

- **Figure 1.** Accessibility to mobility assistive technologies (MATs) within participating hospitals as reported by survey respondents (n=67), bars represent the percentage of respondents reporting each device as accessible, not accessible, or unknown, across all three hospitals combined
- **Figure 2.** Comparison of mobility assistive technology (MAT) accessibility across three participating hospitals in Saudi Arabia, showing regional disparities in (a) electrically powered wheelchairs, (b) lower limb prostheses, (c) carbon fibre AFOs, and (d) reclining power wheelchairs.
- **Figure 3.** Barriers to the provision of mobility assistive technologies (MATs) in Saudi Arabia, synthesised using the Consolidated Framework for Implementation Research (CFIR)

Supplementary Files

- Supplementary File 1. Questionnaire
- Supplementary File 2. Interview guide
- Supplementary File 3. CFIR codebook guidance
- Supplementary File 4. Example of within-case analysis of the CFIR inner setting domain – Hospital A: available resources and access to knowledge
- Supplementary File 5. Cross-case analysis and document integration details
- Supplementary File 6. Example of a detailed comparison between sites and participants' views
- Supplementary File 7. Summary table of documentary analysis findings
- Supplementary File 8. Summary of barriers identified in this study mapped to the CFIR constructs