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Theories, models and frameworks to understand barriers to the provision of mobility assistive technologies: A scoping review

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Abstract

Objectives There is strong evidence that mobility-assistive technologies (MATs) improve occupational performance, social participation, educational and employment access, and overall quality of life in people with disabilities. However, people with disabilities still face barriers to accessing MATs. This review aims at summarising and synthesising the following:1) theories, models, and frameworks that have been used to understand MATs access, and 2) specific determinants of access.

Design a Scoping review using the five-step Arksey and O'Malley Framework.

Data sources We searched the MEDLINE, EMBASE, and CINAHL databases for publications between 2000 and 2023. We searched for articles published up to 15 June 2023.

Eligibility criteria We included English-published literature in peer-reviewed journals that reported (a) barriers to the provision of MATs, (b) including at least one theory, model, or framework, and (c) between 2000 and 2023.

Data extraction and synthesis We extracted study characteristics, theories, models and framework usage, research recommendations, key findings on MAT barriers, and theoretical propositions. We conduct a theoretical synthesis guided by Turner's approach.

Results We included 15 articles using six theories, models, and frameworks that were synthesised into nine propositions. The synthesised theory emphasises that mobility is essential for human flourishing and that certain health conditions may impose restrictions on mobility. This impact can be alleviated by two direct determinants: (1) the provision of suitable services, and (2) their comprehensive provision. Policies and costs indirectly influence these services. Additionally, sociocultural and personal factors affect the use of these services. Ineffectively addressing these determinants could limit access to MAT and subsequent disabilities.

Conclusion Our synthetic model describes the logic of providing evidence-based MATs, and we identify the determinants of access which can act as targets for future work to improve MAT service provision.

Strengths and limitations of this study

- This is the first scoping review synthesis of the theories, models, frameworks, and barriers to the provision of MATs. We expanded the coverage of the resulting synthesis from individual theoretical perspectives by combining propositions from different theoretical perspectives, thus improving our ability to predict the barriers encountered in accessing AT services.
- Another strength of this study is the use of determinants organised around the Consolidated Framework for Implementation Research (CFIR), which allows local implementation strategies to be tailored to different policy jurisdictions.
- The limitations of this study include the exclusion of non-English language studies, which may limit the applicability of the findings.
- Patient and public engagement could have added additional perspectives and insights to the study.

Introduction

Neurological conditions, musculoskeletal disorders, and aging are associated with considerable humanistic burdens, including decreased quality of life (QoL)[1,2], limited social participation[3,4], fewer employment opportunities[3], and increased caregiver burden[5]. Mobility-assistive technologies (MATs) are vital for addressing the challenges posed by these conditions, as they can help improve QoL[6], promote independence[7], and alleviate the burden on individuals, families, and societies[8]. MATs include devices and systems that maintain and enhance independent mobility[9]. These include wheelchairs, walkers, scooters, prosthetic and orthopaedic devices, and exoskeletons[10].

Wheeled mobility devices, prosthetics, and orthotics are cost-effective in improving the QoL and independence of people with disabilities[11,12]. Despite being endorsed by the United Nations [13] and the World Health Organization [14] as essential for creating equitable opportunities for people with disabilities, access to these MATs remains limited[9]. There is considerable unmet need for MATs worldwide[15], with only a small percentage of those who require them having access [9].

The reasons for the unmet need for MATs are poorly understood but include the absence of national policies[14,16], high costs[17,18], and insufficiently trained personnel[18]. Several pre-existing theories, models, and frameworks (TMFs) have been used to understand the determinants of access and uptake, each with different conceptual coverage and terminology, which could help plan corrective actions. When a research area is characterised by theoretical incoherence, researchers must choose between rigid empiricism, selecting theories based on their virtues, developing their own theory, and theoretical synthesis[19]. Theoretical synthesis can amalgamate propositions from different theories in a propositional network, enabling researchers to extend the coverage, content validity, and document points of convergence[19]. Scoping reviews are ideal for uncovering key concepts and informing future research designs[20]. This paper presents a scoping review which identifies and synthesises the TMFs which have been used to understand the barriers to the provision of MATs to people with mobility issues.

Method

We report a five-stage scoping review based on the approach outlined by Arksey and O'Malley [21]in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR)[22]. This study did not meet the eligibility requirements for registration using PROSPERO.

Eligibility criteria

The research question was as follows: What theories, models, and frameworks have been used to understand the barriers to the provision of MATs to people with mobility issues? The Behaviour of interest; Health context; Exclusions; Models or Theories (BeHEMoTH) framework [23] was employed to formulate the search terms (Table 1) and eligibility criteria (Table 2).

Table 1 Search strategy developed using the BeHEMoTh procedure on Medline

BeHEMoTH	Concept	Search strategy 'Medline via Ovid'
Be	Barriers to Access or provision	(Provision* adj10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)). ab,ti.
H	People with mobility issues AND MATs	Mobility Limitation/ AND Self-Help Devices
E	NA	NA
MoTh	Models or Theories	(theor* or framework* or model* or taxonom* or classifi* or concept*). ab,ti.

Table 2 Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria	Rationale
Publications reporting on the barriers to the provision of MATs	Publication concentrates on aspects other than barriers to access, and there is no report on barriers	This review focuses on understanding barriers to the provision of MATs
Publications including at least a theory, model, or framework	Publications that did not employ a theory, model, or framework	To ensure that the articles concentrate on theory, model, or framework to understand the barriers
Publications in peer-reviewed journals	Other publications such as conference abstracts and theses	To ensure that studies had undergone rigorous evaluation
Publications published in the English language	Publications in other languages	Costs and time commitment associated with article translation
Publications between 2000 and 2023	Publication published before 2000	To ensure using the most relevant publications from the previous 20 years

Information sources and Searches

Literature searches were performed by (AA) on MEDLINE (Ovid), EMBASE (Ovid), and CINAHL (EBSCO) databases for studies published from 1 January 2000 to 15 June 2023. To identify appropriate publications relevant to the research issue, a *priori* search strategy was established in collaboration with the authors (AA and DH) and an information specialist (FZ). The search terms combined the concepts of 'barriers to provision, mobility issues, AND 'MATs', and a theory/model/framework'. Free text terms, subject heading, use of the Boolean operators "AND" and "OR", and truncation were all used to ensure a successful search. The final search strategy was tested on MEDLINE via Ovid, and translated into other databases. The full search strategy and results are presented in online supplemental appendix 1. We reviewed the reference lists of the included articles to identify additional relevant articles [21]but restricted eligibility to peer-reviewed studies, excluding grey literature.

Study selection

The Rayyan platform (https://www.rayaan.ai) was used for the study selection. Initial title and abstract screening was conducted by (AA), with regular consultations with other reviewers (DH, SR, and BF) to resolve any discrepancies. Full-text screening involved consistent discussions between (AA, DH, SR, and BF), and the full texts of eligible articles were subsequently retrieved for a more detailed assessment.

Data charting process

To facilitate consistent data presentation and synthesis, we charted the general and study-specific information from the studies directly into Microsoft Excel spreadsheets. Data items included country of origin, study population, aims, sample size, study design, data collection tool, TMF used, a brief description of the purpose of its use, research recommendations, and key findings related to barriers to the provision of MATs. We extracted theoretical propositions from the TMFs. We mapped the reported barriers to one of the 39 constructs of the Consolidated Framework for Implementation Research (CFIR), a synthetic framework of constructs used in 19 implementation theories[24], using a codebook (https://cfirguide.org/tools/). The CFIR provides a set of standardised constructs to guide researchers, creating a common language for explicitly and consistently describing the aspects that may affect the provision[25].

Synthesis of results

Tabular summaries and narrative syntheses were completed for the included articles and their TMFs[26]. We conducted a theoretical synthesis to generate new insights that were unavailable for any TMF[27]. The synthesis was guided by Turner's [28] approach. In Step 1, the TMFs are summarised and their shared themes are identified. In Step 2, the aspects of the TMF that pertain to core concepts by extracting the phrases used, their definitions, and their explicit and implicit relationships are identified. In Step 3, the TMFs are broken into simple propositions that can be compared and tabulated. In Step 4, the theories are compared and determined how they converge or diverge by combining similar elements. In Step 5, the convergent elements from the TMF are

combined into a single conceptual model that focused on the relationships between concepts. For example, during this stage, we examined how concepts from these TMFs—such as cost, services, and activity (mobility)— interacted and influenced each other within the synthesised theory to gain theoretical insight. We incorporated statements from the studies included in this review to strengthen the synthesis and support the resulting conceptual model (Step 6).

Gaps analysis

To identify knowledge gaps and areas for future research, we reviewed the papers and tabulated explicit recommendations, which is a core function of scoping reviews[20].

Patients and public involvement

No patients or public were involved in the study.

Results

Characteristics of the studies

The literature search yielded 200 citations after duplicates were removed. A total of 149 citations were excluded after initial screening, and 51 potentially eligible articles were retrieved for full-text review. Of these, 38 were excluded because they were not reported (*n* =9), TMFs were not reported (*n*=24), citations were conference abstracts (*n*=4) or, a thesis (*n*=1). Thirteen studies identified from the databases met all eligibility criteria. After reviewing the reference lists and conducting manual searches, 23 additional studies were identified and examined for eligibility, and two studies were determined to be eligible (Figure 1)[29].

Figure 1 PRISMA flow diagram.

The final synthesis included 15 articles (online supplemental appendix 2) [30–44]. Eight studies addressed the challenges associated with the provision and use of MATs [30,31,34,36,39,41–43]. Four studies examined the environmental barriers to participation[32,37,40,44]. Two studies explored the experiences of patients and caregivers, and their rehabilitation needs[35,38]. One study sought to draw attention to inconsistencies in an assistive technologies (AT) provision schemes[33]. There were (*n*=4) secondary studies and (*n*= 11) primary research studies conducted between 2012 and 2023 in South Africa[42], Mongolia[40], Canada and India[38], Australia[30,33], Malaysia[36], New Zealand[32], Uganda[39], Brazil[35], United States[34], Sweden[37], Tanzania[44], Canada, and the United States[31]. Primary research studies contained between one and 318 participants.

Six TMFs representing various perspectives were identified. Two were biopsychosocial in orientation: the International Classification of Functioning, Disability, and Health framework (ICF) [45] and The Human Activity Assistive Technology model (HAAT)[46], which focused on AT. Another model focusing on AT is the integrated multi-intervention paradigm for the assessment and application of concurrent treatments (IMPACT^2)[47]. Three other identified TMFs were applied to AT access: Levesque's theoretical framework,[48] Gibson's affordances theory,[49] and the Systemic development model (SDM)[50]. The most frequently used TMF was the ICF (n = 11). All included studies applied one TMF, except one[33], which used two in combination - the ICF and IMPACT^2. There are three distinct applications of TMFs (Table 3). The majority were used as a basis for analysis and interpretation (n = 10), or as a guide for designing the surveys and interviews (n = 2). In addition, TMFs were used as a comprehensive framework to provide context for reviewing relevant literature (n = 3).

Table 3 Theories, models, frameworks, and their purpose of application in eligible studies

Papers	**Theory/Model/Framework**	**The purpose of using Theory/Model/Framework**
McIntyre, Cleland and Ramklass (2021) [42]	Levesque's conceptual framework	To analyse the data and classify the facilitators and barriers to the five components of the framework (Approachability, Acceptability, Availability, Affordability, Appropriateness)
Dorjbal et al. (2020) [40]	ICF	To create a topic guide for interviews based on the ICF's components (Health conditions, environmental factors, and personal factors)
Jindal et al. (2018) [38]	ICF	To analyse and structure the data around the components of the ICF
Bhidayasiri et al. (2022) [43]	HAAT	To analyse and structure the data around the components of HAAT (human, the activity, and the AT)
Layton, (2012) [30]	ICF	To analyse the survey data
Mairami et al. (2017) [36]	Gibson's affordances theory	To identify the ways in which affordances affect recovery and wellbeing following a stroke

Dwyer and Mulligan (2015) [32]	ICF	To analyse the data and classify the facilitators and barriers to the five components of the ICF
Seymour, Geiger and Scheffler (2019) [39]	ICF	To analyse the data and structure the data around the components of the ICF
Gonçalves Junior, Knabben and Luz (2017) [35]	ICF	To analyse and organise the data representing the ICF components
Arthanat, Elsaesser and Bauer (2017) [34]	ICF	To design constructs for the survey
Gowran et al. (2021) [41]	SDM	To categorise barriers to access suitable wheelchairs to SDM components (natural, social, economic, and political)
Steel and Layton (2016) [33]	ICF and IMPACT^2	IMPACT^2: To organise and summarise sources of information around the components of a model (Context, Baseline, Intervention approaches, Outcome covariates, Outcomes) ICF: To expand the context of IMPACT^2 by considering societal and global factors
Widehammar et al. (2020) [37]	ICF	To create a topic guide for interviews based on the ICF components
Hammel et al. (2013) [31]	ICF	To organise the data representing the ICF components
Serres-Lafontaine et al. (2023) [44]	ICF	Data were coded deductively using the ICF

Barriers to MATs provision synthesised using CFIR

In the intervention characteristics domain, the key barriers were cost concerns[30–34,36,38,40–42], intervention complexity[31,37,39,41], and inadequate evidence of effectiveness [33,34]

(Table 4). The outer-setting domain highlights unmet patient needs[33,35–37,39,40,42,44], geographic distance[33,35,42], and a lack of supportive legislation[31,37,39–41,43,44]. Within the inner-setting domain, resource constraints[34,35,39,41,42], restricted knowledge, and information access hinder implementation readiness[30,31,34,39,41,43]. The characteristics of the individuals' domains revealed beliefs about the intervention [39–41,43] and low self-efficacy among healthcare professionals [34,42] as barriers to its adoption. In the process domain, barriers include insufficient stakeholder engagement[31,34,43], the absence of interdisciplinary standards[34], and limited strategic planning[31]. Finally, we identified two additional barriers not covered by the CFIR domains: limited information access [30–32,35,37,42] and lack of awareness[42,43].

Table 4 Barriers to the provision of MATs

CFIR Domain	CFIR Construct	Barriers
Intervention characteristics		
	Evidence Strength and Quality	▪ Insufficient rigorous research to demonstrate the efficacy of most MATs and associated services [33,34]
	Complexity	▪ The complexity of the device and its associated information [39,41] ▪ The length and complexity of the provisioning process [31,37,39,41]
	Cost	▪ ATs costs and expenses associated with their provision [36,38,42] ▪ Funding constraints [30–34,36,40,41]
	Design Quality and Packaging	▪ Inconsistent quality of devices [35,41,44]
Outer setting		
	Patient needs and resources	▪ Organisations are unaware of their patient's needs and are not involving them in service delivery [36,37,39,40,44] ▪ Services' geographical distances [33,35,42]
	External Policy and Incentives	▪ Inconsistencies between policies and their implementation [31,37,39,40] ▪ lack of legislation and policies [41,43,44]
	Cosmopolitanism	▪ Limited awareness and trustworthiness of AT vendors [31] ▪ Excluding MATs from insurance coverage [37]
Inner setting		
	Structural characteristics	▪ Service infrastructure issues [41]
	Networks and communications	▪ Communication issues among professionals [31] ▪ Lack of coordination across different systems within the organisation [31]
	Readiness for implementation 'Available resources'	▪ Shortage of staff [35,39,41,42] ▪ Lack of available workspace [41,42]

		▪ Lack of suitable standard instruments [34] ▪ Lack of time to interact with the patient [39,42]
	Readiness for implementation' Access to knowledge and information'	▪ Lack of information and a limited understanding of AT services [31] ▪ Healthcare Professionals (HCPs) training and education deficiencies [30,31,34,39,41,43] ▪ HCPs were not adequately prepared for this role by their professional education [34]
Characteristics of individuals		
	Knowledge, beliefs about the intervention	▪ The unfamiliarity of HCPs with AT [41,43] ▪ The lack of awareness and suggestions by treating physicians [43] ▪ AT is viewed negatively by the public [39,40,43]
	Self-efficacy	▪ Incompetent staff [34,42]
Process		
	Planning	▪ Lack of a strategic plan [31]
	Engaging 'key stakeholders'	▪ lack of physician involvement and failure to refer to ATs [31,43] ▪ Absence of interdisciplinary AT standards [34]
	Engaging 'Internal Implementation Leaders'	▪ A lack of engagement among the organisation Leaders [36,42]
	Engaging 'External Change Agents'	▪ Limited engagement from the government, donor organisations and AT vendors [31,33,40] ▪ Education programmes' weakness [34]
Barriers not mapped to the CFIR		
	Patient access to information	▪ Lack of accessible information for the patients [30–32,35,37,42]
	Awareness among patients	▪ The unfamiliarity of users with ATs [42,43]

Theories, Models and Frameworks (TMF) Synthesis

The propositions derived from the theories, models, and frameworks are described in online supplemental appendix 3, and the resulting synthetic model is presented in Figure 2.

Figure 2 Synthetic model.

Proposition 1: mobility is essential for human flourishing

The ICF framework highlights activity as a key component of health, with disability resulting from restricted activities, such as mobility issues[45]. This affects the participation in everyday activities such as work, socialisation, and healthcare access[45]. The HAAT model explains a similar concept, describing the 'activity' as the action of performing a task that represents the functional outcome of human performance[46]. Building on these insights, 'mobility' is viewed as an individual's ability to perform tasks that enable meaningful participation. The HAAT model and IMPACT^2 emphasise the importance of participation in everyday activities, such as working and socialising, for overall health[46,47], describing it as "necessary to human existence"[46]. According to the HAAT model, a 'human' is defined by their intrinsic physical, cognitive, and emotional abilities[46]. Accordingly, mobility is viewed more as a necessary means of meaningful participation than an end to developing physical, cognitive, and psychosocial skills throughout life[30,38].

Proposition 2: health conditions and personal factors influence mobility

The individuals' mobility is influenced by health and personal factors, which, in turn, affect their participation in social, work, and leisure activities. For example, the ICF framework clearly describes how health issues and personal factors can affect activities and participation[45], and describes health conditions as an umbrella term for disease, disorder, injury, or trauma[45]. Similarly, the HAAT model highlights the impact of a person's physical and cognitive abilities and personal elements, such as emotional and psychological factors, on their ability to perform activities[46]. Accordingly, 'personal factors' that encompass elements such as psychological attributes, age, and coping style influence an individual's ability to perform activities[45]. For instance, Dwyer and Mulligan [32] highlighted how emotional changes caused by spinal cord injury (SCI) could impede participation in rehabilitation services and other areas of reintegration such as employment and leisure activities.

Proposition 3: appropriate services influence mobility

The ICF and HAAT models explicitly describe the relationships between the activities and their environments. Both emphasise the importance of activities for participating and developing in life, and some interventions can improve a person's ability to engage in the desired activities[45,46]. For instance, in the ICF framework, AT services are considered to be an environmental factor, which is appropriate for helping individuals achieve their intended activities and participate in various situations[45]. Levesque's framework identifies that 'the appropriateness of a service' is determined by its alignment with the needs of the client, whereas the HAAT model emphasises that with AT, the individual's capabilities are increased[46,48]. Consequently, to meet the individual needs and maximise capabilities, we define the appropriateness of services based on the extent to which services are tailored. This demonstrates that MATs are vital for people with disabilities and older people who require them, thus enhancing their independence and participation in daily life[30,38].

Proposition 4: service delivery must be comprehensive to influence human mobility

Institutional factors significantly influence individual activities, as explained by the HAAT model [46] and ICF frameworks[45]. Levesque's framework emphasises the importance of how services are provided to meet client needs[48]. Similarly, the IMPACT^2 model is not only concerned with providing services but also with ensuring that outcomes are met, including QOL, participation, and satisfaction with the services provided[47]. Accordingly, the concept of 'comprehensive services' refers to providing clients with all necessary support services to meet their needs and achieve satisfaction. Providing comprehensive services encompassing assessment, training, and maintenance is crucial for enhancing personal mobility[31,41]. Effective delivery of AT services requires well-trained personnel[41]. These are the critical components of service delivery systems that help individuals enhance their mobility.

Proposition 5: the socio-cultural environment influences individuals' decision to seek appropriate health care services

AT interventions for mobility and participation are influenced by social and cultural factors that affect the individuals' health and well-being. The ICF framework views disability as a health experience arising from context, and not solely within an individual[45]. It emphasises how society can create barriers, such as inaccessible services, or neglected facilitators, such as the lack of AT[45]. Furthermore, an individual's level of functioning is determined by relationships with family, people, and healthcare providers, all of which can influence the decision to seek medical care[45]. A similar concept of how society impacts activities is highlighted by the HAAT model, which places particular emphasis on an individual's cultural context[46]. For example, parents of children with disabilities oppose wheelchairs because of social stigma[38], and some older people perceive AT negatively because of stigmatising symbolism[43]. This demonstrates the significant influence of 'sociocultural factors' such as support and relationships from family, health professionals, and community on MAT accessibility and acceptance.

Proposition 6: policies influence the provision of services

The SDM framework highlights how organisational service delivery policies influence appropriate service provision[50], whereas the ICF explains how policies affect participation and activities[45]. As part of the ICF, the term 'policy' is commonly used within the environmental factor domain as an external factor that can impact an individual's health and function[45]. This is a set of guidelines, rules, and regulations that govern the range of services provided to individuals, such as policies and standards that define the eligibility criteria for services[45]. For instance, prostheses are not considered to be life-saving medical devices or crucial components of the healthcare system[35]. However, they are life-changing for users and quickly restore most functions over time[35]. Levesque's framework argues that the availability of health services implies that those in need can access either physical space or healthcare personnel[48].

Therefore, individuals cannot access healthcare if they are unavailable in their geographic area or if insurance does not cover their treatment[48]. This can prevent individuals from receiving the healthcare they require, which can adversely affect their health. Disparities between government and institutional policies can result in confusion among AT providers and decrease service utilisation[39,41].

Proposition 7: Cost influences the provision of appropriate services

The SDM framework [50] highlights the significant influence of economic factors on service delivery, reinforcing the idea that costs can significantly influence access to healthcare services. The term ‘cost’ refers to the expenses that individuals and healthcare systems incur to provide healthcare services[47,48]. This comprises the direct prices of services, such as consultation fees, device costs, and related expenses[48]. For instance, the IMPACT^2 model underlines the role of cost implications in selecting intervention approaches and demonstrating the cost effects at each stage of AT provision[47]. The ability of an individual to generate economic resources, such as income, to cover these costs is also critical, according to Lavesque et al. [48] framework. Therefore, costs can play a considerable role in determining AT use and access.

Proposition 8: Personal factors influence healthcare utilisation

Healthcare utilisation is influenced by various 'personal factors’ representing an individual’s internal aspects, such as psychological characteristics[45]. This concept is explained using Levesque’s framework. It highlights factors such as an individual's need for care, awareness of these needs, and desire for treatment[48]. Gibson's affordance theory suggests that an individual's perception of their environment is based on its potential to fulfil their needs, thereby shaping their decisions[49]. Therefore, the individual is responsible for unravelling the utility presented by affordance. For instance, Mairami et al. [36] adapted a chair from a home to a wheelchair. This demonstrates how the client's perception of their environment shaped recovery when an existing structure was found to have assistive potential. The ICF model explains the significance of environmental factors such as the visibility of services in determining an individual's level of functioning[45], which is related to Gibson's affordance theory, in which environmental cues trigger actions[49]. Consequently, a lack of service limits the activities that can be conducted.

Proposition 9: Limited access to healthcare services creates disability

The ICF acknowledges the influence of environmental factors on disability development and emphasises the limitations it imposes on individuals' abilities to access healthcare services and engage in social activities[45]. As defined by the ICF, disabilities include impairments, limitations in activity levels, and restrictions on participation[45]. Consequently, restricted AT accessibility impairs body function, hinders participation, and contributes to disabilities. The SDM framework explains the significance of economic factors, particularly the "lack of economic means”, which limit access to services such as MAT[50]. Restricted access can trigger continuous cycles of disabilities and poverty[41]. Persistent mobility constraints, whether due to

inadequate MAT service support or diminished participation in daily life, have been identified as significant factors that lead to disability[39,40].

Gaps analysis

This review highlights the key research areas in AT services that warrant further investigation [online supplemental appendix 4]. Investigations should focus on AT access in remote regions;[30,38,42] stakeholder perspectives concerning rehabilitation services and AT access barriers;[39,42,44] and funding, policy, and legislation challenges[32,34,36,40,41,44]. Data collection and methodological enhancements are required, including standardised instruments for assessing functioning and disability[35,37], comparisons of user experiences with and without AT[31,33], and comprehensive evaluation tools that combine objective and subjective measures[31,33]. Emphasis should also be placed on understanding the in-country perspectives, inclusive solutions, and the impact of contextual factors on access to AT and service evaluation[41]. Addressing these research gaps can contribute to the development of more effective, inclusive, and accessible AT services for individuals with disabilities.

Discussion

This scoping review offers a summary of the barriers to MAT provision and synthesises theories to guide future work based on 15 articles. The synthesised theory emphasises that mobility is essential for human flourishing (Proposition 1) and that certain health conditions may impose restrictions on mobility (Proposition 2). This impact can be ameliorated by two direct determinants: the provision of suitable services (Proposition 3), and their comprehensive provision (Proposition 4). These services are indirectly influenced by policies (Proposition 6) and costs (Proposition 7). Furthermore, an individual's decision to access these services is also determined by their sociocultural environment (Proposition 5) and personal factors (Proposition 8). If these direct and indirect determinants are not effectively addressed, it could result in limited access to MATs and subsequent disability (Proposition 9). This synthesised theory integrates empirical and ethical dimensions and provides evidence-based approaches for solving problems[51].

To the best of our knowledge, this is the first report on the synthesis of TMFs and barriers to MAT provision. Although De Alves and Matsukura's [52] literature review outlines the various theoretical models used in the AT literature, they did not attempt theoretical synthesis. TMFs organise concepts and thoughts that can provide insights into different elements of practice and research[53]. Lakatos proposes that scientific enquiry should appraise a series of theories, rather than a single theory, noting that "the members of such series of theories are usually connected by a remarkable continuity which welds them into research programmes"[54]. Lakatos advocated for a 'pluralistic model' of scientific theories, in which a number of theories, which are organised deductively to varying degrees, are brought together in a unified approach[54]. Unlike Lakatos, we view this work as enhancing problem-solving effectiveness[55]. By combining propositions from different theories, we increase the coverage of the resulting syntheses of individual theories. It follows that it should predict the range of barriers encountered in AT access and provision.

The theory covers a socially significant issue given that it addresses the current research priorities identified by expert panels organised by government agencies and clinical specialty organisations[10,56,57]. It addresses the phenomenon of interest to rehabilitation scholars by filling the gaps in existing TMFs. Specification adequacy is achieved by providing a clear and concise overview of the theoretical synthesis. Additionally, we establish linkage adequacy by defining concepts and their relationships[58]. The theory is testable because it contains observable concepts and propositions that can be operationalised and corroborated in empirical research. A limitation of the scoping review was the exclusion of non-English language studies, which could limit the applicability of the findings[59], and patient and public engagement could have added additional perspectives and insights to the study.

The insights from this review and the resulting integrated model have the potential to influence clinical practice and policymaking in line with the ethical imperatives outlined by the WHO and UN[9,13]. These organisations have emphasised the necessity of AT to meet individual needs and enable equitable opportunities for people with disabilities. Therefore, this review proposes a theoretical basis for reforming the existing system to align with these international standards, thus addressing pressing and unmet needs more equitably and personally. To achieve this, future research must examine these determinants, understand the barriers to MAT provision, and plan and evaluate strategies to enhance provision. Having a set of determinants organised around the CFIR [24] allows the creation of local implementation strategies to suit different policy jurisdictions.

There is a consensus [60,61] and evidence-based route [62] to overcoming the barriers to effective AT provision found in this review. The barriers identified by the CFIR can be linked to the Expert Recommendations for Implementing Change (ERIC) strategies[63]. These strategies guide the selection of implementation methods to mitigate barriers and include: (1) activating local clinical leaders or champions, (2) providing educational materials, (3) organising meetings, and (4) implementing outreach or ongoing training. Notably, these strategies demonstrate average effect sizes of 12%, 2%, 6%, and 6%, respectively[62]. The implementation of these strategies can assist decision-makers in making informed choices regarding the selection of strategies for MAT provision.

Conclusion

The synthesised theory emphasises that mobility is a crucial aspect in human life, and that certain health conditions may restrict mobility. Providing comprehensive and appropriate services can reduce this impact; however, cost and policy decisions regarding these services impact their provision. The accessibility of these services is also affected by sociocultural and personal factors. This knowledge can be used to develop strategies to enhance provision.

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Association for the Advancement of Assistive Technology in Europe (AAATE 2023) held in Paris between 30 August and 1 September, 2023[64].

Contributors

All authors contributed to the conceptualisation and design of the study. Initial title and abstract screening was conducted by AA, with regular consultations with DH, SR, and BF. AA performed data extraction independently with regular discussions with DH, SR, and BF. The initial data synthesis was conducted by AA and refined by DH, SR, and BF. The manuscript was drafted by AA, and major revisions were made by DH, SR, and BF. All authors (AA, DH, SR, and BF) read and approved the final manuscript.

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Competing interests

The authors report there are no competing interests to declare.

Data availability statement

The authors confirm that the data supporting the findings of this study are available in the article and supplementary material.

Rights Retention Statement

Supporting materials

Appendix 1, Table. Systematic search conducted in MEDLINE, EMBASE and CINAHL
Appendix 2, Table. Characteristics of included papers
Appendix 3, Table. Propositions derived from the theories, models, and frameworks
Appendix 4, Table. Gaps analysis

Appendix 5, Checklist. Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR)

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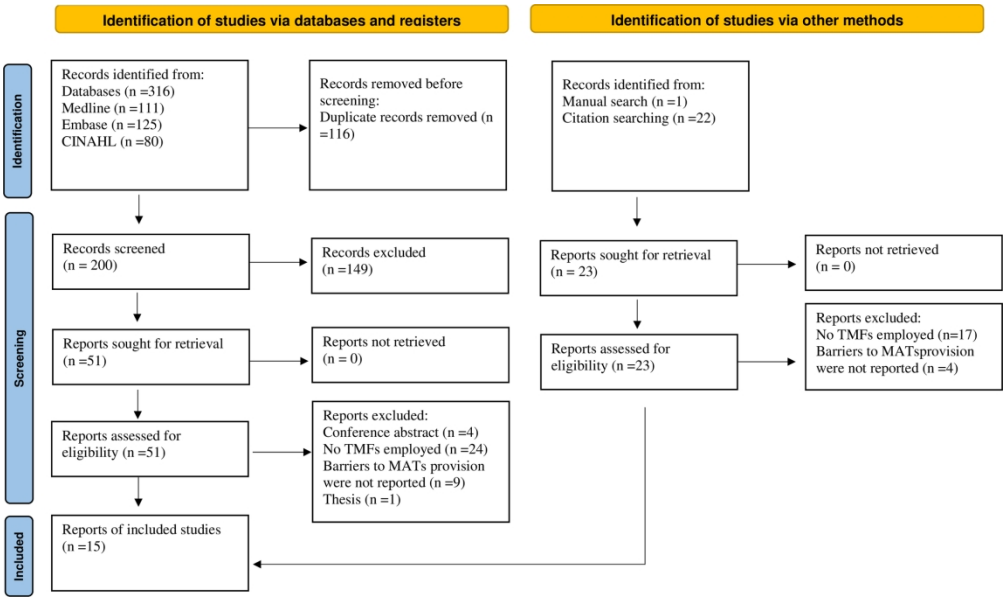

Figure 1 PRISMA flow diagram

190x112mm (300 x 300 DPI)

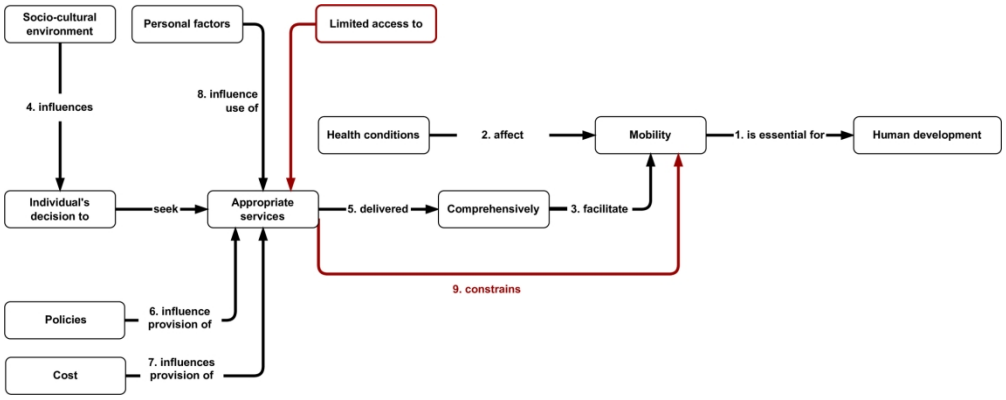

Figure 2 Synthetic model

190x74mm (300 x 300 DPI)

Appendix1. Systematic search conducted in MEDLINE, EMBASE and CINAHL

Database(s): **Ovid MEDLINE(R)** Search Strategy:

#	Query	Results from 15 June 2023
1	(Access* adj10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)).ab,ti.	60,142
2	(Provision* adj10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)).ab,ti.	7,533
3	(Provide* adj10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)).ab,ti.	98,418
4	(Adoption* adj10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)).ab,ti.	6,925
5	Wheelchairs/	5,387
6	Orthotic Devices/	6,900
7	Exoskeleton Device/	1,423
8	Mobility device*.ab,ti.	509
9	Mobility technolog*.ab,ti.	48
10	Wheelchair*.ab,ti.	8,603
11	Scooter*.ab,ti.	763
12	Walker*.ab,ti.	14,979
13	Prosthetic*.ab,ti.	62,479
14	prosthesis/	49,611
15	orthotic*.ab,ti.	3,593
16	Self-Help Devices/	5,679
17	Exoskeleton*.ab,ti.	4,327
18	Orthos*.ab,ti.	25,430
19	power mobility.ab,ti.	126
20	Prosthe* device*.ab,ti.	2,343
21	(Assistive technolog* adj10 mobility).ab,ti.	129
22	(Assistive device* adj10 mobility).ab,ti.	199
23	Disabled Persons/	47,551
24	Mobility Limitation/	5,263
25	Elder*.ti,ab.	300,845
26	Physical* Disable*.ab,ti.	927
27	Disable*.ab,ti.	28,928
28	Disabilit*.ab,ti.	237,278
29	Walking difficult*.ab,ti.	641

30	Handicap*.ab,ti.	25,545
31	physical* impair*.ab,ti.	3,077
32	physical* Challeng*.ab,ti.	657
33	Ambulat* Difficult*.ab,ti.	83
34	Mobility difficult*.ab,ti.	233
35	Mobility impair*.ab,ti.	1,314
36	Mobility limit*.ab,ti.	1,405
37	Amput*.ab,ti.	52,056
38	Motor difficult*.ab,ti.	510
39	Amputation/	23,717
40	Geriatrics/	31,360
41	(theor* or framework* or model* or taxonom* or classifi* or concept*).ab,ti.	5,542,093
42	5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22	127,001
43	23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40	671,443
44	1 or 2 or 3 or 4	165,668
45	42 and 43 and 44	416
46	41 and 45	119
47	limit 46 to english language	113
48	limit 47 to yr="2000 -Current"	111

Database(s): **Ovid Embase** Search Strategy:

#	Query	Results from 15 June 2023
1	(Access* adj10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)).ab,ti.	83,427
2	(Provision* adj10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)).ab,ti.	10,063
3	(Provide* adj10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)).ab,ti.	126,340
4	(Adoption* adj10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)).ab,ti.	8,412
5	Wheelchairs/	10,870
6	Orthotic Devices/	7,175
7	Exoskeleton Device/	1,300
8	Mobility device*.ab,ti.	619
9	Mobility technolog*.ab,ti.	58
10	Wheelchair*.ab,ti.	13,074
11	Scooter*.ab,ti.	946
12	Walker*.ab,ti.	17,493
13	Prosthetic*.ab,ti.	75,413
14	prosthesis/	34,102
15	orthotic*.ab,ti.	5,157
16	Self-Help Devices/	2,780
17	Exoskeleton*.ab,ti.	4,975
18	Orthos*.ab,ti.	35,586
19	power mobility.ab,ti.	158
20	Prosthe* device*.ab,ti.	2,755
21	(Assistive technolog* adj10 mobility).ab,ti.	161
22	(Assistive device* adj10 mobility).ab,ti.	289
23	Disabled Persons/	30,776
24	Mobility Limitation/	14,073
25	Elder*.ti,ab.	430,022
26	Physical* Disable*.ab,ti.	1,195
27	Disable*.ab,ti.	37,699
28	Disabilit*.ab,ti.	341,446
29	Walking difficult*.ab,ti.	1,206
30	Handicap*.ab,ti.	31,319

31	physical* impair*.ab,ti.	4,424
32	physical* Challeng*.ab,ti.	932
33	Ambulat* Difficult*.ab,ti.	124
34	Mobility difficult*.ab,ti.	328
35	Mobility impair*.ab,ti.	1,786
36	Mobility limit*.ab,ti.	1,880
37	Amput*.ab,ti.	66,146
38	Motor difficult*.ab,ti.	721
39	Amputation/	26,124
40	Geriatrics/	33,963
41	(theor* or framework* or model* or taxonom* or classifi* or concept*).ab,ti.	6,952,806
42	5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22	156,888
43	23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40	923,960
44	1 or 2 or 3 or 4	218,126
45	42 and 43 and 44	473
46	41 and 45	128
47	limit 46 to english language	125
48	limit 47 to yr="2000 -Current"	125

Database(s): **EBSCO CINAHL** Search Strategy:

#	Query	Results
S1	TI ((Access* n10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*))) OR AB ((Access* n10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)))	28,922
S2	TI ((Provision* n10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*))) OR AB ((Provision* n10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)))	5,212
S3	TI (Provide* n10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*))) OR AB (Provide* n10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)))	41,065
S4	TI ((Adoption* n10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*))) OR AB ((Adoption* n10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)))	3,286
S5	(MH "Wheelchairs")	5,024
S6	(MH "Orthoses")	7,098
S7	(MH "Exoskeleton Devices")	453
S8	TI (“Mobility device*”) OR AB (“Mobility device*”)	428
S9	TI "Mobility technolog*" OR AB "Mobility technolog*"	49
S10	TI Wheelchair* OR AB Wheelchair*	6,404
S11	TI Scooter* OR AB Scooter*	444
S12	TI Walker* OR AB Walker*	4,060
S13	TI Prosthetic* OR AB Prosthetic*	12,806
S14	(MH "Limb Prosthesis")	2,890
S15	TI orthotic* OR AB orthotic*	2,832
S16	(MH "Assistive Technology Devices")	6,496
S17	TI Exoskeleton* OR AB Exoskeleton*	783

S18	TI Orthose* OR AB Orthose*	2,473
S19	TI "power mobility" OR AB "power mobility"	144
S20	TI "Prosthet* device*" OR AB "Prosthet* device*"	426
S21	TI ("Assistive technolog*" n10 mobility) OR AB ("Assistive technolog*" n10 mobility)	128
S22	TI ("Assistive device*" n10 mobility) OR AB ("Assistive device*" n10 mobility)	149
S23	(MH "Persons with Disabilities")	36,262
S24	(MH "Physical Mobility")	7,277
S25	TI Elder* OR AB Elder*	110,994
S26	TI "Physical* Disable*" OR AB "Physical* Disable*"	463
S27	TI Disable* OR AB Disable*	13,488
S28	TI Disabilit* OR AB Disabilit*	129,247
S29	TI "Walking difficult*" OR AB "Walking difficult*"	236
S30	TI Handicap* OR AB Handicap*	6,419
S31	TI "physical* impair*" OR AB "physical* impair*"	1,722
S32	TI "physical* Challeng*" OR AB "physical* Challeng*"	407
S33	TI "Ambulat* Difficult*" OR AB "Ambulat* Difficult*"	27
S34	TI "Mobility difficult*" OR AB "Mobility difficult*"	164
S35	TI "Mobility impair*" OR AB "Mobility impair*"	795
S36	TI "Mobility limit*" OR AB "Mobility limit*"	934
S37	TI Amput* OR AB Amput*	14,878

S38	TI "Motor difficult*" OR AB "Motor difficult*"	236
S39	(MH "Amputation")	7,419
S40	(MH "Geriatrics")	5,918
S41	TI (theor* OR framework* OR model* OR taxonom* OR classifi* OR concept*) OR AB (theor* OR framework* OR model* OR taxonom* OR classifi* OR concept*)	1,047,119
S42	S1 OR S2 OR S3 OR S4	73,562
S43	S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21 OR S22	42,041
S44	S23 OR S24 OR S25 OR S26 OR S27 OR S28 OR S29 OR S30 OR S31 OR S32 OR S33 OR S34 OR S35 OR S36 OR S37 OR S38 OR S39 OR S40	294,686
S45	S42 AND S43 AND S44	339
S46	S41 AND S45	84
S47	S41 AND S45 Limiters - Language: English	80

Theories, models and frameworks to understand barriers to the provision of mobility assistive technologies: A scoping review

Appendix 2, Table. Characteristics of included papers

Authors and Year	Study design	Aims of the study	Population (n, characteristics	Country
McIntyre, Cleland and Ramklass (2021) [42]	Qualitative, Semi-structured interviews	To explore facilitators and barriers to accessible wheelchair services	11(8 occupational therapists and 3 physiotherapists)	South Africa
Dorjbal et al. (2020) [40]	Qualitative, Semi-structured interviews	To identify environmental barriers and their influence on daily life	16(SCI patients)	Mongolia
Jindal et al. (2018) [38]	Qualitative, Semi-structured interviews	To investigate parents' perceptions of rehabilitation and their information needs for their child with cerebral palsy (CP)	18 (parents of children with CP)	India and Canada
Bhidayasiri et al. (2022) [43]	Review article	To present clinical viewpoints on the unfulfilled needs of wearable technology, such as exoskeletons and orthoses	N/A	N/A
Layton (2012) [30]	Mixed method	To identify barriers and facilitators to optimal mobility from the perspective of AT users	100 (AT users. Neurological conditions)	Australia, Survey, Open-ended responses
Mairami et al. (2017) [36]	Qualitative, case study, Semi-	1. To illustrate how AT influences stroke recovery and how the	1(Stroke patient)	Malaysia

	structured interview	environment might be altered to facilitate recovery 2. To examine the issues of AT affordability and accessibility		
Dwyer and Mulligan (2015) [32]	Literature review	To determine the obstacles and enablers for community reintegration as experienced by individuals with SCI	A total of 373 participants in the 7 included studies	New Zealand
Seymour, Geiger and Scheffler (2019) [39]	Qualitative, Focus group	To identify the issues associated with wheelchair provision and the elements that contribute to or mitigate these challenges	21 (Community rehabilitation workers)	Uganda
Gonçalves Junior, Knabben and Luz (2017) [35]	Qualitative, Semi-structured interviews	To demonstrate how people with lower limb amputation function and express their limitations	6 (patients with amputation)	Brazil
Arthanat, Elsaesser and Bauer (2017) [34]	Quantitative, Survey	To explore how AT providers perceive their education and training, the use of evidence and guidelines, financing policies.	318 (AT providers)	US
Gowran et al. (2021) [41]	Position Paper	To examine the global challenges related to wheelchair accessibility	N/A	N/A
Steel and Layton (2016) [33]	Feature Article	An exploration of the complexities of AT provision in Australia	N/A	Australia
Widehammar	Qualitative, Semi-structured interviews	An exploration of how users' experiences of power mobility devices	14(AT users)	Sweden

et al. (2020) [37]		are influenced by environmental factors		
Hammel et al. (2013) [31]	Qualitative, multiple case study, Focus groups	Multiple stakeholders' perspectives, issues, and priorities related to accessing, using, and evaluating MATs	65(45 AT users, 10 caregivers, 10 service providers)	USA and Canada
Serres-Lafontaine et al. (2023) [44]	Qualitative, photovoice method	To study how peer training affects social involvement	10 Wheelchair users (SCI patients)	Tanzania

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Appendix 3 Table. Propositions identified in the theories, models and frameworks

Name of the theory, model or framework	Propositions
International Classification of Functioning, Disability, and Health (ICF)	1. A health condition can affect both the mental and physical body functions. 2. An individual's activities are impacted by their health condition. 3. Health conditions affect an individual's engagement in activities, determining their level of participation. 4. External factors, for example, social factors, can either inhibit or facilitate an individual's level of functioning. 5. Society may create barriers, for example, inaccessible services or lack of facilitators, such as the unavailability of AT, which can affect an individual's performance. 6. An individual's functioning is affected by the presence or absence of services, for example, equipment, products, and technologies in their environment.

7. External elements like systems and policies that regulate and facilitate the provision of services can impact a person's functional capacity.
8. An individual's level of functioning can also be influenced by external factors such as support and relationships, including family, people in positions of authority, and health professionals.
9. Personal factors of an individual represent their internal aspects, including psychological factors, that can affect their level of functioning.
10. Individuals' functioning and disabilities are influenced by their health status as well as contextual factors, such as environmental and personal factors.
11. Functioning is defined as encompassing body functions, body structures, activities, and participation.

	12. An impairment, an activity limitation, or a restriction on participation constitutes a disability.
Levesque's conceptual framework	1. The concept of approachability is related to the ability of individuals with health needs to recognise the existence of available services, access them, and receive effective healthcare that can improve their health. 2. Cultural and social factors determine the acceptability of health services within their context. 3. The reachability of health services depends on their physical presence and timeliness. 4. Factors like personal mobility, transportation availability, adaptability in occupation, and knowledge of accessible health services are interconnected and contribute to an individual's capacity to access healthcare providers physically.

5. The concept of affordability in healthcare refers to the ability of people to pay for services without causing undue financial hardship or affecting their ability to afford basic necessities.
6. The ability to afford healthcare services is connected to a person's financial resources, including income, savings, and borrowing capacity.
7. Appropriateness in healthcare refers to the fit between the services provided and the needs and preferences of clients, as well as the quality and safety of those services.
8. Engaging in healthcare involves the active participation of clients in decision-making and treatment planning, which helps to ensure that care is aligned with their goals and values.
9. Accessibility of health services is affected by the availability of information.

	10. Personal autonomy and the ability to choose care-seeking are linked to the ability to access health care.
The Human Activity Assistive Technology model (HAAT)	1. AT enhances an individual's capabilities to complete desired tasks. 2. Human activities are essential, learnable, and influenced by societal and cultural contexts. 3. The use of desired technology is influenced by human skills and abilities (physical, cognitive, emotional). 4. An individual's ability to perform activities is affected by their skills and abilities (physical, cognitive, emotional). 5. The use of AT to perform an activity is influenced by various factors in the environment, including physical, social, cultural, and institutional elements.

	6. Choosing and implementing the right AT requires considering the interaction between different elements, including the activity being performed, the user's needs and abilities, and the broader environmental context in which the technology will be used. 7. The process of performing an activity leads to a functional result of human performance.
Gibson's affordances theory	1. Cognition: Affordances exist as a cognitive process which comes through people and organisations interacting with material entities. 2. Perception: Affordances need to be perceived or recognised by the person or organisation. 3. Behaviour: the affordance is actualised as the behaviour that people/organisations adopt acting on the perceived opportunity for action.

	4. Evaluation: Evaluating the effects of this behaviour. 5. Environmental factors and structures can impact disabilities.
Systemic development model (SDM)	1. Understanding personal, organisational, and institutional capacity requires consideration of factors such as health, culture, economics, and politics. 2. It is crucial to provide appropriate services to improve the health, well-being, and fundamental freedoms of individuals in need. 3. Limited access to services can create a cycle of poverty and disability. 4. Service delivery systems that are tailored to specific contexts play a significant role in ensuring appropriate service provision. 5. Economic factors impact the availability of products and services

	and can affect the viability of service provision. 6. Evaluation of the quality, development, performance, and procurement standards of products is crucial for improving service delivery systems and individual health outcomes. 7. Political governance also plays a role in ensuring access to appropriate services.
Multi Intervention Paradigm for Assessment and Application of Concurrent Treatments (IMPACT^2)	1. The results of interventions can be outlined by examining the six phases, including: 1) Pre-Intervention, 2) Context, 3) Baseline, 4) Intervention Strategies, 5) Outcome Covariates, and 6) Outcomes. 2. Personal and contextual factors influence the devices and services used by individuals to perform activities.

3. Universal design and health promotion are two methods that can be utilised to enhance functional performance.
4. The context in which AT is used to perform a task within an environment is crucial for improving participation and QoL.
5. Intervention approaches, such as reducing the impairment, compensating for the impairment, using AT, and redesigning the activity, are used to support the use of AT and optimise an individual's functioning.
6. Consumer satisfaction is a desirable outcome of AT provision.
7. Outcome(function) is defined as participation, QoL, and engagement.
8. Cost influences the Intervention approaches therefore affecting Outcomes.

Appendix 4, Table. Gaps analysis

Gaps	**Recommendations for future research**
Remote Regions and Accessibility	Key areas for future investigation included examining access to AT in remote regions [30,42] by investigating challenges and barriers faced in remote regions [42].
Stakeholder Perspectives	The included papers in this review draw attention to several issues, such as investigating policymakers' and HCPs' views on rehabilitation services [38]. Understanding the challenges faced by people with disabilities [44]. This includes understanding stakeholder perspectives on the various aspects of access by identifying the enablers and barriers that might aid in planning to increase access to AT services [39,42].
Funding, Policy, and Legislation	Future research should investigate funding and policy-related barriers [32,34,40], the impact of legislation on accessibility and participation for powered mobility device users [37], fostering low-cost approaches in low- and middle-income countries [36], and promoting inclusive solutions for wheelchair service provision [41,44].
Data Collection and methodological improvements	Adoption of standardised instruments to assess functioning and disability is needed [35,37]. Comparing perceptions users with and without AT [35,37]. Exploration of user

	satisfaction, choice, and control in relation to MATs and its impact on overall outcomes [31]. Development of standards for testing AT effectiveness [43].
Contextual Understanding and service evaluation	Importance of investigating in-country perspectives consideration of personal, social, economic, environmental, historical, and political factors [41]. Incorporating subjective measures in service evaluations [33].

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Appendix 5. Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
TITLE			
Title	1	Identify the report as a scoping review.	1
ABSTRACT			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	4
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	4
METHODS			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	4 (not registered)
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	4
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	6
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	Appendix 1.
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	6
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	6
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	6

Theories, models and frameworks to understand barriers to the provision of mobility assistive technologies: A scoping review

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	NA
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	6
RESULTS			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	7
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	7 and Appendix 3
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	NA
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	7-11, Table 3,4, Appendix 3
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	10-17
DISCUSSION			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	17
Limitations	20	Discuss the limitations of the scoping review process.	18
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	18
FUNDING			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	19

JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.

* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.

† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).

‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.

§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that

may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

From: Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMAScR): Checklist and Explanation. Ann Intern Med. 2018;169:467–473. doi: 10.7326/M18-0850

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Theories, models and frameworks to understand barriers to the provision of mobility assistive technologies: A scoping review

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Abstract

Objectives There is strong evidence that mobility-assistive technologies improve occupational performance, social participation, educational and employment access, and overall quality of life in people with disabilities. However, people with disabilities still face barriers in accessing mobility products and related services. This review aims to summarise and synthesise: 1) theories, models, and frameworks that have been used to understand mobility-assistive technology access, 2) determinants of access, and 3) gaps in knowledge.

Design A Scoping review using the five-step Arksey and O'Malley Framework.

Data sources We searched the MEDLINE, EMBASE, CINAHL, and SCOPUS databases for publications published between 2000 and 2023. We searched for articles published up to 15 June 2023.

Eligibility criteria We included English-published literature in peer-reviewed journals that reported (a) barriers to the provision of mobility-assistive technologies, (b) including at least one theory, model, or framework, and (c) between 2000 and 2023.

Data extraction and synthesis We extracted the study characteristics, theories, models, framework usage, research recommendations, key findings on mobility-assistive technology barriers, and theoretical propositions. We conduct a theoretical synthesis guided by Turner's approach.

Results We included 17 articles using seven theories, models, and frameworks, synthesised into nine propositions. The synthesised theory emphasises that mobility is essential for human flourishing and that certain health conditions may impose restrictions on mobility. This impact can be alleviated by two direct determinants: (1) the provision of suitable services and (2) their comprehensive provision. Policies and costs influence these services indirectly. Environmental and personal factors also affect the use of these services. Ineffectively addressing these determinants can limit access to mobility-assistive technologies and subsequent disabilities.

Conclusion Our synthetic model describes the logic of providing evidence-based mobility-assistive technologies, and we identify the determinants of access which can act as targets for future work to improve mobility-assistive technologies provision.

Strengths and limitations of this study

- We used a comprehensive search strategy developed with an information specialist to identify relevant publications.
- We mapped reported barriers to a widely used conceptual framework - the Consolidated Framework for Implementation Research - for consistent terminology.
- We conducted a theoretical synthesis to generate new insights.
- We excluded non-English studies, potentially limiting the applicability of our findings.
- We exclude grey literature, which further narrows the scope of the review.

INTRODUCTION

Neurological conditions, musculoskeletal disorders, and ageing are associated with considerable human burdens, including decreased quality of life (QoL) [1,2], activity limitations [3], participation restrictions [4,5], increased dependence, and caregiver burden [6]. Mobility-assistive technologies (MATs) are vital for addressing the challenges posed by these conditions, as they can help improve QoL, promote independence, enhance occupational performance, increase participation, and alleviate the burden on individuals, families, and societies [7]. MATs encompass assistive products for mobility and related systems and services [7]. These assistive products include devices, software, or instruments specifically designed or widely available to enhance the functioning of an individual [8]. They support or substitute the ability to move, thereby facilitating movement from one location to another [8]. Examples include wheelchairs, walking frames, rollators, and prosthetic and orthotic products [8].

Wheeled mobility products, prosthetics, and orthotics are cost-effective for improving the QoL and independence of people with disabilities [9,10]. Despite being endorsed by the United Nations [11] and World Health Organization (WHO) [7], which are essential for creating equitable opportunities for people with disabilities, access to these MATs remains limited [7,12]. There is a considerable unmet need for MATs worldwide, with only a small percentage of those who require them having access [7,12]. Access to assistive technology (AT) is defined as the equitable and sustainable provision of assistive products and support services that adhere to six key principles: accessibility, affordability, availability, adaptability, acceptability, and quality [7]. These principles ensure that assistive products and services are reachable, cost-effective, adaptable to individual needs, culturally appropriate, widely available, and of high quality [7].

The reasons for the unmet need for MATs are poorly understood but include the absence of national policies, high costs, and insufficiently trained personnel [7]. Several pre-existing theories, models, and frameworks (TMFs) have been used to understand the determinants of access and uptake, each with different conceptual coverage and terminology, which could help plan corrective actions. A framework is a structure for organising concepts that enable the description of phenomena [13,14]. For instance, Levesque's conceptual framework defines five dimensions of healthcare accessibility: approachability, acceptability, availability, affordability, and appropriateness [15]. The International Classification of Functioning, Disability, and Health framework (ICF) is a framework developed by the WHO that classifies the health and disability components of functioning and contextual factors [16]. These include multi-aspect concepts related to body functions, structures, activities, participation, and environmental factors [16].

A model is a simplified representation of reality that holds for a specific case or population [13,17,18]; models may describe the relationship between their components but tend to be descriptive rather than explanatory [13]. For example, the Human Activity Assistive Technology (HAAT) model describes the interaction between human activity, AT, and the physical, social, and cultural contexts in which it is used [19]. The integrated multi-intervention paradigm for the assessment and application of concurrent treatments (IMPACT^2) model describes the variables related to AT interventions [20]. The Matching Person and Technology (MPT) is a model that describes the interaction between environmental, personal, and technological factors in the success of AT uptake [21]. The Systemic Development Model (SDM), developed by the World Engagement Institute (WEI), describes four interconnected pillars of sustainability—health, culture, economics, and politics—to enhance the understanding of capacities at the personal, organisational, and institutional levels [22].

A theory is an interconnected set of abstract statements that explain, predict, or prescribe phenomena, going beyond specific contexts to consider broader meanings and implications [13,14,17,23]. For instance, Gibson's theory proposes that the environment contains actionable (and

therefore explanatory) properties, "affordances", that are directly perceived [24]. When a research area is characterised by theoretical incoherence, researchers must choose between rigid empiricism, selecting theories based on their virtues, developing their own theory, and theoretical synthesis [25]. Theoretical synthesis can amalgamate propositions from different theories into a propositional network, enabling researchers to extend the coverage, content validity, and document points of convergence [25]. Scoping reviews are ideal for uncovering key concepts and informing future research designs [26]. This paper presents a scoping review that summarises and synthesises the TMFs used to understand MAT access, identifies the determinants of access, and highlights the gaps in current knowledge.

METHOD

We report a five-stage scoping review based on the approach outlined by Arksey and O'Malley [27], in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) (online supplemental appendix 1) [28]. This study did not meet the eligibility requirements for registration using PROSPERO. The research questions were as follows: What theories, models, and frameworks have been used to understand the barriers to the provision of MATs for people with mobility issues? What are the determinants of access to MATs for people with mobility issues? What are the current knowledge gaps in access to MATs for people with mobility issues?

Eligibility criteria

The Behaviour of Interest, Health Context, Exclusion, Models, or Theories (BeHEMoTH) framework [29] was employed to formulate the search concepts (Table 1) and eligibility criteria (Table 2).

Table 1 Application of the BeHEMoTH framework to define search concepts

BeHEMoTH	Concept
Be – Behaviour of interest:	Barriers to access or provision
H – Health context	People with mobility issues AND MATs
E – Exclusions	NA
MoTh – Models or Theories	Models or Theories or Frameworks

Table 2 Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria	Rationale
Publications reporting on the barriers to the provision of MATs	Publication concentrates on aspects other than barriers to	This review focuses on understanding barriers to the provision of MATs

	access, and there is no report on barriers	
Publications including at least a theory, model, or framework	Publications that did not employ a theory, model, or framework	To ensure that the articles concentrate on theory, model, or framework to understand the barriers
Publications in peer-reviewed journals	Other publications such as conference abstracts and theses	To ensure that studies had undergone rigorous evaluation
Publications published in the English language	Publications in other languages	Costs and time commitment associated with article translation
Publications between 2000 and 2023	Publication published before 2000	To ensure using the most relevant publications from the previous 23 years

Information sources and Searches

Literature searches were performed by (AA) on MEDLINE (Ovid), EMBASE (Ovid), CINAHL (EBSCO), and SCOPUS databases for studies published between 1 January 2000 and 15 June 2023. To identify the appropriate publications relevant to the research issue, a *priori* search strategy was established in collaboration with the authors (AA and DH) and an information specialist (FZ). The search terms combined the concepts of 'barriers to provision, mobility issues, AND 'MATs', and a theory/model/framework'. Free text terms, subject heading, use of the Boolean operators "AND" and "OR", and truncation were all used to ensure a successful search. The final search strategy was tested on MEDLINE via Ovid, and then translated into other databases. The full search strategy and results are presented in online supplemental appendix 2. We reviewed the reference lists of the included articles to identify additional relevant articles [27] but restricted the eligibility to peer-reviewed studies, excluding grey literature.

Study selection

The Rayyan platform (https://www.rayaan.ai) was used for study selection. Initial title and abstract screening were conducted by (AA), where the primary aim was to assess studies for potential relevance based on predefined inclusion and exclusion criteria. Given the subjective nature of this assessment, any uncertainties regarding study eligibility encountered by AA were systematically discussed with the other reviewers (DH, SR, and BF). Full-text screening involved consistent discussions among (AA, DH, SR, and BF), and the full texts of eligible articles were subsequently retrieved for a more detailed assessment.

Data charting process

To facilitate consistent data presentation and synthesis, we charted general and study-specific information from the studies in Microsoft Excel spreadsheets. Data items included country of origin, study population, aims, sample size, study design, data collection tool, TMF used, a brief description of its purpose, research recommendations, and key findings related to barriers to the provision of MATs. We extracted theoretical propositions from the TMFs, as discussed in the articles included in our review. In instances in which these articles did not provide a comprehensive explanation of TMFs, such as Gibson's affordances theory, the IMPACT^2 model, and the HAAT model, we referred to the foundational sources. The sources cited within the included articles are original materials in which TMFs were first introduced or explained thoroughly. This ensured that our understanding and coverage of TMFs was comprehensive, especially when the application of these TMFs in the reviewed articles lacked depth. Although these foundational sources were not directly included in our review as they did not meet our inclusion criteria, they were consulted for additional insights. We mapped the reported barriers to one of the updated constructs of the Consolidated Framework for Implementation Research (CFIR), a synthetic framework of constructs used in 19 implementation theories [30,31], using a codebook (https://cfirguide.org/). The CFIR provides a set of standardised constructs to guide researchers, creating a common language for explicitly and consistently describing aspects that may affect the provision [32].

Synthesis of results

Tabular summaries and narrative syntheses were completed for the included articles and their TMFs [33]. We conducted a theoretical synthesis to generate new insights that were unavailable for any TMF [34]. The synthesis was guided by Turner's [35] approach. In Step 1, the TMFs are summarised, and their shared themes are identified. In Step 2, the aspects of the TMF that pertain to core concepts by extracting the phrases used, their definitions, and their explicit and implicit relationships are identified. In Step 3, the TMFs are broken into simple propositions that can be compared and tabulated. In Step 4, the theories are compared and determined how they converge or diverge by combining similar elements. In Step 5, the convergent elements from the TMF are combined into a single conceptual model that focuses on the relationships between concepts. For example, during this stage, we examined how concepts from these TMFs—such as cost, services, and activity (mobility)—interacted and influenced each other within the synthesised theory to gain theoretical insight. We incorporated statements from the studies included in this review to strengthen the synthesis and support the resulting conceptual model (Step 6).

Gaps analysis

To identify knowledge gaps and areas for future research, we reviewed papers and tabulated explicit recommendations, which is a core function of scoping reviews [26].

Patients and public involvement

No patients or public were involved in the study.

RESULTS

Characteristics of the studies

The literature search yielded 291 citations after the removal of duplicates. A total of 235 citations were excluded after initial screening, and 56 potentially eligible articles were retrieved for full-text review. Of these, 42 were excluded because barriers were not reported (*n* =9), TMFs were not reported (*n*=25), and the citations were conference abstracts (*n*=7) or theses (*n*=1). Fourteen studies identified from the databases met all the eligibility criteria. After reviewing the reference lists and conducting manual searches, 24 additional studies were identified and examined for eligibility, and three studies were determined to be eligible (Figure 1) [36].

Figure 1 PRISMA flow diagram.

The final synthesis included 17 articles (online supplemental appendix 3) [21,22,37–51]. Eight studies addressed the challenges associated with the provision and use of MATs [21,22,37,38,41,43,46,48,49]. Four studies examined environmental barriers to participation [39,44,47,50,51]. Two studies explored the experiences of patients and caregivers and their rehabilitation needs [42,45]. One study drew attention to inconsistencies in AT provision schemes [40]. There were (*n*=5) secondary studies and (*n*= 12) primary research studies conducted between 2012 and 2023 in South Africa [48], Mongolia [47], Canada, India [45], Australia [37,40], Malaysia [43], New Zealand [39], Uganda [46], Brazil [42], United States [41], Sweden [21,44], Tanzania [50], Canada, and the United States [38]. The primary studies contained between one and 318 participants.

Seven TMFs, representing various perspectives, were identified. Two were biopsychosocial in orientation: the ICF [16] and HAAT [19], which focused on AT. Two other models that focus on AT are IMPACT^2 [20] and MPT [21]. Three other identified TMFs were applied to AT access: Levesque's theoretical framework [15], Gibson's affordances theory [24], and the SDM [52]. The most frequently used TMF was ICF (*n* = 12). All included studies applied one TMF, except for one [40], which used two in combination: ICF and IMPACT^2. There are three distinct applications of TMFs, as shown in Figure 2. The majority were used as a basis for analysis and interpretation (*n* = 12) or as a guide for designing the surveys and interviews (*n* = 2). In addition, TMFs were used as a comprehensive framework to provide a context for reviewing the relevant literature (*n* = 3).

Figure 2 Theories, models, frameworks, and their purpose of application in eligible studies.

Barriers to MATs provision synthesised using CFIR

The key barriers in the innovation domain are cost concerns [22,37–41,43,45,47,48], intervention complexity [22,38,44,46], inadequate evidence of effectiveness [40,41], product-related factors such as comfort, durability, and fit [51]; and limited models and colour choices available [21] (Figure 3). The outer-setting domain highlights societal attitudes toward AT [21,46,47,49,51], geographic distance [40,42,48], a lack of supportive legislation [22,38,44,46,47,49,50], and environmental barriers [21,51]. Within the inner-setting domain, resource constraints [22,41,42,46,48], restricted knowledge, and information access hinder provision [22,37,38,41,46,49]. The characteristics of the individuals' domains revealed knowledge about the intervention [22,46,47,49] and low self-efficacy among healthcare professionals [41,48] as barriers to its adoption. In addition, within the

characteristics of individual domains, barriers include limited information access [37–39,42,44,48], lack of awareness among users [48,49], and insufficient inclusion of user preferences in prescriptions [21]. In the process domain, barriers include insufficient stakeholder engagement [38,41,49], absence of interdisciplinary standards [41], and limited strategic planning [38].

Figure 3 Barriers to the provision of MATs synthesised using the CFIR.

Theories, Models and Frameworks (TMF) Synthesis

The propositions derived from the theories, models, and frameworks are described in Supplemental Appendix 4, and the resulting synthetic model is presented in Figure 4.

Figure 4 Synthetic model.

Proposition 1: mobility is essential for human flourishing

The ICF framework highlights activity as a key component of health, with disabilities resulting from restricted activities, such as mobility issues [16]. This affects participation in everyday activities, such as work, socialisation, and healthcare access [16]. The HAAT model explains a similar concept, describing the 'activity' as the action of performing a task that represents the functional outcome of human performance [19]. Building on these insights, 'mobility' is viewed as an individual's ability to perform tasks that enable meaningful participation. The HAAT model and IMPACT^2 emphasise the importance of participation in everyday activities, such as working and socialising, for overall health [19,20], describing it as "necessary to human existence"[19]. According to the HAAT model, humans are defined based on their intrinsic physical, cognitive, and emotional abilities [19]. Accordingly, mobility is viewed more as a necessary means of meaningful participation than an end to the development of physical, cognitive, and psychosocial skills throughout life [37,45].

Proposition 2: health conditions and personal factors influence mobility

An individual's mobility is influenced by health and personal factors, which, in turn, affect their participation in social, work, and leisure activities. For example, the ICF framework clearly describes how health issues and personal factors can affect activities and participation [16] and describes health conditions as umbrella terms for diseases, disorders, injuries, or trauma [16]. Similarly, the HAAT model highlights the impact of a person's physical and cognitive abilities and personal elements, such as emotional and psychological factors, on their ability to perform activities [46]. Accordingly, 'personal factors' that encompass elements, such as psychological attributes, age, and coping style influence an individual's ability to perform activities [16]. For example, Dwyer and Mulligan [39] highlighted how emotional changes caused by spinal cord injury (SCI) could impede participation in rehabilitation services and other areas of reintegration, such as employment and leisure activities.

Proposition 3: appropriate services influence mobility

The ICF and HAAT models explicitly describe the relationships between the activities and their environments. Both emphasise the importance of activities for participating in and developing in life, and some interventions can improve a person's ability to engage in the desired activities [16,19]. For

instance, in the ICF framework, AT services are considered to be an environmental factor, which is appropriate for helping individuals achieve their intended activities and participate in various situations [16]. Similarly, the MPT model proposes that AT acts as an essential means of bridging the gap between an individual's capabilities and the demands of tasks in their environment, thereby significantly enhancing their engagement in the desired activities [21]. Levesque's framework identifies that 'the appropriateness of a service' is determined by its alignment with the needs of the client, whereas the HAAT and MPT models emphasise that with AT, an individual's capabilities are increased [15,19,21]. Consequently, to meet individual needs and maximise capabilities, we define the appropriateness of services based on the extent to which they are tailored. This demonstrates that MATs are vital for people with disabilities and for older people who require them, thus enhancing their independence and participation in daily life [37,45].

Proposition 4: service delivery must be comprehensive to influence human mobility

Institutional factors significantly influence individual activities, as explained by the HAAT model [19] and ICF frameworks [16]. Levesque's framework emphasises the importance of how services are provided to meet client needs [15]. Similarly, the IMPACT^2 model is concerned with providing services and ensuring that outcomes are met, including QOL, participation, and satisfaction with the services provided [20]. The MPT model demonstrates that user satisfaction with service provision can be achieved by considering key features of products such as usability, quality, weight, stability, and safety [21]. Accordingly, the concept of 'comprehensive services' refers to providing clients with high-quality products and the necessary support services to meet their needs and achieve satisfaction. Providing comprehensive services encompassing assessment, training, and maintenance is crucial for enhancing personal mobility [22,38]. Effective delivery of AT services requires well-trained personnel [22]. These are critical components of service delivery systems that help individuals enhance their mobility.

Proposition 5: environmental factors influence individuals' decision to seek appropriate health care services

Assistive products for mobility and participation are influenced by environmental factors such as social, cultural, and physical environments, which affect individuals' health and well-being. The ICF framework views disability as a health experience arising from context and not solely within an individual [16]. It emphasises how society can create barriers such as inaccessible services or neglected facilitators, such as the lack of AT [16]. Furthermore, an individual's level of functioning is determined by their relationships with family, people, and healthcare providers, all of which can influence their decision to seek healthcare [16]. A similar concept of how society affects activities is highlighted by the HAAT model, which places particular emphasis on an individual's cultural context [19]. The MPT model also emphasises the role of sociocultural factors, acknowledging how a user's social setting and cultural attitudes towards disability can influence their perception of and adoption of mobility products. This includes consideration of product-related social implications and stigmas [21]. For example, parents of children with disabilities oppose wheelchairs because of social stigma [45], and some older people perceive mobility products negatively because of stigmatising symbolism [49]. This demonstrates the significant influence of sociocultural factors, such as support and relationships from family, health professionals, and community on MAT accessibility and acceptance.

Furthermore, the MPT model emphasises the importance of the physical environment, which includes both the built environment within the user's home and the external surroundings, in affecting use and acceptance [21]. For example, if a wheelchair does not fit the physical and psychosocial environment in which it is used, it is more likely to limit function rather than enhance it [21]. Therefore, the success of MAT is not measured solely by its technical features but also by its ability to fit into the user's psychosocial context [21].

Proposition 6: policies influence the provision of services

The SDM framework highlights how organisational service delivery policies influence appropriate service provision [52], whereas the ICF explains how policies affect participation and activities [16]. As part of the ICF, the term 'policy' is commonly used within the environmental factor domain as an external factor that can impact an individual's health and function [16]. This set of guidelines, rules, and regulations governs the range of services provided to individuals, including policies and standards that define the eligibility criteria for services [45]. For instance, prostheses are not considered to be life-saving medical devices or crucial components of the healthcare system [42]. However, they are life-changing for users and can quickly restore most functions [42]. Levesque's framework argues that the availability of health services implies that those in need can access either the physical space or healthcare personnel [15]. Therefore, individuals cannot access healthcare if it is unavailable in their geographic areas or if insurance does not cover their treatment [15]. This can prevent individuals from receiving the required healthcare, which can adversely affect their health. Disparities between government and institutional policies can result in confusion among AT providers and decrease service utilisation [22,46].

Proposition 7: cost influences the provision of appropriate services

The SDM framework [52] highlights the significant influence of economic factors on service delivery and reinforces the idea that costs can significantly influence access to healthcare services. The term ‘cost’ refers to the expenses incurred by individuals and healthcare systems to provide services [15,20]. This comprises the direct prices of services such as consultation fees, product costs, and related expenses [15]. For instance, the IMPACT^2 model underlines the role of cost implications in selecting intervention approaches and demonstrating the cost effects at each stage of AT provision [20]. According to Levesque et al. [15], an individual’s ability to generate economic resources such as income is critical. Therefore, costs can play a significant role in determining AT use and access.

Proposition 8: personal factors influence healthcare utilisation

Healthcare utilisation is influenced by various 'personal factors’ that represent an individual’s internal aspects, such as psychological characteristics [16]. This concept is explained using Levesque’s framework. It highlights factors such as an individual's need for care, awareness of these needs, and desire for treatment [15]. Gibson's affordance theory suggests that an individual's perception of their environment is based on its potential to fulfil their needs, thereby shaping their decisions [24]. Therefore, the individual is responsible for unravelling the utility presented by affordance. For instance, the client in Mairami et al. [43] adapted a chair from a home to a wheelchair. This demonstrates how the client's perception of their environment shaped their recovery when an existing structure was found to have assistive potential. The ICF model explains the significance of

environmental factors, such as the visibility of services, in determining an individual's level of functioning [16], which is related to Gibson's affordance theory, in which environmental cues trigger actions [24]. Consequently, the lack of service limits the activities that can be conducted. Personal factors not classified within the ICF are acknowledged to have a significant impact on healthcare access [16]. The MPT model highlights that the choice of assistive products is deeply personal and shaped by individual aspirations, anticipated satisfaction of needs, and perceived personal value of these products [21]. These elements play a crucial role in influencing the uptake of MATs, as they are associated with the context of users' lives [21].

Proposition 9: limited access to healthcare services creates disability

The ICF acknowledges the influence of environmental factors on disability development and emphasises the limitations it imposes on individuals' abilities to access healthcare services and engage in social activities [16]. As defined by the ICF, disabilities include impairments, limitations in activity levels, and restrictions on participation [16]. Consequently, restricted AT accessibility impairs body function, hinders participation, and contributes to disabilities. The SDM framework explains the significance of economic factors, particularly the "lack of economic means", which limit access to services such as MAT [52]. Restricted access can trigger continuous cycles of disabilities and poverty [22]. Persistent mobility constraints, whether due to inadequate MAT service support or diminished participation in daily life, have been identified as significant factors leading to disability [46,47].

Gaps analysis

This review highlights key research areas in AT services that warrant further investigation (online supplemental appendix 5). Investigations should focus on AT access in remote regions [37,45,48]; stakeholder perspectives concerning rehabilitation services and AT access barriers [46,48,50]; and funding, policy, and legislation challenges [21,22,39,41,43,47,50]. Data collection and methodological enhancements are required, including standardised instruments for assessing functioning and disability [42,44], comparisons of user experiences with and without AT [38,40], and comprehensive evaluation tools combining objective and subjective measures [38,40]. Emphasis should also be placed on understanding the in-country perspectives, inclusive solutions, and the impact of contextual factors on AT access [22]. This involves evaluating how new products impact workplace settings and determining which types of AT are essential [21]. Future studies should examine product compatibility, enhance user skills, and improve accessibility to the built environment [51]. Addressing these research gaps could contribute to the development of more effective, inclusive, and accessible AT services for individuals with disabilities.

DISCUSSION

This scoping review offers a summary of the barriers to MAT provision and synthesis theories to guide future work based on 17 articles. The synthesised theory emphasises that mobility is essential for human flourishing (Proposition 1) and that certain health conditions may impose restrictions on mobility (Proposition 2). This impact can be ameliorated by two direct determinants: the provision of suitable services (Proposition 3) and their comprehensive provision (Proposition 4). Policies (Proposition 6) and costs (Proposition 7) indirectly influence these services. Furthermore, an individual's decision to access these services is determined by their environment (Proposition 5) and

personal factors (Proposition 8). If these direct and indirect determinants are not effectively addressed, it could result in limited access to MATs and subsequent disability (Proposition 9). This synthesised theory integrates empirical and ethical dimensions and provides evidence-based approaches to solving problems [17].

To the best of our knowledge, this is the first report on the synthesis of TMFs and the barriers to MAT provision. Although De Alves and Matsukura's [53] literature review outlined the various theoretical models used in the AT literature, they did not attempt theoretical synthesis. TMFs organise concepts and thoughts to provide insights into different elements of practice and research [13]. Lakatos proposes that scientific enquiry should appraise a series of theories rather than a single theory, noting that "the members of such series of theories are usually connected by a remarkable continuity which welds them into research programmes" [54]. Lakatos advocated for a 'pluralistic model' of scientific theories, in which several theories, which are organised deductively to varying degrees, are brought together in a unified approach [54]. Unlike Lakatos, we view this study as an enhancement of problem-solving effectiveness [55]. By combining propositions from different theories, we increased the coverage of the resulting syntheses of individual theories. It should predict the range of barriers encountered in MAT access and provision.

The theory covers a socially significant issue given that it addresses the current research priorities identified by expert panels organised by government agencies and clinical speciality organisations [7,56–58]. It addresses the phenomenon of interest to rehabilitation scholars by filling the gaps in the existing TMFs. An adequate specification was achieved by providing a clear and concise overview of the theoretical synthesis. In addition, we establish linkage adequacy by defining the concepts and their relationships [59]. The theory is testable because it contains observable concepts and propositions that can be operationalised and corroborated in empirical research. A limitation of the scoping review was the exclusion of non-English language studies, which could limit the applicability of the findings; research from other languages could have offered additional valuable insights [60]. Another limitation is that the review's focus on studies from 2000 to 2023 potentially omitted earlier relevant research on barriers and TMF. However, a broader historical scope may have reduced the relevance of the findings to contemporary decision-making in the provision of AT. The exclusion of grey literature, including government reports and policy documents, further narrowed the scope of the review. This exclusion may have resulted in the omission of relevant non-peer-reviewed TMFs. In addition, the processes of data extraction, coding using CFIR, and synthesis inherently involve subjectivity. Search terms such as 'service delivery,' 'service*,' 'deliver*,' and additional or alternative terms for older people, such as 'older person*' or 'older adult*,' may have identified additional studies.

The insights from this review and the resulting integrated model have the potential to influence clinical practice and policymaking in line with the ethical imperatives outlined by the WHO and the UN [7,11]. These organisations have emphasised the necessity of AT to meet individual needs and enable equitable opportunities for people with disabilities. The synthesised theory aligns with the principles of access to AT as advocated by the WHO and UNICEF, highlighting the necessity for assistive products and services to be reachable, affordable, adaptable to individual needs and environments, culturally appropriate, and of high quality. By addressing the direct and indirect determinants of access, as identified in the theory, including service provision, policies, costs, physical, social, cultural factors, and personal preferences, we can align better with these global principles [7]. Therefore, this review proposes a theoretical basis for reforming the existing system to align it with international standards, thus addressing the pressing and unmet needs more equitably and personally. To achieve this, future research must examine these determinants, understand the barriers to MAT provision, and plan and evaluate strategies to enhance its provision. Having a set of

determinants organised around the CFIR [31] allows the creation of local implementation strategies to suit different policy jurisdictions.

There is a consensus [61,62] and evidence-based approach [63] to overcome the barriers to effective AT provision found in this review. The barriers identified by the CFIR can be linked to Expert Recommendations for Implementing Change (ERIC) strategies [64]. These strategies guide the selection of implementation methods to mitigate barriers and include (1) activating local clinical leaders or champions, (2) providing educational materials, (3) organising meetings, and (4) implementing outreach or ongoing training. The implementation of these strategies can assist decision-makers in making informed choices regarding the selection of strategies for MAT provision.

CONCLUSION

The synthesised theory emphasises that mobility is a crucial aspect of human life and certain health conditions may restrict mobility. Providing comprehensive and appropriate services can reduce this impact; however, cost and policy decisions regarding these services affect their provision. Accessibility to these services is also affected by environmental and personal factors. This knowledge can be used to develop strategies to enhance provision.

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CONTRIBUTORS

All authors contributed to the conceptualisation and design of the study. Initial title and abstract screening were conducted by AA, with regular consultations with DH, SR, and BF. AA performed the data extraction independently, with regular discussions with DH, SR, and BF. The initial data synthesis was conducted by AA and refined by DH, SR, and BF. The manuscript was drafted by AA, and major revisions were made by DH, SR, and BF. All the authors (AA, DH, SR, and BF) have read and approved the final manuscript.

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COMPETING INTERESTS

The authors report there are no competing interests to declare.

DATA AVAILABILITY STATEMENT

The authors confirm that the data supporting the findings of this study are available in the article and supplementary materials.

RIGHTS RETENTION STATEMENT

SUPPORTING MATERIALS

Appendix 1, Checklist. Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR)
Appendix 2, Table. Systematic search conducted in MEDLINE, EMBASE, CINAHL, and SCOPUS
Appendix 3, Table. Characteristics of included papers
Appendix 4, Table. Propositions derived from the theories, models, and frameworks
Appendix 5, Table. Gaps analysis

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Ethical approval was not required for this scoping review. The dissemination plan includes publishing in peer-reviewed journals and presenting at academic conferences.

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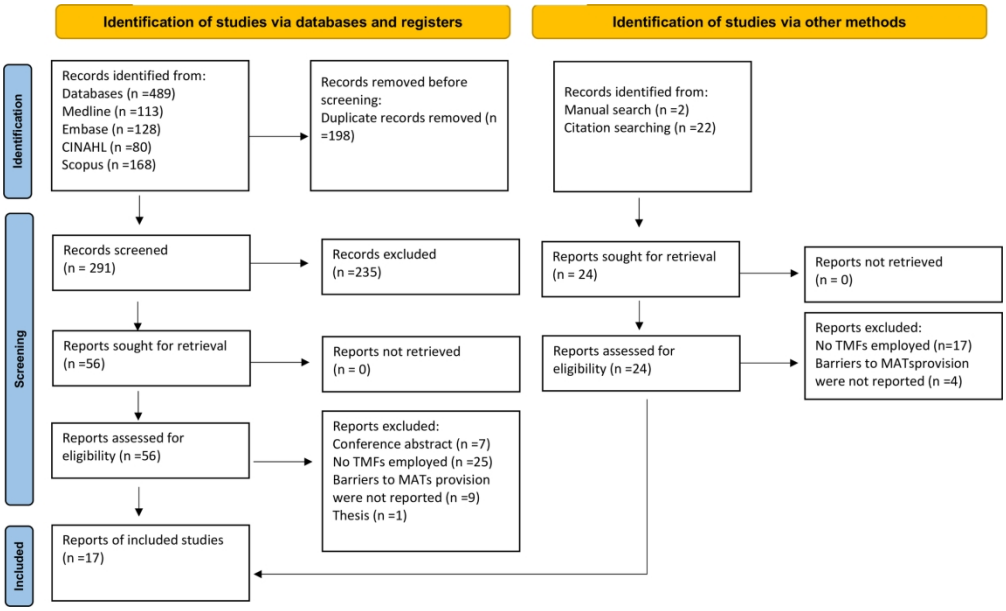

Figure 1 PRISMA flow diagram

190x114mm (300 x 300 DPI)

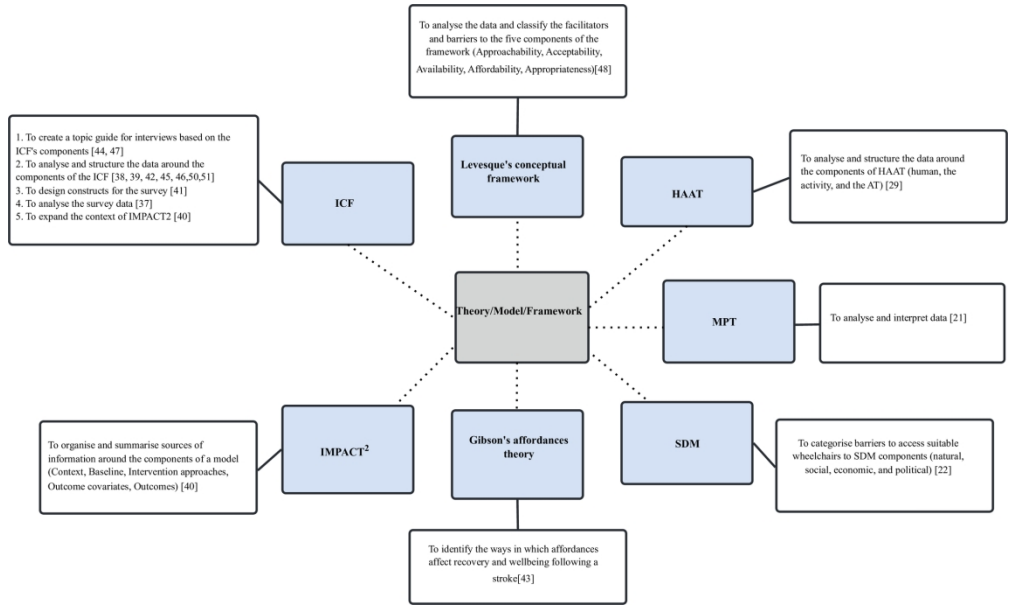

Figure 2 Theories, models, frameworks, and their purpose of application in eligible studies

190x114mm (300 x 300 DPI)

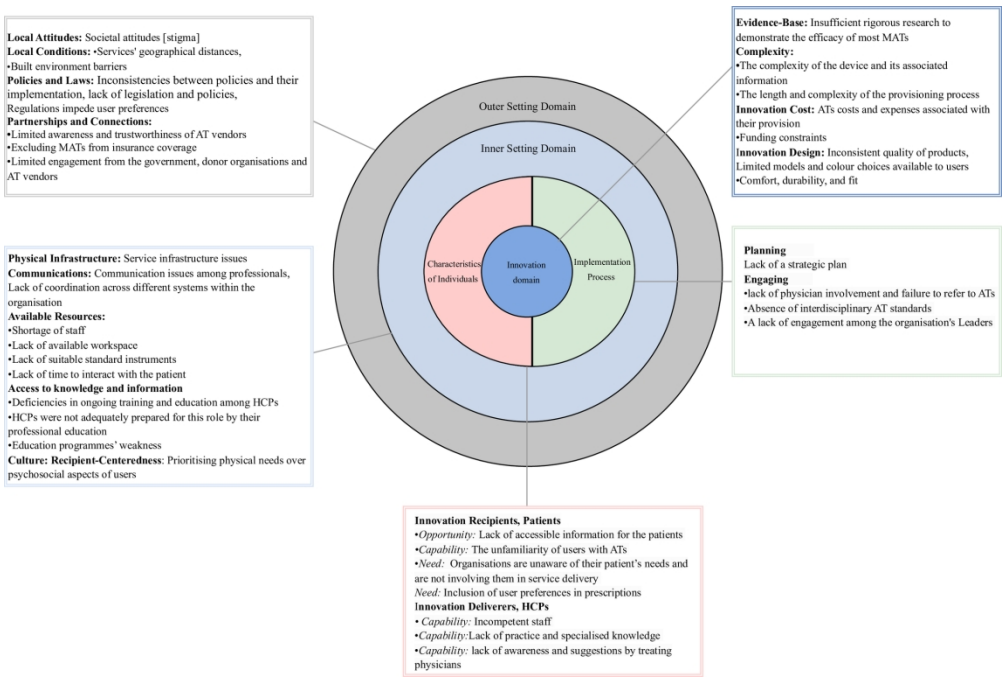

Figure 3 Barriers to the provision of MATs synthesised using the CFIR

190x127mm (300 x 300 DPI)

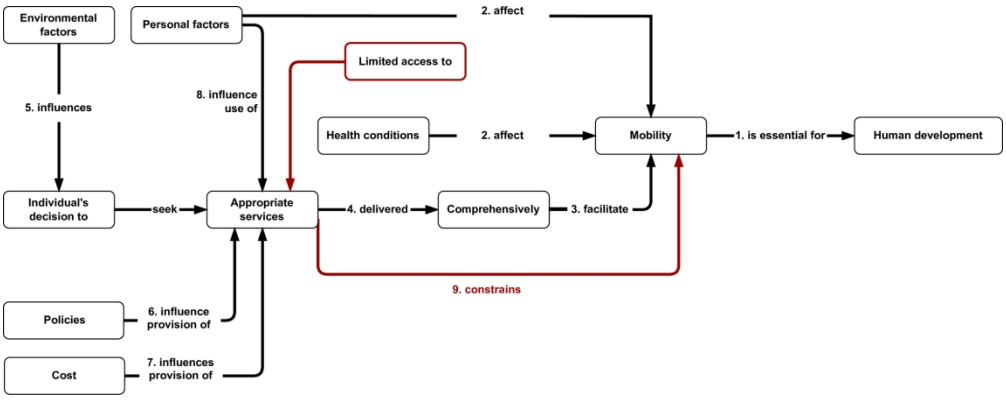

Figure 4 Synthetic model

190x74mm (300 x 300 DPI)

Theories, models and frameworks to understand barriers to the provision of mobility assistive technologies: A scoping review

Appendix 1. Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
TITLE			
Title	1	Identify the report as a scoping review.	#1
ABSTRACT			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	#2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	#4-5
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	#5
METHODS			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	#5 (not registered)
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	#5-6
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	#6
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	Appendix 1.
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	#6
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	#6
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	#6

Theories, models and frameworks to understand barriers to the provision of mobility assistive technologies: A scoping review

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	NA
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	#6
RESULTS			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	#7
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	#7-8 and Appendix 3
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	NA
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	#7-8, Figure2,3, Appendix 3
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	#8-12
DISCUSSION			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	#12
Limitations	20	Discuss the limitations of the scoping review process.	#13
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	#13-14
FUNDING			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	#14

JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.

* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.

† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).

‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.

§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that

Theories, models and frameworks to understand barriers to the provision of mobility assistive technologies: A scoping review

may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

From: Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMAScR): Checklist and Explanation. Ann Intern Med. 2018;169:467–473. doi: 10.7326/M18-0850

Appendix 2. Systematic search conducted in MEDLINE, EMBASE and CINAHL, SCOPUS

Database(s): **Ovid MEDLINE(R)** Search Strategy:

#	Query	Results from 25 Jan 2024
1	(Access* adj10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)).ab,ti.	64,598
2	(Provision* adj10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)).ab,ti.	7,907
3	(Provide* adj10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)).ab,ti.	104,059
4	(Adoption* adj10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)).ab,ti.	7,541
5	Wheelchairs/	5,496
6	Orthotic Devices/	6,985
7	Exoskeleton Device/	1,592
8	Mobility device*.ab,ti.	536
9	Mobility technolog*.ab,ti.	51
10	Wheelchair*.ab,ti.	8,831
11	Scooter*.ab,ti.	840
12	Walker*.ab,ti.	15,385
13	Prosthetic*.ab,ti.	64,198
14	prosthesis/	50,184
15	orthotic*.ab,ti.	3,738
16	Self-Help Devices/	5,821
17	Exoskeleton*.ab,ti.	4,672
18	Orthos*.ab,ti.	26,208
19	power mobility.ab,ti.	133
20	Prosthe* device*.ab,ti.	2,414
21	(Assistive technolog* adj10 mobility).ab,ti.	134
22	(Assistive device* adj10 mobility).ab,ti.	211
23	assistive product*.ab,ti.	107
24	mobility product*.ab,ti.	24
25	Disabled Persons/	48,333
26	Mobility Limitation/	5,302
27	Elder*.ti,ab.	309,362
28	Physical* Disable*.ab,ti.	946
29	Disable*.ab,ti.	29,513
30	Disabilit*.ab,ti.	248,032
31	Walking difficult*.ab,ti.	676
32	Handicap*.ab,ti.	25,939
33	physical* impair*.ab,ti.	3,179
34	physical* Challeng*.ab,ti.	693
35	Ambulat* Difficult*.ab,ti.	88
36	Mobility difficult*.ab,ti.	248

37	Mobility impair*.ab,ti.	1,375
38	Mobility limit*.ab,ti.	1,475
39	Amput*.ab,ti.	53,720
40	Motor difficult*.ab,ti.	538
41	Amputation/	24,036
42	Geriatrics/	31,564
43	(theor* or framework* or model* or taxonom* or classifi* or concept*).ab,ti.	5,792,006
44	(Matching Person and Technology).ab,ti.	22
45	(("abandonment" or "discontinuance") and "model").ab,ti.	652
46	43 or 44 or 45	5,792,010
47	1 or 2 or 3 or 4	176,120
48	25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42	693,119
49	44 or 45	672
50	5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24	177,267
51	46 and 47 and 48 and 50	125
52	limit 51 to english language	119
53	limit 52 to dt=20000101-20230615	**113**
54	23 or 24	131
55	43 and 47 and 48 and 54	7
56	limit 55 to english language	7
57	limit 56 to dt=20000101-20230615	6
58	44 or 45	672
59	47 and 48 and 50 and 58	1
60	limit 59 to english language	1
61	limit 60 to dt=20000101-20230615	1

Database(s): **Ovid Embase** Search Strategy:

#	Query	Results from 25 Jan 2024
1	(Access* adj10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)).ab,ti.	87,961
2	(Provision* adj10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)).ab,ti.	10,436
3	(Provide* adj10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)).ab,ti.	130,869
4	(Adoption* adj10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)).ab,ti.	8,868
5	Wheelchairs/	11,328
6	Orthotic Devices/	7,401
7	Exoskeleton Device/	1,439
8	Mobility device*.ab,ti.	651
9	Mobility technolog*.ab,ti.	60
10	Wheelchair*.ab,ti.	13,334
11	Scooter*.ab,ti.	1,019
12	Walker*.ab,ti.	17,951
13	Prosthetic*.ab,ti.	76,782
14	prosthesis/	34,110
15	orthotic*.ab,ti.	5,397
16	Self-Help Devices/	2,991
17	Exoskeleton*.ab,ti.	5,220
18	Orthos*.ab,ti.	36,392
19	power mobility.ab,ti.	164
20	Prosthe* device*.ab,ti.	2,827
21	(Assistive technolog* adj10 mobility).ab,ti.	167
22	(Assistive device* adj10 mobility).ab,ti.	304
23	assistive product*.ab,ti.	116
24	mobility product*.ab,ti.	24
25	Disabled Persons/	31,702
26	Mobility Limitation/	14,782
27	Elder*.ti,ab.	438,514
28	Physical* Disable*.ab,ti.	1,216
29	Disable*.ab,ti.	38,359
30	Disabilit*.ab,ti.	351,478
31	Walking difficult*.ab,ti.	1,256
32	Handicap*.ab,ti.	31,675
33	physical* impair*.ab,ti.	4,519
34	physical* Challeng*.ab,ti.	964
35	Ambulat* Difficult*.ab,ti.	133
36	Mobility difficult*.ab,ti.	341
37	Mobility impair*.ab,ti.	1,840
38	Mobility limit*.ab,ti.	1,960
39	Amput*.ab,ti.	67,426
40	Motor difficult*.ab,ti.	753

41	Amputation/	26,615
42	Geriatrics/	34,445
43	(theor* or framework* or model* or taxonom* or classifi* or concept*).ab,ti.	7,145,078
44	(Matching Person and Technology).ab,ti.	32
45	(("abandonment" or "discontinuance") and "model").ab,ti.	807
46	43 or 44 or 45	7,145,085
47	5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24	160,676
48	25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42	945,466
49	1 or 2 or 3 or 4	227,351
50	47 and 48 and 49	511
51	46 and 50	138
52	limit 51 to english language	135
53	limit 52 to dc=20000101-20230615	**128**
54	44 or 45	837
55	47 and 48 and 49 and 54	0
56	23 or 24	140
57	43 and 48 and 49 and 56	13
58	limit 57 to english language	13
59	limit 58 to dc=20000101-20230615	13

Database(s): **EBSCO CINAHL** Search Strategy:

#	Query	Results January 25, 2024
S54	S46 AND S47 AND S48 AND S53	0
S53	S44 OR S45	228
S52	S46 AND S48 AND S51 AND S43 Limiters - Publication Date: 20000101-20230631; Language: English	3
S51	S23 OR S24	83
S50	S49 AND EM 20000101-20230620	**79**
S49	S46 AND S47 AND S48 AND S43 Limiters - Language: English	83
S48	S25 OR S26 OR S27 OR S28 OR S29 OR S30 OR S31 OR S32 OR S33 OR S34 OR S35 OR S36 OR S37 OR S38 OR S39 OR S40 OR S41 OR S42	301,747
S47	S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21 OR S22 OR S23 OR S24	43,351
S46	S1 OR S2 OR S3 OR S4	76,486
S45	TI (("abandonment" or "discontinuance") and "model") OR AB (("abandonment" or "discontinuance") and "model")	208
S44	TI "Matching Person and Technology" OR AB "Matching Person and Technology"	22
S43	TI (theor* OR framework* OR model* OR taxonom* OR classifi* OR concept*) OR AB (theor* OR framework* OR model* OR taxonom* OR classifi* OR concept*)	1,078,845
S42	(MH "Geriatrics")	6,037
S41	(MH "Amputation")	7,602
S40	TI "Motor difficult*" OR AB "Motor difficult*"	243
S39	TI Amput* OR AB Amput*	15,295
S38	TI "Mobility limit*" OR AB "Mobility limit*"	972
S37	TI "Mobility impair*" OR AB "Mobility impair*"	820
S36	TI "Mobility difficult*" OR AB "Mobility difficult*"	170
S35	TI "Ambulat* Difficult*" OR AB "Ambulat* Difficult*"	28
S34	TI "physical* Challeng*" OR AB "physical* Challeng*"	422
S33	TI "physical* impair*" OR AB "physical* impair*"	1,749
S32	TI Handicap* OR AB Handicap*	6,519
S31	TI "Walking difficult*" OR AB "Walking difficult*"	242
S30	TI Disabilit* OR AB Disabilit*	133,132
S29	TI Disable* OR AB Disable*	13,792
S28	TI "Physical* Disable*" OR AB "Physical* Disable*"	466
S27	TI Elder* OR AB Elder*	116,611
S26	(MH "Physical Mobility")	7,634
S25	(MH "Persons with Disabilities")	37,272
S24	TI "mobility product*" OR AB "mobility product*"	13
S23	TI "assistive product*" OR AB "assistive product*"	70
S22	TI ("Assistive device*" n10 mobility) OR AB ("Assistive device*" n10 mobility)	151

S21	TI ("Assistive technolog*" n10 mobility) OR AB ("Assistive technolog*" n10 mobility)	136
S20	TI "Prosthet* device*" OR AB "Prosthet* device*"	428
S19	TI "power mobility" OR AB "power mobility"	147
S18	TI Orthose* OR AB Orthose*	2,518
S17	TI Exoskeleton* OR AB Exoskeleton*	837
S16	(MH "Assistive Technology Devices")	6,676
S15	TI orthotic* OR AB orthotic*	2,904
S14	(MH "Limb Prosthesis")	2,974
S13	TI Prosthetic* OR AB Prosthetic*	13,058
S12	TI Walker* OR AB Walker*	4,154
S11	TI Scooter* OR AB Scooter*	477
S10	TI Wheelchair* OR AB Wheelchair*	6,563
S9	TI "Mobility technolog*" OR AB "Mobility technolog*"	49
S8	TI (“Mobility device*”) OR AB (“Mobility device*”)	471
S7	(MH "Exoskeleton Devices")	320
S6	(MH "Orthoses")	7,168
S5	(MH "Wheelchairs")	5,113
S4	TI ((Adoption* n10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*))) OR AB ((Adoption* n10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)))	3,417
S3	TI (Provide* n10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*))) OR AB (Provide* n10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)))	42,436
S2	TI ((Provision* n10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*))) OR AB ((Provision* n10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)))	5,384
S1	TI ((Access* n10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*))) OR AB ((Access* n10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)))	30,413

Database(s): **Scopus** Search Strategy:

(((TITLE-ABS (access* W/10 (barrier* OR challeng* OR restrict* OR obstacle* OR impediment* OR difficult* OR issue*)))) OR ((TITLE-ABS (provision* W/10 (barrier* OR challeng* OR restrict* OR obstacle* OR impediment* OR difficult* OR issue*)))) OR ((TITLE-ABS (provide* W/10 (barrier* OR challeng* OR restrict* OR obstacle* OR impediment* OR difficult* OR issue*)))) OR ((TITLE-ABS (adoption* W/10 (barrier* OR challeng* OR restrict* OR obstacle* OR impediment* OR difficult* OR issue*))))) AND (TITLE-ABS ("Disabled Person*" OR "Mobility* Limitation*" OR elder* OR "Physically Disabled" OR disable* OR disabilit* OR "Walking difficult*" OR handicap* OR "physically impair*" OR "Physically Challeng*" OR "Ambulat* difficult*" OR "Mobility difficult*" OR "Mobility impair*" OR "Mobility limit*" OR "Amput*" OR "Motor difficult*" OR amputation*)) AND (TITLE-ABS (theor* OR framework* OR model* OR taxonom* OR classifi* OR concept* OR "Matching Person and Technology" OR (abandonment OR discontinuance AND model))) AND (TITLE-ABS (wheelchair* OR "power mobility*" OR "Mobility device*" OR "Mobility technolog*" OR ("Assistive technolog*" W/10 mobility) OR ("Assistive device*" W/10 mobility) OR orthotic* OR exoskeleton* OR scooter* OR walker* OR prosthet* OR orthos* OR prosthetic* OR "Prosthe* device*" OR orthotic* OR "mobility product*" OR "assistive product*")) AND PUBYEAR > 1999 AND PUBYEAR < 2024 AND (LIMIT-TO (LANGUAGE,"English"))

168 documents

Theories, models and frameworks to understand barriers to the provision of mobility assistive technologies: A scoping review

Appendix 3, Table. Characteristics of included papers

Authors and Year	Study design	Aims of the study	Population (n, characteristics	Country
McIntyre, Cleland and Ramklass (2021) [48]	Qualitative, Semi-structured interviews	To explore facilitators and barriers to accessible wheelchair services	11(8 occupational therapists and 3 physiotherapists)	South Africa
Dorjbal et al. (2020) [47]	Qualitative, Semi-structured interviews	To identify environmental barriers and their influence on daily life	16(SCI patients)	Mongolia
Jindal et al. (2018) [45]	Qualitative, Semi-structured interviews	To investigate parents' perceptions of rehabilitation and their information needs for their child with cerebral palsy (CP)	18 (parents of children with CP)	India and Canada
Bhidayasiri et al. (2022) [49]	Review article	To present clinical viewpoints on the unfulfilled needs of wearable technology, such as exoskeletons and orthoses	N/A	N/A
Layton (2012) [37]	Mixed method	To identify barriers and facilitators to optimal mobility from the perspective of AT users	100 (AT users. Neurological conditions)	Australia, Survey, Open-ended responses
Mairami et al. (2017) [43]	Qualitative, case study, Semi-	1. To illustrate how AT influences stroke recovery and how the	1(Stroke patient)	Malaysia

	structured interview	environment might be altered to facilitate recovery 2. To examine the issues of AT affordability and accessibility		
Dwyer and Mulligan (2015) [39]	Literature review	To determine the obstacles and enablers for community reintegration as experienced by individuals with SCI	A total of 373 participants in the 7 included studies	New Zealand
Seymour, Geiger and Scheffler (2019) [46]	Qualitative, Focus group	To identify the issues associated with wheelchair provision and the elements that contribute to or mitigate these challenges	21 (Community rehabilitation workers)	Uganda
Gonçalves Junior, Knabben and Luz (2017) [42]	Qualitative, Semi-structured interviews	To demonstrate how people with lower limb amputation function and express their limitations	6 (patients with amputation)	Brazil
Arthanat, Elsaesser and Bauer (2017) [41]	Quantitative, Survey	To explore how AT providers perceive their education and training, the use of evidence and guidelines, financing policies.	318 (AT providers)	US
Gowran et al. (2021) [22]	Position Paper	To examine the global challenges related to wheelchair accessibility	N/A	N/A
Steel and Layton (2016) [40]	Feature Article	An exploration of the complexities of AT provision in Australia	N/A	Australia
Widehammar et al. (2020) [44]	Qualitative, Semi-structured interviews	An exploration of how users' experiences of power mobility products	14(AT users)	Sweden

		are influenced by environmental factors		
Hammel et al. (2013) [38]	Qualitative, multiple case study, Focus groups	Multiple stakeholders' perspectives, issues, and priorities related to accessing, using, and evaluating MATs	65(45 AT users, 10 caregivers, 10 service providers)	USA and Canada
Serres-Lafontaine et al. (2023) [50]	Qualitative, photovoice method	To study how peer training affects social involvement	10 Wheelchair users (SCI patients)	Tanzania
Oskar et al. (2011) [21]	A postal questionnaire	To explore and assess the experiences of active wheelchair prescribers under the regulations and provisions set by local Swedish governments	278 prescribers	Sweden
Smith et al. (2016) [51]	Review article	To investigate the determinants influencing participation among wheelchair users	35 studies were included	N/A

Appendix 4 Table. Propositions identified in the theories, models and frameworks

Name of the theory, model or framework	Propositions
International Classification of Functioning, Disability, and Health (ICF)	1. A health condition can affect both the mental and physical body functions. 2. An individual's activities are impacted by their health condition. 3. Health conditions affect an individual's engagement in activities, determining their level of participation. 4. External factors, for example, social factors, can either inhibit or facilitate an individual's level of functioning. 5. Society may create barriers, for example, inaccessible services or lack of facilitators, such as the unavailability of AT, which can affect an individual's performance. 6. An individual's functioning is affected by the presence or absence of services, for example, equipment, products, and technologies in their environment.

7. External elements like systems and policies that regulate and facilitate the provision of services can impact a person's functional capacity.
8. An individual's level of functioning can also be influenced by external factors such as support and relationships, including family, people in positions of authority, and health professionals.
9. Personal factors of an individual represent their internal aspects, including psychological factors, that can affect their level of functioning.
10. Individuals' functioning and disabilities are influenced by their health status as well as contextual factors, such as environmental and personal factors.
11. Functioning is defined as encompassing body functions, body structures, activities, and participation.

	12. An impairment, an activity limitation, or a restriction on participation constitutes a disability.
Levesque's conceptual framework	1. The concept of approachability is related to the ability of individuals with health needs to recognise the existence of available services, access them, and receive effective healthcare that can improve their health. 2. Cultural and social factors determine the acceptability of health services within their context. 3. The reachability of health services depends on their physical presence and timeliness. 4. Factors like personal mobility, transportation availability, adaptability in occupation, and knowledge of accessible health services are interconnected and contribute to an individual's capacity to access healthcare providers physically.

5. The concept of affordability in healthcare refers to the ability of people to pay for services without causing undue financial hardship or affecting their ability to afford basic necessities.
6. The ability to afford healthcare services is connected to a person's financial resources, including income, savings, and borrowing capacity.
7. Appropriateness in healthcare refers to the fit between the services provided and the needs and preferences of clients, as well as the quality and safety of those services.
8. Engaging in healthcare involves the active participation of clients in decision-making and treatment planning, which helps to ensure that care is aligned with their goals and values.
9. Accessibility of health services is affected by the availability of information.

	10. Personal autonomy and the ability to choose care-seeking are linked to the ability to access health care.
The Human Activity Assistive Technology model (HAAT)	1. AT enhances an individual's capabilities to complete desired tasks. 2. Human activities are essential, learnable, and influenced by societal and cultural contexts. 3. The use of desired technology is influenced by human skills and abilities (physical, cognitive, emotional). 4. An individual's ability to perform activities is affected by their skills and abilities (physical, cognitive, emotional). 5. The use of AT to perform an activity is influenced by various factors in the environment, including physical, social, cultural, and institutional elements.

	6. Choosing and implementing the right AT requires considering the interaction between different elements, including the activity being performed, the user's needs and abilities, and the broader environmental context in which the technology will be used. 7. The process of performing an activity leads to a functional result of human performance.
Gibson's affordances theory	1. Cognition: Affordances exist as a cognitive process which comes through people and organisations interacting with material entities. 2. Perception: Affordances need to be perceived or recognised by the person or organisation. 3. Behaviour: the affordance is actualised as the behaviour that people/organisations adopt acting on the perceived opportunity for action.

	4. Evaluation: Evaluating the effects of this behaviour. 5. Environmental factors and structures can impact disabilities.
Systemic development model (SDM)	1. Understanding personal, organisational, and institutional capacity requires consideration of factors such as health, culture, economics, and politics. 2. It is crucial to provide appropriate services to improve the health, well-being, and fundamental freedoms of individuals in need. 3. Limited access to services can create a cycle of poverty and disability. 4. Service delivery systems that are tailored to specific contexts play a significant role in ensuring appropriate service provision. 5. Economic factors impact the availability of products and services

	and can affect the viability of service provision. 6. Evaluation of the quality, development, performance, and procurement standards of products is crucial for improving service delivery systems and individual health outcomes. 7. Political governance also plays a role in ensuring access to appropriate services.
Multi Intervention Paradigm for Assessment and Application of Concurrent Treatments (IMPACT^2)	1. The results of interventions can be outlined by examining the six phases, including: 1) Pre-Intervention, 2) Context, 3) Baseline, 4) Intervention Strategies, 5) Outcome Covariates, and 6) Outcomes. 2. Personal and contextual factors influence the products and services used by individuals to perform activities.

3. Universal design and health promotion are two methods that can be utilised to enhance functional performance.
4. The context in which AT is used to perform a task within an environment is crucial for improving participation and QoL.
5. Intervention approaches, such as reducing the impairment, compensating for the impairment, using AT, and redesigning the activity, are used to support the use of AT and optimise an individual's functioning.
6. Consumer satisfaction is a desirable outcome of AT provision.
7. Outcome(function) is defined as participation, QoL, and engagement.
8. Cost influences the Intervention approaches therefore affecting Outcomes.

Matching Person and Technology (MPT)	1. AT serves as a bridge between individual capabilities and the demands of tasks within their environment. 2. Personal autonomy and the performance of everyday activities are enhanced by integrating technology that matches individual needs. 3. The compatibility of assistive products with the user's lifestyle is crucial for successful adoption and satisfaction. 4. The user's physical, cognitive, and emotional dimensions must be considered to optimise the functionality of AT. 5. AT should empower individuals, promoting independence and self-efficacy in their desired roles and activities. 6. The design and functionality of assistive technology must reflect the

user's self-image and socio-cultural identity to foster acceptance.

7. AT should assist and elevate the user's ability to engage in social roles and activities with confidence and ease.
8. The choice of AT is personal, influenced by individual preferences, aspirations, and the context of their lives.
9. Effective AT integrates into the user's environment, enhancing their capabilities without introducing new barriers.
10. The success of an assistive product is measured not only by its technical features but also by its ability to align with the user's psychosocial context and enhance their QoL.

Theories, models and frameworks to understand barriers to the provision of mobility assistive technologies: A scoping review

Appendix 5, Table. Gaps analysis

Gaps	**Recommendations for future research**
Remote Regions and Accessibility	Key areas for future investigation included examining access to AT in remote regions [37, 48, 45] by investigating challenges and barriers faced in remote regions [48], and concentrating on modifiable elements like wheelchair skills and ease of access [51]
Stakeholder Perspectives	The included papers in this review draw attention to several issues, such as investigating policymakers' and HCPs' views on rehabilitation services [45]. Understanding the challenges faced by people with disabilities [50]. This includes understanding stakeholder perspectives on the various aspects of access by identifying the enablers and barriers that might aid in planning to increase access to AT services [46,48].
Funding, Policy, and Legislation	Future research should investigate funding and policy-related barriers [21, 39, 41, 47], the impact of legislation on accessibility and participation for powered mobility product users [44], fostering low-cost approaches in low- and middle-income countries [43], and promoting inclusive solutions for wheelchair service provision [22,50].
Data Collection and methodological improvements	Adoption of standardised instruments to assess functioning and disability is needed

	[42,44]. Comparing perceptions users with and without AT [42,44]. Exploration of user satisfaction, choice, and control in relation to MATs and its impact on overall outcomes [38]. Development of standards for testing AT effectiveness [49].
Contextual Understanding and service evaluation	Importance of investigating in-country perspectives consideration of personal, social, economic, environmental, historical, and political factors [22]. Incorporating subjective measures in service evaluations [40]. Assessing the effects of new products on work environments and identifying the annually prescribed types of AT are essential undertakings [21].

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Theories, models and frameworks to understand barriers to the provision of mobility assistive technologies: A scoping review

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Abstract

Objectives There is strong evidence that mobility-assistive technologies improve occupational performance, social participation, educational and employment access, and overall quality of life in people with disabilities. However, people with disabilities still face barriers in accessing mobility products and related services. This review aims to summarise and synthesise: 1) theories, models, and frameworks that have been used to understand mobility-assistive technology access, 2) determinants of access, and 3) gaps in knowledge.

Design A Scoping review using the five-step Arksey and O'Malley Framework.

Data sources We searched the MEDLINE, EMBASE, CINAHL, and SCOPUS databases for publications published between 2000 and 2024. We searched for articles published up to 20 March 2024.

Eligibility criteria We included English-published literature in peer-reviewed journals that reported (a) barriers to the provision of mobility-assistive technologies, (b) including at least one theory, model, or framework, and (c) between 2000 and 2024.

Data extraction and synthesis We extracted the study characteristics, theories, models, framework usage, research recommendations, key findings on mobility-assistive technology barriers, and theoretical propositions. We conduct a theoretical synthesis guided by Turner's approach.

Results We included 18 articles that used eight theories, models, and frameworks, synthesised into nine propositions. The synthesised theory emphasises that mobility is essential for human flourishing, and that certain health conditions may impose restrictions on mobility. This impact can be alleviated by two direct determinants: (1) the provision of suitable services and (2) their comprehensive provision. Policies and costs influence these services indirectly. Environmental and personal factors also affect the use of these services. Ineffectively addressing these determinants can limit access to mobility-assistive technologies and subsequent disabilities.

Conclusion Our synthetic model describes the logic of providing evidence-based mobility-assistive technologies, and we identify the determinants of access which can act as targets for future work to improve mobility-assistive technologies provision.

Strengths and limitations of this study

- We used a comprehensive search strategy developed with an information specialist to identify relevant publications.
- We mapped reported barriers to a widely used conceptual framework - the Consolidated Framework for Implementation Research - for consistent terminology.
- We conducted a theoretical synthesis to generate new insights.
- We excluded non-English studies, potentially limiting the applicability of our findings.
- We exclude grey literature, which further narrows the scope of the review.

INTRODUCTION

Neurological conditions, musculoskeletal disorders, and ageing are associated with considerable human burdens, including decreased quality of life (QoL) [1,2], activity limitations [3], participation restrictions [4,5], increased dependence, and caregiver burden [6]. Mobility-assistive technologies (MATs) are vital for addressing the challenges posed by these conditions, as they can help improve QoL, promote independence, enhance occupational performance, increase participation, and alleviate the burden on individuals, families, and societies [7]. MATs encompass assistive products for mobility and related systems and services [7]. These assistive products include devices, software, or instruments specifically designed or widely available to enhance the functioning of an individual [8]. They support or substitute the ability to move, thereby facilitating movement from one location to another [8]. Examples include wheelchairs, walking frames, rollators, and prosthetic and orthotic products [8].

Wheeled mobility products, prosthetics, and orthotics are cost-effective for improving the QoL and independence of people with disabilities [9,10]. Despite being endorsed by the United Nations [11] and World Health Organization (WHO) [7], which are essential for creating equitable opportunities for people with disabilities, access to these MATs remains limited [7,12]. There is a considerable unmet need for MATs worldwide, with only a small percentage of those who require them having access [7,12]. Access to assistive technology (AT) is defined as the equitable and sustainable provision of assistive products and support services that adhere to six key principles: accessibility, affordability, availability, adaptability, acceptability, and quality [7]. These principles ensure that assistive products and services are reachable, cost-effective, adaptable to individual needs, culturally appropriate, widely available, and of high quality [7].

The reasons for the unmet need for MATs are poorly understood but include the absence of national policies, high costs, and insufficiently trained personnel [7]. Several pre-existing theories, models, and frameworks (TMFs) have been used to understand the determinants of access and uptake, each with different conceptual coverage and terminology, which could help plan corrective actions. A framework is a structure for organising concepts that enable the description of phenomena [13,14]. For instance, Levesque's conceptual framework defines five dimensions of healthcare accessibility: approachability, acceptability, availability, affordability, and appropriateness [15]. This framework builds upon Penchansky and Thomas' foundational work, which originally identified the key dimensions of access to healthcare services as availability, accessibility, accommodation, affordability, and acceptability. These dimensions define access by assessing how well healthcare systems are prepared to meet patients' needs [16]. The International Classification of Functioning, Disability, and Health framework (ICF) is a framework developed by the WHO that classifies the health and disability components of functioning and contextual factors [17]. These include multi-aspect concepts related to body functions, structures, activities, participation, and environmental factors [17].

A model is a simplified representation of reality that holds for a specific case or population [13,18,19]; models may describe the relationship between their components but tend to be descriptive rather than explanatory [13]. For example, the Human Activity Assistive Technology (HAAT) model describes the interaction between human activity, AT, and the physical, social, and cultural contexts in which it is used [20]. The integrated multi-intervention paradigm for the assessment and application of concurrent treatments (IMPACT^2) model describes the variables related to AT interventions [21]. The Matching Person and Technology (MPT) is a model that describes the interaction between environmental, personal, and technological factors in the success of AT uptake [22]. The Systemic Development Model (SDM), developed by the World Engagement Institute (WEI), describes four

interconnected pillars of sustainability—health, culture, economics, and politics—to enhance the understanding of capacities at the personal, organisational, and institutional levels [23].

A theory is an interconnected set of abstract statements that explain, predict, or prescribe phenomena, going beyond specific contexts to consider broader meanings and implications [13,14,18,24]. For instance, Gibson's theory proposes that the environment contains actionable (and therefore explanatory) properties, "affordances", that are directly perceived [25]. When a research area is characterised by theoretical incoherence, researchers must choose between rigid empiricism, selecting theories based on their virtues, developing their own theory, and theoretical synthesis [26]. Theoretical synthesis can amalgamate propositions from different theories into a propositional network, enabling researchers to extend the coverage, content validity, and document points of convergence [26]. Scoping reviews are ideal for uncovering key concepts and informing future research designs [27]. This paper presents a scoping review that summarises and synthesises the TMFs used to understand MAT access, identifies the determinants of access, and highlights the gaps in current knowledge.

METHOD

We report a five-stage scoping review based on the approach outlined by Arksey and O'Malley [28], in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) (online supplemental appendix 1) [29]. This study did not meet the eligibility requirements for registration using PROSPERO. The research questions were as follows: What theories, models, and frameworks have been used to understand the barriers to the provision of MATs for people with mobility issues? What are the determinants of access to MATs for people with mobility issues? What are the current knowledge gaps in access to MATs for people with mobility issues?

Eligibility criteria

The Behaviour of Interest, Health Context, Exclusion, Models, or Theories (BeHEMoTH) framework [30] was employed to formulate the search concepts (Table 1) and eligibility criteria (Table 2).

Table 1 Application of the BeHEMoTH framework to define search concepts

BeHEMoTH	Concept
Be – Behaviour of interest:	Barriers to access or provision
H – Health context	People with mobility issues AND MATs
E – Exclusions	NA
MoTh – Models or Theories	Models or Theories or Frameworks

Table 2 Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria	Rationale

Publications reporting on the barriers to the provision of MATs	Publication concentrates on aspects other than barriers to access, and there is no report on barriers	This review focuses on understanding barriers to the provision of MATs
Publications including at least a theory, model, or framework	Publications that did not employ a theory, model, or framework	To ensure that the articles concentrate on theory, model, or framework to understand the barriers
Publications in peer-reviewed journals	Other publications such as conference abstracts and theses	To ensure that studies had undergone rigorous evaluation
Publications published in the English language	Publications in other languages	Costs and time commitment associated with article translation
Publications between 2000 and 2024	Publication published before 2000	To ensure using the most relevant publications from the previous 24 years

Information sources and Searches

Literature searches were performed by (AA) on MEDLINE (Ovid), EMBASE (Ovid), CINAHL (EBSCO), and SCOPUS databases for studies published between 1 January 2000 and 20 March 2024. To identify the appropriate publications relevant to the research issue, a *priori* search strategy was established in collaboration with the authors (AA and DH) and an information specialist (FZ). The search terms combined the concepts of 'barriers to provision, mobility issues, AND 'MATs', and a theory/model/framework'. Free text terms, subject heading, use of the Boolean operators "AND" and "OR", and truncation were all used to ensure a successful search. The final search strategy was tested on MEDLINE via Ovid, and then translated into other databases. The full search strategy and results are presented in online supplemental appendix 2. We reviewed the reference lists of the included articles to identify additional relevant articles [28] but restricted the eligibility to peer-reviewed studies, excluding grey literature.

Study selection

The Rayyan platform (https://www.rayaan.ai) was used for study selection. Initial title and abstract screening were conducted by (AA), where the primary aim was to assess studies for potential relevance based on predefined inclusion and exclusion criteria. Given the subjective nature of this assessment, any uncertainties regarding study eligibility encountered by AA were systematically discussed with the other reviewers (DH, SR, and BF). Full-text screening involved consistent discussions among (AA, DH, SR, and BF), and the full texts of eligible articles were subsequently retrieved for a more detailed assessment.

Data charting process

To facilitate consistent data presentation and synthesis, we charted general and study-specific information from the studies in Microsoft Excel spreadsheets. Data items included country of origin, study population, aims, sample size, study design, data collection tool, TMF used, a brief description of its purpose, research recommendations, and key findings related to barriers to the provision of MATs. We extracted theoretical propositions from the TMFs, as discussed in the articles included in our review. In instances in which these articles did not provide a comprehensive explanation of TMFs, such as Gibson's affordances theory, the IMPACT^2 model, and the HAAT model, we referred to the foundational sources. The sources cited within the included articles are original materials in which TMFs were first introduced or explained thoroughly. This ensured that our understanding and coverage of TMFs was comprehensive, especially when the application of these TMFs in the reviewed articles lacked depth. Although these foundational sources were not directly included in our review as they did not meet our inclusion criteria, they were consulted for additional insights. We mapped the reported barriers to one of the updated constructs of the Consolidated Framework for Implementation Research (CFIR), a synthetic framework of constructs used in 19 implementation theories [31,32], using a codebook (https://cfirguide.org/). The CFIR provides a set of standardised constructs to guide researchers, creating a common language for explicitly and consistently describing aspects that may affect the provision [33].

Synthesis of results

Tabular summaries and narrative syntheses were completed for the included articles and their TMFs [34]. We conducted a theoretical synthesis to generate new insights that were unavailable for any TMF [35]. The synthesis was guided by Turner's [36] approach. In Step 1, the TMFs are summarised, and their shared themes are identified. In Step 2, the aspects of the TMF that pertain to core concepts by extracting the phrases used, their definitions, and their explicit and implicit relationships are identified. In Step 3, the TMFs are broken into simple propositions that can be compared and tabulated. In Step 4, the theories are compared and determined how they converge or diverge by combining similar elements. In Step 5, the convergent elements from the TMF are combined into a single conceptual model that focuses on the relationships between concepts. For example, during this stage, we examined how concepts from these TMFs—such as cost, services, and activity (mobility)—interacted and influenced each other within the synthesised theory to gain theoretical insight. We incorporated statements from the studies included in this review to strengthen the synthesis and support the resulting conceptual model (Step 6).

Gaps analysis

To identify knowledge gaps and areas for future research, we reviewed papers and tabulated explicit recommendations, which is a core function of scoping reviews [27].

Patients and public involvement

No patients or public were involved in the study.

RESULTS

Characteristics of the studies

The literature search yielded 306 citations after the removal of duplicates. A total of 246 citations were excluded after initial screening, and 60 potentially eligible articles were retrieved for full-text review. Of these, 45 were excluded because barriers were not reported (*n* =10), TMFs were not reported (*n*=27), and the citations were conference abstracts (*n*=7) or theses (*n*=1). Fifteen studies identified from the databases met all the eligibility criteria. After reviewing the reference lists and conducting manual searches, 25 additional studies were identified and examined for eligibility, and three studies were determined to be eligible (Figure 1) [37].

Figure 1 PRISMA flow diagram.

The final synthesis included 18 articles (online supplemental appendix 3) [16,22,23,38–52]. Eight studies addressed the challenges associated with the provision and use of MATs [16,22,23,38,39,42,44,47,49,50]. Four studies examined environmental barriers to participation [40,45,48,51,52]. Two studies explored the experiences of patients and caregivers and their rehabilitation needs [43,46]. One study drew attention to inconsistencies in AT provision schemes [41]. There were (*n*=5) secondary studies and (*n*= 13) primary research studies conducted between 2012 and 2023 in South Africa [49], Mongolia [48], Canada, India [46], Australia [38,41], Malaysia [44], New Zealand [40], Uganda [47], Brazil [43], United States [42], Iran [16], Sweden [22,45], Tanzania [51], Canada, and the United States [39]. The primary studies contained between one and 318 participants.

Eight TMFs, representing various perspectives, were identified. Two were biopsychosocial in orientation: the ICF [17] and HAAT [20], which focused on AT. Two other models that focus on AT are IMPACT^2 [21] and MPT [22]. Four other identified TMFs were applied to AT access: Penchansky and Thomas's framework [16], Levesque's theoretical framework [15], Gibson's affordances theory [25], and the SDM [53]. The most frequently used TMF was ICF (*n* = 12). All included studies applied one TMF, except for one [41], which used two in combination: ICF and IMPACT^2. There are three distinct applications of TMFs, as shown in Supplemental Figure 1. The majority were used as a basis for analysis and interpretation (*n* = 13) or as a guide for designing the surveys and interviews (*n* = 2). In addition, TMFs were used as a comprehensive framework to provide a context for reviewing the relevant literature (*n* = 3).

Barriers to MATs provision synthesised using CFIR

The key barriers in the innovation domain are cost concerns [16,23,38–42,44,46,48,49], intervention complexity [23,39,45,47], inadequate evidence of effectiveness [41,42], product-related factors such as comfort, durability, and fit [52]; and limited models and colour choices available [22] (Figure 2). The outer-setting domain highlights societal attitudes toward AT [22,47,48,50,52], geographic distance [16,41,43,49], a lack of supportive legislation [16,23,39,45,47,48,50,51], and environmental barriers [22,52]. Within the inner-setting domain, resource constraints [23,42,43,47,49], restricted knowledge, and information access hinder provision [23,38,39,42,47,50]. The characteristics of the individuals' domains revealed knowledge about the intervention [23,47,48,50] and low self-efficacy among healthcare professionals [16,42,49] as barriers to its adoption. In addition, within the

characteristics of individual domains, barriers include limited information access [16,38–40,43,45,49], such as a lack of access to training and instructions on the use and management of mobility products [16]. Furthermore, there is a lack of awareness among users [49,50], and insufficient inclusion of user preferences in prescriptions [22]. In the process domain, barriers include insufficient stakeholder engagement [39,42,50], absence of interdisciplinary standards [42], and limited strategic planning [39].

Figure 2 Barriers to the provision of MATs synthesised using the CFIR.

Theories, Models and Frameworks (TMF) Synthesis

The propositions derived from the theories, models, and frameworks are described in Supplemental Appendix 4, and the resulting synthetic model is presented in Figure 3.

Figure 3 Synthetic model.

Proposition 1: mobility is essential for human flourishing

The ICF framework highlights activity as a key component of health, with disabilities resulting from restricted activities, such as mobility issues [17]. This affects participation in everyday activities, such as work, socialisation, and healthcare access [17]. The HAAT model explains a similar concept, describing the 'activity' as the action of performing a task that represents the functional outcome of human performance [20]. Building on these insights, 'mobility' is viewed as an individual's ability to perform tasks that enable meaningful participation. The HAAT model and IMPACT^2 emphasise the importance of participation in everyday activities, such as working and socialising, for overall health [20,21], describing it as "necessary to human existence" [20]. According to the HAAT model, humans are defined based on their intrinsic physical, cognitive, and emotional abilities [20]. Accordingly, mobility is viewed more as a necessary means of meaningful participation than an end to the development of physical, cognitive, and psychosocial skills throughout life [38,46]

Proposition 2: health conditions and personal factors influence mobility

An individual's mobility is influenced by health and personal factors, which, in turn, affect their participation in social, work, and leisure activities. For example, the ICF framework clearly describes how health issues and personal factors can affect activities and participation [17] and describes health conditions as umbrella terms for diseases, disorders, injuries, or trauma [17]. Similarly, the HAAT model highlights the impact of a person's physical and cognitive abilities and personal elements, such as emotional and psychological factors, on their ability to perform activities [46]. Accordingly, 'personal factors' that encompass elements, such as psychological attributes, age, and coping style influence an individual's ability to perform activities [17]. For example, Dwyer and Mulligan [40] highlighted how emotional changes caused by spinal cord injury (SCI) could impede participation in rehabilitation services and other areas of reintegration, such as employment and leisure activities.

Proposition 3: appropriate services influence mobility

The ICF and HAAT models explicitly describe the relationships between the activities and their environments. Both emphasise the importance of activities for participating in and developing in life, and some interventions can improve a person's ability to engage in the desired activities [17,20]. For instance, in the ICF framework, AT services are considered to be an environmental factor, which is appropriate for helping individuals achieve their intended activities and participate in various situations [17]. Similarly, the MPT model was developed considering the ICF framework and focusing on the relationship between individuals and AT [54]. This suggests that AT is an essential means of bridging the gap between an individual's capabilities and the demands of tasks in their environment, thereby significantly enhancing their engagement in the desired activities [22]. Levesque's framework, building upon the foundational work of Penchansky and Thomas, identifies that 'the appropriateness of a service' is determined by its alignment with the needs of the client, whereas the HAAT and MPT models emphasise that with AT, an individual's capabilities are increased [15,16,20,22]. Consequently, to meet individual needs and maximise capabilities, we define the appropriateness of services based on the extent to which they are tailored. This demonstrates that MATs are vital for people with disabilities and for older people who require them, thus enhancing their independence and participation in daily life [38,46].

Proposition 4: service delivery must be comprehensive to influence human mobility

Institutional factors significantly influence individual activities, as explained by the HAAT model [20] and ICF frameworks [17]. Levesque's framework emphasises the importance of how services are provided to meet client needs [15], whereas Penchansky and Thomas highlight the necessity of adequate resources, including staff, to ensure that these needs are effectively met [16]. Similarly, the IMPACT^2 model is concerned with providing services and ensuring that outcomes are met, including QOL, participation, and satisfaction with the services provided [21]. The MPT model demonstrates that user satisfaction with service provision can be achieved by considering key features of products such as usability, quality, weight, stability, and safety [22]. Accordingly, the concept of 'comprehensive services' refers to providing clients with high-quality products and the necessary support services to meet their needs and achieve satisfaction. Providing comprehensive services encompassing assessment, training, and maintenance is crucial for enhancing personal mobility [23,39]. Effective delivery of AT services requires well-trained personnel [23]. These are critical components of service delivery systems that help individuals enhance their mobility.

Proposition 5: environmental factors influence individuals' decision to seek appropriate health care services

Assistive products for mobility and participation are influenced by environmental factors such as social, cultural, and physical environments, which affect individuals' health and well-being. The ICF framework views disability as a health experience arising from context and not solely within an individual [17]. It emphasises how society can create barriers such as inaccessible services or neglected facilitators, such as the lack of AT [17]. Furthermore, an individual's level of functioning is determined by their relationships with family, people, and healthcare providers, all of which can influence their decision to seek healthcare [17]. A similar concept of how society affects activities is highlighted by the HAAT model, which places particular emphasis on an individual's cultural context [20]. The MPT model also emphasises the role of sociocultural factors, acknowledging how a user's

social setting and cultural attitudes towards disability can influence their perception of and adoption of mobility products. This includes consideration of product-related social implications and stigmas [22]. For example, parents of children with disabilities oppose wheelchairs because of social stigma [46], and some older people perceive mobility products negatively because of stigmatising symbolism [50]. This demonstrates the significant influence of sociocultural factors, such as support and relationships from family, health professionals, and community on MAT accessibility and acceptance. Furthermore, the MPT model emphasises the importance of the physical environment, which includes both the built environment within the user's home and the external surroundings, in affecting use and acceptance [22]. For example, if a wheelchair does not fit the physical and psychosocial environment in which it is used, it is more likely to limit function rather than enhance it [22]. Therefore, the success of MAT is not measured solely by its technical features but also by its ability to fit into the user's psychosocial context [22].

Proposition 6: policies influence the provision of services

The SDM framework highlights how organisational service delivery policies influence appropriate service provision [53], whereas the ICF explains how policies affect participation and activities [17]. As part of the ICF, the term 'policy' is commonly used within the environmental factor domain as an external factor that can impact an individual's health and function [17]. This set of guidelines, rules, and regulations governs the range of services provided to individuals, including policies and standards that define the eligibility criteria for services [45]. For instance, prostheses are not considered to be life-saving medical devices or crucial components of the healthcare system [43]. However, they are life-changing for users and can quickly restore most functions [43]. Levesque's framework argues that the availability of health services should ensure those in need can access either the physical facilities or healthcare personnel [15]. However, barriers to access emerge when healthcare is unavailable in certain geographic areas or when individuals' insurance does not cover the necessary treatments [15,16]. Penchansky and Thomas further emphasised the need for a well-organised supply of resources, including the integration of telephone or remote service consultations [16]. The lack of such accommodations can prevent individuals from obtaining the required healthcare, potentially leading to adverse health outcomes. Disparities between government and institutional policies can result in confusion among AT providers and decrease service utilisation [23,47].

Proposition 7: cost influences the provision of appropriate services

The SDM framework [53] highlights the significant influence of economic factors on service delivery and reinforces the idea that costs can significantly influence access to healthcare services. The term ‘cost’ refers to the expenses incurred by individuals and healthcare systems to provide services [15,21]. This comprises the direct prices of services such as consultation fees, product costs, and related expenses [15]. For instance, the IMPACT^2 model underlines the role of cost implications in selecting intervention approaches and demonstrating the cost effects at each stage of AT provision [21]. Both Penchansky and Thomas [16] and Levesque et al. [15] emphasised the critical role of an individual's financial capacity, including income and willingness to pay, in accessing healthcare. Therefore, costs can significantly influence access to AT.

Proposition 8: personal factors influence healthcare utilisation

Healthcare utilisation is influenced by various 'personal factors' that represent an individual's internal aspects, such as psychological characteristics [17]. This concept is explained using Levesque's framework. It highlights factors such as an individual's need for care, awareness of these needs, and desire for treatment [15]. Gibson's affordance theory suggests that an individual's perception of their environment is based on its potential to fulfil their needs, thereby shaping their decisions [25]. Therefore, the individual is responsible for unravelling the utility presented by affordance. For instance, the client in Mairami et al. [44] adapted a chair from a home to a wheelchair. This demonstrates how the client's perception of their environment shaped their recovery when an existing structure was found to have assistive potential. The ICF model explains the significance of environmental factors, such as the visibility of services, in determining an individual's level of functioning [17], which is related to Gibson's affordance theory, in which environmental cues trigger actions [25]. Consequently, the lack of service limits the activities that can be conducted. Personal factors not classified within the ICF are acknowledged to have a significant impact on healthcare access [17]. The MPT model highlights that the choice of assistive products is deeply personal and shaped by individual aspirations, anticipated satisfaction of needs, and perceived personal value of these products [22]. These elements play a crucial role in influencing the uptake of MATs, as they are associated with the context of users' lives [22].

Proposition 9: limited access to healthcare services creates disability

The ICF acknowledges the influence of environmental factors on disability development and emphasises the limitations it imposes on individuals' abilities to access healthcare services and engage in social activities [17]. As defined by the ICF, disabilities include impairments, limitations in activity levels, and restrictions on participation [17]. Consequently, restricted AT accessibility impairs body function, hinders participation, and contributes to disabilities. The SDM framework explains the significance of economic factors, particularly the "lack of economic means", which limit access to services such as MAT [53]. Restricted access can trigger continuous cycles of disabilities and poverty [23]. Persistent mobility constraints, whether due to inadequate MAT service support or diminished participation in daily life, have been identified as significant factors leading to disability [47,48].

Gaps analysis

This review highlights key research areas in AT services that warrant further investigation (online supplemental appendix 5). Investigations should focus on AT access in remote regions [38,46,49], examine gender disparities in service accessibility [16], explore stakeholder perspectives on rehabilitation services and barriers to AT access [47,49,51], and address challenges related to funding, policy, and legislation [22,23,40,42,44,48,51]. Data collection and methodological enhancements are required, including standardised instruments for assessing functioning and disability [43,45], comparisons of user experiences with and without AT [39,41], and comprehensive evaluation tools combining objective and subjective measures [39,41]. Emphasis should also be placed on understanding the in-country perspectives, inclusive solutions, and the impact of contextual factors on AT access [23]. This involves evaluating how new products impact workplace settings and determining which types of AT are essential [22]. Future studies should examine product compatibility, enhance user skills, and improve accessibility to the built environment [52]. Addressing these research gaps could contribute to the development of more effective, inclusive, and accessible AT services for individuals with disabilities.

DISCUSSION

This scoping review offers a summary of the barriers to MAT provision and synthesis theories to guide future work based on 18 articles. The synthesised theory emphasises that mobility is essential for human flourishing (Proposition 1) and that certain health conditions may impose restrictions on mobility (Proposition 2). This impact can be ameliorated by two direct determinants: the provision of suitable services (Proposition 3) and their comprehensive provision (Proposition 4). Policies (Proposition 6) and costs (Proposition 7) indirectly influence these services. Furthermore, an individual's decision to access these services is determined by their environment (Proposition 5) and personal factors (Proposition 8). If these direct and indirect determinants are not effectively addressed, it could result in limited access to MATs and subsequent disability (Proposition 9). This synthesised theory integrates empirical and ethical dimensions and provides evidence-based approaches to solving problems [18].

To the best of our knowledge, this is the first report on the synthesis of TMFs and the barriers to MAT provision. Although De Alves and Matsukura's [55] literature review outlined the various theoretical models used in the AT literature, they did not attempt theoretical synthesis. TMFs organise concepts and thoughts to provide insights into different elements of practice and research [13]. Lakatos proposes that scientific enquiry should appraise a series of theories rather than a single theory, noting that “the members of such series of theories are usually connected by a remarkable continuity which welds them into research programmes” [56]. Lakatos advocated for a 'pluralistic model' of scientific theories, in which several theories, which are organised deductively to varying degrees, are brought together in a unified approach [56]. Unlike Lakatos, we view this study as an enhancement of problem-solving effectiveness [57]. By combining propositions from different theories, we increased the coverage of the resulting syntheses of individual theories. It should predict the range of barriers encountered in MAT access and provision.

The theory covers a socially significant issue given that it addresses the current research priorities identified by expert panels organised by government agencies and clinical speciality organisations [7,58–60]. It addresses the phenomenon of interest to rehabilitation scholars by filling the gaps in the existing TMFs. Although the MPT model does not explicitly discuss barriers to AT access, it provides valuable insights into the interactions between the personal, technological, and environmental factors that influence successful AT adoption [22]. The MPT model, developed based on the ICF framework [54], highlights the importance of aligning assistive products with user needs, preferences, and contexts to optimise functionality and satisfaction. Future research should further explore how the MPT model can inform strategies to address barriers to access and provision of MAT.

An adequate specification was achieved by providing a clear and concise overview of the theoretical synthesis. In addition, we establish linkage adequacy by defining the concepts and their relationships [61]. The theory is testable because it contains observable concepts and propositions that can be operationalised and corroborated in empirical research. A limitation of the scoping review was the exclusion of non-English language studies, which could limit the applicability of the findings; research from other languages could have offered additional valuable insights [62]. Another limitation is that the review's focus on studies from 2000 to 2024 potentially omitted earlier relevant research on barriers and TMF. However, a broader historical scope may have reduced the relevance of the findings to contemporary decision-making in the provision of AT. The exclusion of grey literature, including government reports and policy documents, further narrowed the scope of the review. This exclusion may have resulted in the omission of relevant non-peer-reviewed TMFs. In addition, the processes of data extraction, coding using CFIR, and synthesis inherently involve subjectivity. Search

terms such as 'service delivery,' 'service*,' 'deliver*,' and additional or alternative terms for older people, such as 'older person*' or 'older adult*,' may have identified additional studies.

Our review highlights several key knowledge gaps regarding MAT access and provision. These include the need for research on AT access in remote regions, stakeholder perspectives on barriers and enablers, funding and policy challenges, and the impact of contextual factors [23,38,40,42,44,46,47,49,51]. Methodological improvements such as the adoption of standardised instruments and the incorporation of user satisfaction measures are also needed to advance the field [39,41,43,45]. Importantly, the widely used ICF framework does not include personal factors that play a crucial role in MAT access [17]. Future research should address these gaps to provide a more comprehensive understanding of the determinants of access to MAT. Figures 2 and Supplemental Figure 1 provide overviews of the identified barriers and the TMFs used in the included studies, respectively. Although no single model can fully capture the complexity of MAT access, researchers and practitioners should consider the strengths and limitations of each TMF and select the most appropriate one(s) based on specific research questions and contexts.

The insights from this review and the resulting integrated model have the potential to influence clinical practice and policymaking in line with the ethical imperatives outlined by the WHO and the UN [7,11]. These organisations have emphasised the necessity of AT to meet individual needs and enable equitable opportunities for people with disabilities. The synthesised theory aligns with the principles of access to AT as advocated by the WHO and UNICEF, highlighting the necessity for assistive products and services to be reachable, affordable, adaptable to individual needs and environments, culturally appropriate, and of high quality. By addressing the direct and indirect determinants of access, as identified in the theory, including service provision, policies, costs, physical, social, cultural factors, and personal preferences, we can align better with these global principles [7]. Therefore, this review proposes a theoretical basis for reforming the existing system to align it with international standards, thus addressing the pressing and unmet needs more equitably and personally. To achieve this, future research must examine these determinants, understand the barriers to MAT provision, and plan and evaluate strategies to enhance its provision. Having a set of determinants organised around the CFIR [32] allows the creation of local implementation strategies to suit different policy jurisdictions.

There is a consensus [63,64] and evidence-based approach [65] to overcome the barriers to effective AT provision found in this review. The barriers identified by the CFIR can be linked to Expert Recommendations for Implementing Change (ERIC) strategies [66]. These strategies guide the selection of implementation methods to mitigate barriers and include (1) activating local clinical leaders or champions, (2) providing educational materials, (3) organising meetings, and (4) implementing outreach or ongoing training. The implementation of these strategies can assist decision-makers in making informed choices regarding the selection of strategies for MAT provision.

CONCLUSION

The synthesised theory emphasises that mobility is a crucial aspect of human life and certain health conditions may restrict mobility. Providing comprehensive and appropriate services can reduce this impact; however, cost and policy decisions regarding these services affect their provision. Accessibility to these services is also affected by environmental and personal factors. This knowledge can be used to develop strategies to enhance provision.

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CONTRIBUTORS

All authors contributed to the conceptualisation and design of the study. Initial title and abstract screening were conducted by AA, with regular consultations with DH, SR, and BF. AA performed the data extraction independently, with regular discussions with DH, SR, and BF. The initial data synthesis was conducted by AA and refined by DH, SR, and BF. The manuscript was drafted by AA, and major revisions were made by DH, SR, and BF. All the authors (AA, DH, SR, and BF) have read and approved the final manuscript.

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COMPETING INTERESTS

The authors report there are no competing interests to declare.

DATA AVAILABILITY STATEMENT

The authors confirm that the data supporting the findings of this study are available in the article and supplementary materials.

RIGHTS RETENTION STATEMENT

SUPPORTING MATERIALS

Supplemental Appendix 1, Checklist. Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR)
Supplemental Appendix 2, Table. Systematic search conducted in MEDLINE, EMBASE, CINAHL, and SCOPUS

Supplemental Appendix 3, Table. Characteristics of included papers
Supplemental Appendix 4, Table. Propositions derived from the theories, models, and frameworks
Supplemental Appendix 5, Table. Gaps analysis
Supplemental Figure 1. Theories, models, frameworks, and their purpose of application in eligible studies

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Ethical Approval and Dissemination:

Ethical approval was not required for this scoping review. The dissemination plan includes publishing in peer-reviewed journals and presenting at academic conferences.

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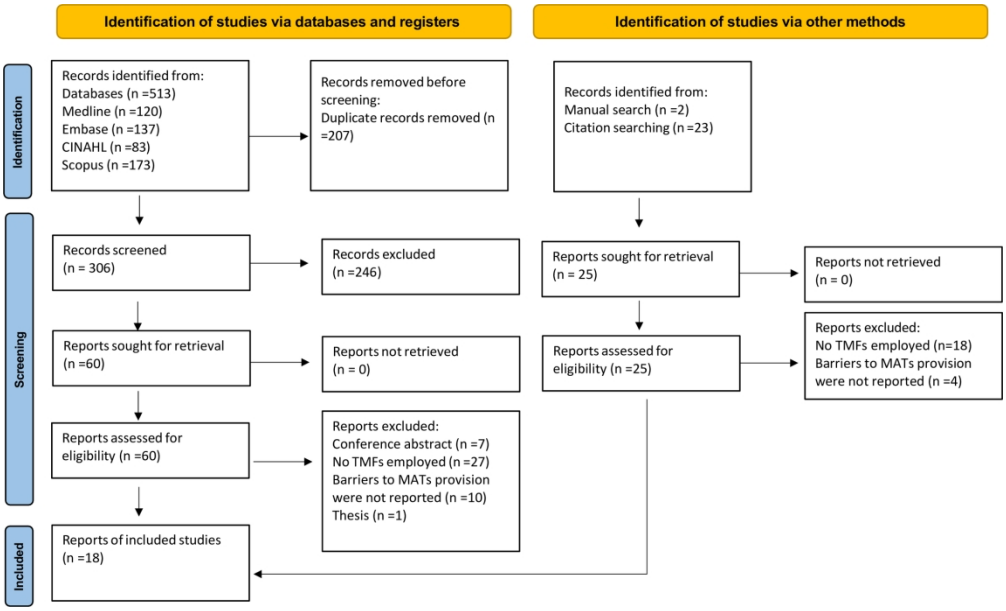
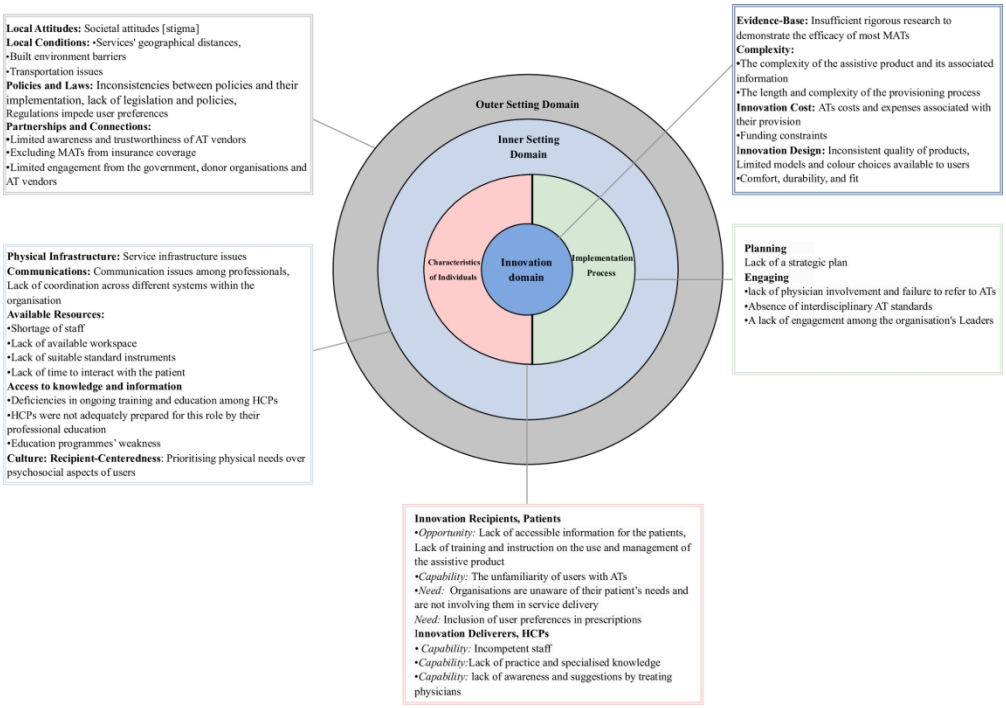


PRISMA flow diagram

190x114mm (300 x 300 DPI)



Barriers to the provision of MATs synthesised using the CFIR

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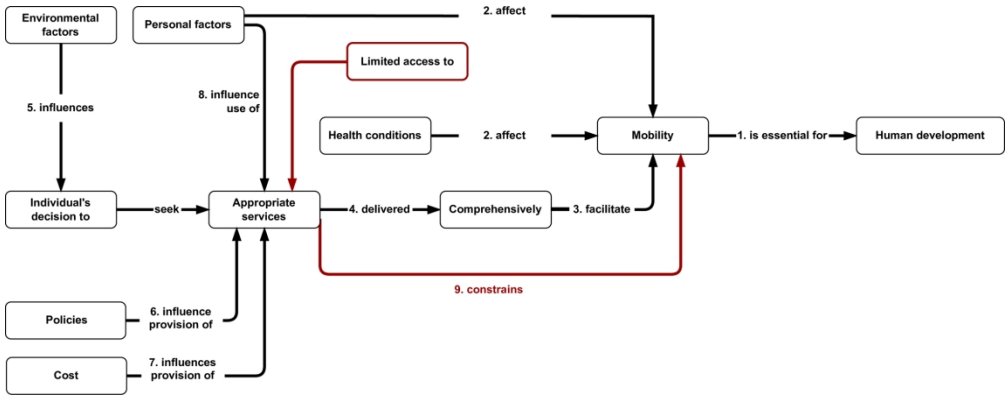
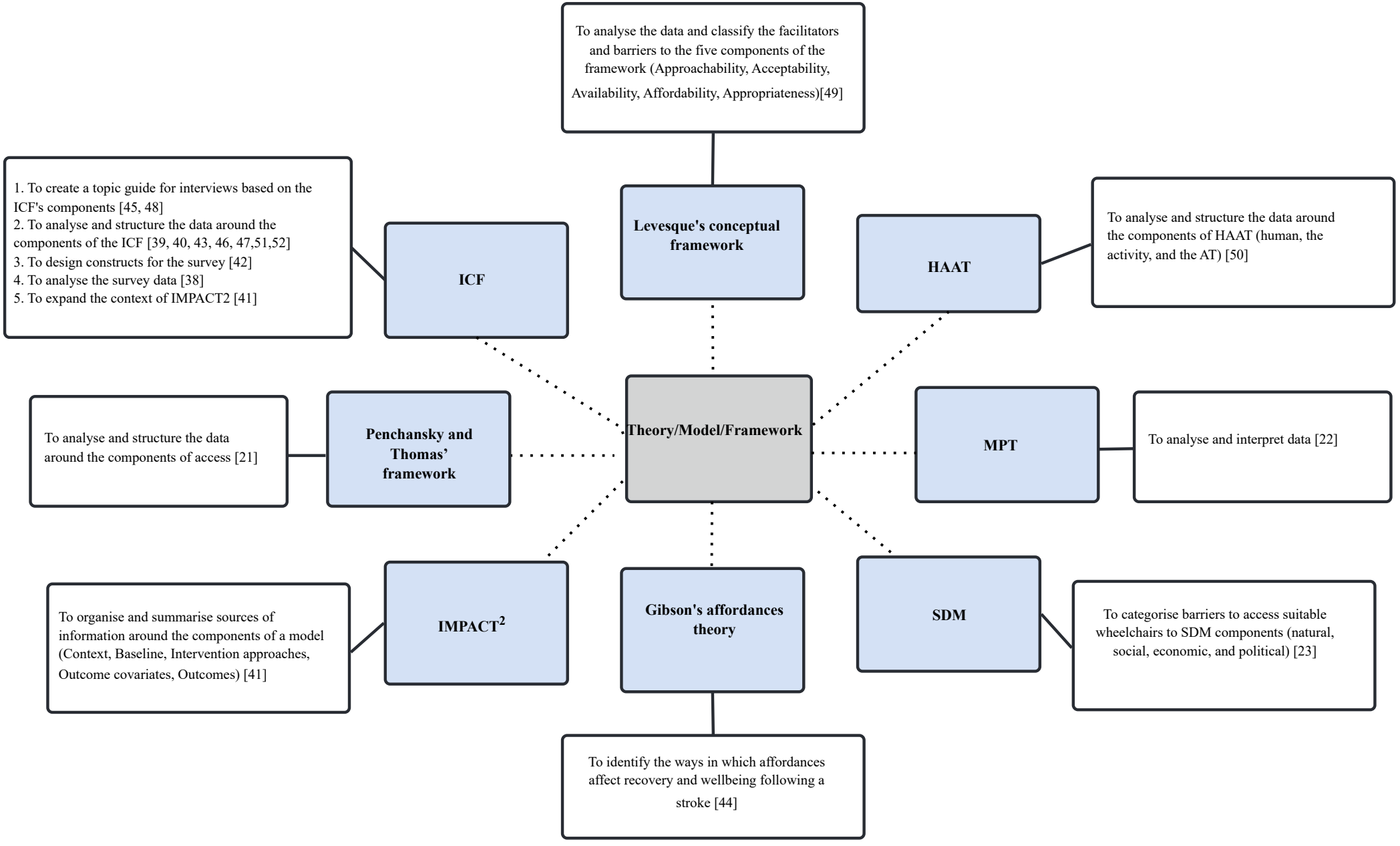


Synthetic model

190x74mm (300 x 300 DPI)

Supplemental Figure 1. Theories, models, frameworks, and their purpose of application in eligible studies



Theories, models and frameworks to understand barriers to the provision of mobility assistive technologies: A scoping review

Appendix 1. Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
TITLE			
Title	1	Identify the report as a scoping review.	#1
ABSTRACT			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	#2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	#4-5
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	#5
METHODS			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	#5 (not registered)
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	#5-6
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	#6
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	Appendix 2
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	#6
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	#7
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	#7

Theories, models and frameworks to understand barriers to the provision of mobility assistive technologies: A scoping review

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	NA
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	#7
RESULTS			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	#8
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	#8 and Appendix 3
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	NA
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	#8-9, Figure2, Supplemental Figure 1, Appendix 3
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	#8-12
DISCUSSION			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	#13
Limitations	20	Discuss the limitations of the scoping review process.	#13
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	#14
FUNDING			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	#15

JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.

* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.

† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).

‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.

§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more

applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

From: Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMAScR): Checklist and Explanation. Ann Intern Med. 2018;169:467–473. doi: 10.7326/M18-0850

Appendix 2. Systematic search conducted in MEDLINE, EMBASE and CINAHL, SCOPUS

Database(s): **Ovid MEDLINE(R)** Search Strategy:

#	Query	Results from 20 Mar 2024
1	(Access* adj10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)).ab,ti.	65,894
2	(Provision* adj10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)).ab,ti.	8,001
3	(Provide* adj10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)).ab,ti.	105,628
4	(Adoption* adj10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)).ab,ti.	7,717
5	Wheelchairs/	5,516
6	Orthotic Devices/	7,001
7	Exoskeleton Device/	1,615
8	Mobility device*.ab,ti.	540
9	Mobility technolog*.ab,ti.	52
10	Wheelchair*.ab,ti.	8,917
11	Scooter*.ab,ti.	848
12	Walker*.ab,ti.	15,484
13	Prosthetic*.ab,ti.	64,657
14	prosthesis/	50,316
15	orthotic*.ab,ti.	3,754
16	Self-Help Devices/	5,848
17	Exoskeleton*.ab,ti.	4,775
18	Orthos*.ab,ti.	26,392
19	power mobility.ab,ti.	135
20	Prosthe* device*.ab,ti.	2,423
21	(Assistive technolog* adj10 mobility).ab,ti.	136
22	(Assistive device* adj10 mobility).ab,ti.	216
23	assistive product*.ab,ti.	112
24	mobility product*.ab,ti.	24
25	Disabled Persons/	48,539
26	Mobility Limitation/	5,317
27	Elder*.ti,ab.	311,486
28	Physical* Disable*.ab,ti.	948
29	Disable*.ab,ti.	29,670
30	Disabilit*.ab,ti.	251,101
31	Walking difficult*.ab,ti.	690
32	Handicap*.ab,ti.	26,041
33	physical* impair*.ab,ti.	3,209
34	physical* Challeng*.ab,ti.	702

35	Ambulat* Difficult*.ab,ti.	89
36	Mobility difficult*.ab,ti.	257
37	Mobility impair*.ab,ti.	1,395
38	Mobility limit*.ab,ti.	1,495
39	Amput*.ab,ti.	54,202
40	Motor difficult*.ab,ti.	547
41	Amputation/	24,156
42	Geriatrics/	31,605
43	(theor* or framework* or model* or taxonom* or classifi* or concept*).ab,ti.	5,861,883
44	(Matching Person and Technology).ab,ti.	22
45	(("abandonment" or "discontinuance") and "model").ab,ti.	660
46	43 or 44 or 45	5,861,887
47	1 or 2 or 3 or 4	179,053
48	25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42	698,993
49	44 or 45	680
50	5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24	178,356
51	43 and 47 and 48 and 50	129
52	limit 51 to english language	123
53	limit 52 to dt=20000101-20240320	120
54	limit 53 to dt=20230615-20240320	7

Database(s): **Ovid Embase** Search Strategy:

#	Query	Results from 20 Mar 2024
1	(Access* adj10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)).ab,ti.	89,392
2	(Provision* adj10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)).ab,ti.	10,528
3	(Provide* adj10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)).ab,ti.	132,393
4	(Adoption* adj10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)).ab,ti.	9,027
5	Wheelchairs/	11,424
6	Orthotic Devices/	7,444
7	Exoskeleton Device/	1,458
8	Mobility device*.ab,ti.	660
9	Mobility technolog*.ab,ti.	61
10	Wheelchair*.ab,ti.	13,417
11	Scooter*.ab,ti.	1,038
12	Walker*.ab,ti.	18,055
13	Prosthetic*.ab,ti.	77,235
14	prosthesis/	34,174
15	orthotic*.ab,ti.	5,418
16	Self-Help Devices/	3,039
17	Exoskeleton*.ab,ti.	5,286
18	Orthos*.ab,ti.	36,589
19	power mobility.ab,ti.	165
20	Prosthe* device*.ab,ti.	2,837
21	(Assistive technolog* adj10 mobility).ab,ti.	169
22	(Assistive device* adj10 mobility).ab,ti.	306
23	assistive product*.ab,ti.	120
24	mobility product*.ab,ti.	24
25	Disabled Persons/	31,831
26	Mobility Limitation/	14,932
27	Elder*.ti,ab.	441,358
28	Physical* Disable*.ab,ti.	1,217
29	Disable*.ab,ti.	38,518
30	Disabilit*.ab,ti.	354,530
31	Walking difficult*.ab,ti.	1,263
32	Handicap*.ab,ti.	31,792
33	physical* impair*.ab,ti.	4,546
34	physical* Challeng*.ab,ti.	970
35	Ambulat* Difficult*.ab,ti.	134
36	Mobility difficult*.ab,ti.	346

37	Mobility impair*.ab,ti.	1,856
38	Mobility limit*.ab,ti.	1,969
39	Amput*.ab,ti.	67,937
40	Motor difficult*.ab,ti.	763
41	Amputation/	26,875
42	Geriatrics/	34,514
43	(theor* or framework* or model* or taxonom* or classifi* or concept*).ab,ti.	7,217,650
44	(Matching Person and Technology).ab,ti.	32
45	(("abandonment" or "discontinuance") and "model").ab,ti.	817
46	43 or 44 or 45	7,217,657
47	5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24	161,702
48	25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42	952,247
49	1 or 2 or 3 or 4	230,360
50	47 and 48 and 49	517
51	46 and 50	140
52	limit 51 to english language	137
53	limit 52 to dc=20000101-20240320	137
54	limit 53 to dc=20230615-20240320	10

Database(s): **EBSCO CINAHL** Search Strategy:

#	Query	Results from 20 Mar 2024
S51	S50 AND EM 20230620-20240320	4
S50	S49 AND EM 20000101-20240320	83
S49	S46 AND S47 AND S48 AND S43 Limiters - Language: English	85
S48	S25 OR S26 OR S27 OR S28 OR S29 OR S30 OR S31 OR S32 OR S33 OR S34 OR S35 OR S36 OR S37 OR S38 OR S39 OR S40 OR S41 OR S42	295,499
S47	S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21 OR S22 OR S23 OR S24	42,407
S46	S1 OR S2 OR S3 OR S4	73,563
S45	TI (("abandonment" or "discontinuance") and "model") OR AB (("abandonment" or "discontinuance") and "model")	206
S44	TI "Matching Person and Technology" OR AB "Matching Person and Technology"	22
S43	TI (theor* OR framework* OR model* OR taxonom* OR classifi* OR concept*) OR AB (theor* OR framework* OR model* OR taxonom* OR classifi* OR concept*)	1,068,768
S42	(MH "Geriatrics")	6,055
S41	(MH "Amputation")	7,658
S40	TI "Motor difficult*" OR AB "Motor difficult*"	246
S39	TI Amput* OR AB Amput*	15,119
S38	TI "Mobility limit*" OR AB "Mobility limit*"	964
S37	TI "Mobility impair*" OR AB "Mobility impair*"	800
S36	TI "Mobility difficult*" OR AB "Mobility difficult*"	164
S35	TI "Ambulat* Difficult*" OR AB "Ambulat* Difficult*"	26
S34	TI "physical* Challeng*" OR AB "physical* Challeng*"	389
S33	TI "physical* impair*" OR AB "physical* impair*"	1,735
S32	TI Handicap* OR AB Handicap*	6,455
S31	TI "Walking difficult*" OR AB "Walking difficult*"	233
S30	TI Disabilit* OR AB Disabilit*	127,711
S29	TI Disable* OR AB Disable*	12,959
S28	TI "Physical* Disable*" OR AB "Physical* Disable*"	450
S27	TI Elder* OR AB Elder*	114,817
S26	(MH "Physical Mobility")	7,752
S25	(MH "Persons with Disabilities")	37,552
S24	TI "mobility product*" OR AB "mobility product*"	6
S23	TI "assistive product*" OR AB "assistive product*"	69
S22	TI ("Assistive device*" n10 mobility) OR AB ("Assistive device*" n10 mobility)	152
S21	TI ("Assistive technolog*" n10 mobility) OR AB ("Assistive technolog*" n10 mobility)	130
S20	TI "Prosthet* device*" OR AB "Prosthet* device*"	410
S19	TI "power mobility" OR AB "power mobility"	136
S18	TI Orthose* OR AB Orthose*	2,497
S17	TI Exoskeleton* OR AB Exoskeleton*	807
S16	(MH "Assistive Technology Devices")	6,723
S15	TI orthotic* OR AB orthotic*	2,695
S14	(MH "Limb Prosthesis")	3,004
S13	TI Prosthetic* OR AB Prosthetic*	12,859

S12	TI Walker* OR AB Walker*	3,882
S11	TI Scooter* OR AB Scooter*	449
S10	TI Wheelchair* OR AB Wheelchair*	5,801
S9	TI "Mobility technolog*" OR AB "Mobility technolog*"	39
S8	TI (“Mobility device*”) OR AB (“Mobility device*”)	425
S7	(MH "Exoskeleton Devices")	328
S6	(MH "Orthoses")	7,208
S5	(MH "Wheelchairs")	5,126
S4	TI ((Adoption* n10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*))) OR AB ((Adoption* n10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)))	3,266
S3	TI (Provide* n10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*))) OR AB (Provide* n10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)))	40,826
S2	TI ((Provision* n10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*))) OR AB ((Provision* n10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)))	5,207
S1	TI ((Access* n10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*))) OR AB ((Access* n10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)))	29,412

Database(s): **Scopus** Search Strategy:
Results from 20 Mar 2024

(((TITLE-ABS (access* W/10 (barrier* OR challeng* OR restrict* OR obstacle* OR impediment* OR difficult* OR issue*)))) OR ((TITLE-ABS (provision* W/10 (barrier* OR challeng* OR restrict* OR obstacle* OR impediment* OR difficult* OR issue*)))) OR ((TITLE-ABS (provide* W/10 (barrier* OR challeng* OR restrict* OR obstacle* OR impediment* OR difficult* OR issue*)))) OR ((TITLE-ABS (adoption* W/10 (barrier* OR challeng* OR restrict* OR obstacle* OR impediment* OR difficult* OR issue*))))) AND (TITLE-ABS ("Disabled Person*" OR "Mobility* Limitation*" OR elder* OR "Physically Disabled" OR disable* OR disabilit* OR "Walking difficult*" OR handicap* OR "physically impair*" OR "Physically Challeng*" OR "Ambulat* difficult*" OR "Mobility difficult*" OR "Mobility impair*" OR "Mobility limit*" OR "Amput*" OR "Motor difficult*" OR amputation*)) AND (TITLE-ABS (theor* OR framework* OR model* OR taxonom* OR classifi* OR concept* OR "Matching Person and Technology" OR (abandonment OR discontinuance AND model))) AND (TITLE-ABS (wheelchair* OR "power mobility*" OR "Mobility device*" OR "Mobility technolog*" OR ("Assistive technolog*" W/10 mobility) OR ("Assistive device*" W/10 mobility) OR orthotic* OR exoskeleton* OR scooter* OR walker* OR prosthet* OR orthos* OR prosthetic* OR "Prosthe* device*" OR orthotic* OR "mobility product*" OR "assistive product*")) AND PUBYEAR > 1999 AND PUBYEAR < 2025 AND (LIMIT-TO (LANGUAGE , "English"))

173 documents

Theories, models and frameworks to understand barriers to the provision of mobility assistive technologies: A scoping review

Appendix 3, Table. Characteristics of included papers

Authors and Year	Study design	Aims of the study	Population (n, characteristics	Country
McIntyre, Cleland and Ramklass (2021) [49]	Qualitative, Semi-structured interviews	To explore facilitators and barriers to accessible wheelchair services	11(8 occupational therapists and 3 physiotherapists)	South Africa
Dorjbal et al. (2020) [48]	Qualitative, Semi-structured interviews	To identify environmental barriers and their influence on daily life	16(SCI patients)	Mongolia
Jindal et al. (2018) [46]	Qualitative, Semi-structured interviews	To investigate parents' perceptions of rehabilitation and their information needs for their child with cerebral palsy (CP)	18 (parents of children with CP)	India and Canada
Bhidayasiri et al. (2022) [50]	Review article	To present clinical viewpoints on the unfulfilled needs of wearable technology, such as exoskeletons and orthoses	N/A	N/A
Layton (2012) [38]	Mixed method	To identify barriers and facilitators to optimal mobility from the perspective of AT users	100 (AT users. Neurological conditions)	Australia, Survey, Open-ended responses
Mairami et al. (2017) [44]	Qualitative, case study, Semi-	1. To illustrate how AT influences stroke recovery and how the	1(Stroke patient)	Malaysia

	structured interview	environment might be altered to facilitate recovery 2. To examine the issues of AT affordability and accessibility		
Dwyer and Mulligan (2015) [40]	Literature review	To determine the obstacles and enablers for community reintegration as experienced by individuals with SCI	A total of 373 participants in the 7 included studies	New Zealand
Seymour, Geiger and Scheffler (2019) [47]	Qualitative, Focus group	To identify the issues associated with wheelchair provision and the elements that contribute to or mitigate these challenges	21 (Community rehabilitation workers)	Uganda
Gonçalves Junior, Knabben and Luz (2017) [43]	Qualitative, Semi-structured interviews	To demonstrate how people with lower limb amputation function and express their limitations	6 (patients with amputation)	Brazil
Arthanat, Elsaesser and Bauer (2017) [42]	Quantitative, Survey	To explore how AT providers perceive their education and training, the use of evidence and guidelines, financing policies.	318 (AT providers)	US
Gowran et al. (2021) [23]	Position Paper	To examine the global challenges related to wheelchair accessibility	N/A	N/A
Steel and Layton (2016) [41]	Feature Article	An exploration of the complexities of AT provision in Australia	N/A	Australia
Widehammar et al. (2020) [45]	Qualitative, Semi-structured interviews	An exploration of how users' experiences of power mobility products	14(AT users)	Sweden

		are influenced by environmental factors		
Hammel et al. (2013) [39]	Qualitative, multiple case study, Focus groups	Multiple stakeholders' perspectives, issues, and priorities related to accessing, using, and evaluating MATs	65(45 AT users, 10 caregivers, 10 service providers)	USA and Canada
Serres-Lafontaine et al. (2023) [51]	Qualitative, photovoice method	To study how peer training affects social involvement	10 Wheelchair users (SCI patients)	Tanzania
Oskar et al. (2011) [22]	A postal questionnaire	To explore and assess the experiences of active wheelchair prescribers under the regulations and provisions set by local Swedish governments	278 prescribers	Sweden
Smith et al. (2016) [52]	Review article	To investigate the determinants influencing participation among wheelchair users	35 studies were included	N/A
Nabizadeh et al., (2023) [16]	Qualitative, Semi-structured interviews	To explore barriers and facilitators to prosthetic services for lower limb amputees	29 individuals with lower limb amputation	Iran

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Appendix 4 Table. Propositions identified in the theories, models and frameworks

Name of the theory, model or framework	Propositions
International Classification of Functioning, Disability, and Health (ICF)	1. A health condition can affect both the mental and physical body functions. 2. An individual's activities are impacted by their health condition. 3. Health conditions affect an individual's engagement in activities, determining their level of participation. 4. External factors, for example, social factors, can either inhibit or facilitate an individual's level of functioning. 5. Society may create barriers, for example, inaccessible services or lack of facilitators, such as the unavailability of AT, which can affect an individual's performance. 6. An individual's functioning is affected by the presence or absence of services, for example, equipment, products, and technologies in their environment.

7. External elements like systems and policies that regulate and facilitate the provision of services can impact a person's functional capacity.
8. An individual's level of functioning can also be influenced by external factors such as support and relationships, including family, people in positions of authority, and health professionals.
9. Personal factors of an individual represent their internal aspects, including psychological factors, that can affect their level of functioning.
10. Individuals' functioning and disabilities are influenced by their health status as well as contextual factors, such as environmental and personal factors.
11. Functioning is defined as encompassing body functions, body structures, activities, and participation.

	12. An impairment, an activity limitation, or a restriction on participation constitutes a disability.
Levesque's conceptual framework	1. The concept of approachability is related to the ability of individuals with health needs to recognise the existence of available services, access them, and receive effective healthcare that can improve their health. 2. Cultural and social factors determine the acceptability of health services within their context. 3. The reachability of health services depends on their physical presence and timeliness. 4. Factors like personal mobility, transportation availability, adaptability in occupation, and knowledge of accessible health services are interconnected and contribute to an individual's capacity to access healthcare providers physically.

5. The concept of affordability in healthcare refers to the ability of people to pay for services without causing undue financial hardship or affecting their ability to afford basic necessities.
6. The ability to afford healthcare services is connected to a person's financial resources, including income, savings, and borrowing capacity.
7. Appropriateness in healthcare refers to the fit between the services provided and the needs and preferences of clients, as well as the quality and safety of those services.
8. Engaging in healthcare involves the active participation of clients in decision-making and treatment planning, which helps to ensure that care is aligned with their goals and values.
9. Accessibility of health services is affected by the availability of information.

	10. Personal autonomy and the ability to choose care-seeking are linked to the ability to access health care.
The Human Activity Assistive Technology model (HAAT)	1. AT enhances an individual's capabilities to complete desired tasks. 2. Human activities are essential, learnable, and influenced by societal and cultural contexts. 3. The use of desired technology is influenced by human skills and abilities (physical, cognitive, emotional). 4. An individual's ability to perform activities is affected by their skills and abilities (physical, cognitive, emotional). 5. The use of AT to perform an activity is influenced by various factors in the environment, including physical, social, cultural, and institutional elements.

	6. Choosing and implementing the right AT requires considering the interaction between different elements, including the activity being performed, the user's needs and abilities, and the broader environmental context in which the technology will be used. 7. The process of performing an activity leads to a functional result of human performance.
Gibson's affordances theory	1. Cognition: Affordances exist as a cognitive process which comes through people and organisations interacting with material entities. 2. Perception: Affordances need to be perceived or recognised by the person or organisation. 3. Behaviour: the affordance is actualised as the behaviour that people/organisations adopt acting on the perceived opportunity for action.

	4. Evaluation: Evaluating the effects of this behaviour. 5. Environmental factors and structures can impact disabilities.
Systemic development model (SDM)	1. Understanding personal, organisational, and institutional capacity requires consideration of factors such as health, culture, economics, and politics. 2. It is crucial to provide appropriate services to improve the health, well-being, and fundamental freedoms of individuals in need. 3. Limited access to services can create a cycle of poverty and disability. 4. Service delivery systems that are tailored to specific contexts play a significant role in ensuring appropriate service provision. 5. Economic factors impact the availability of products and services

	and can affect the viability of service provision. 6. Evaluation of the quality, development, performance, and procurement standards of products is crucial for improving service delivery systems and individual health outcomes. 7. Political governance also plays a role in ensuring access to appropriate services.
Multi Intervention Paradigm for Assessment and Application of Concurrent Treatments (IMPACT^2)	1. The results of interventions can be outlined by examining the six phases, including: 1) Pre-Intervention, 2) Context, 3) Baseline, 4) Intervention Strategies, 5) Outcome Covariates, and 6) Outcomes. 2. Personal and contextual factors influence the products and services used by individuals to perform activities.

3. Universal design and health promotion are two methods that can be utilised to enhance functional performance.
4. The context in which AT is used to perform a task within an environment is crucial for improving participation and QoL.
5. Intervention approaches, such as reducing the impairment, compensating for the impairment, using AT, and redesigning the activity, are used to support the use of AT and optimise an individual's functioning.
6. Consumer satisfaction is a desirable outcome of AT provision.
7. Outcome(function) is defined as participation, QoL, and engagement.
8. Cost influences the Intervention approaches therefore affecting Outcomes.

Matching Person and Technology (MPT)	1. AT serves as a bridge between individual capabilities and the demands of tasks within their environment. 2. Personal autonomy and the performance of everyday activities are enhanced by integrating technology that matches individual needs. 3. The compatibility of assistive products with the user's lifestyle is crucial for successful adoption and satisfaction. 4. The user's physical, cognitive, and emotional dimensions must be considered to optimise the functionality of AT. 5. AT should empower individuals, promoting independence and self-efficacy in their desired roles and activities. 6. The design and functionality of assistive technology must reflect the

	user's self-image and socio-cultural identity to foster acceptance. 7. AT should assist and elevate the user's ability to engage in social roles and activities with confidence and ease. 8. The choice of AT is personal, influenced by individual preferences, aspirations, and the context of their lives. 9. Effective AT integrates into the user's environment, enhancing their capabilities without introducing new barriers. 10. The success of an assistive product is measured not only by its technical features but also by its ability to align with the user's psychosocial context and enhance their QoL.
Penchansky and Thomas' framework of access	1. Access is defined by the degree to which healthcare systems are

equipped to meet the requirements of patients

2. Affordability assesses whether the costs imposed by the provider align with the client's financial capacity and willingness to pay for the services offered.
3. Availability refers to the provider's capacity to meet the client's needs through adequate resources, including staff and technology.
4. Accessibility concerns the ease with which clients can physically reach the provider's location.
5. Accommodation evaluates the extent to which the provider's operational procedures, such as hours of operation and telephone communication, are convenient for the client.
6. Acceptability pertains to the degree of comfort the client experiences with the provider's fixed characteristics and encompasses considerations of the client's

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	health condition and type of health coverage.

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Appendix 5, Table. Gaps analysis

Gaps	**Recommendations for future research**
Remote Regions and Accessibility	Key areas for future investigation included examining access to AT in remote regions [38, 49, 46] by investigating challenges and barriers faced in remote regions [49], and explore the differences between men and women in accessing services [16], and concentrating on modifiable elements like wheelchair skills and ease of access [51]
Stakeholder Perspectives	The included papers in this review draw attention to several issues, such as investigating policymakers' and HCPs' views on rehabilitation services [46]. Understanding the challenges faced by people with disabilities [51]. This includes understanding stakeholder perspectives on the various aspects of access by identifying the enablers and barriers that might aid in planning to increase access to AT services [47,49].
Funding, Policy, and Legislation	Future research should investigate funding and policy-related barriers [22, 40, 42, 48], the impact of legislation on accessibility and participation for powered mobility product users [45], fostering low-cost approaches in low- and middle-income countries [44], and promoting inclusive solutions for wheelchair service provision [23,51].

Theories, models and frameworks to understand barriers to the provision of mobility assistive technologies: A scoping review

Data Collection and methodological improvements	Adoption of standardised instruments to assess functioning and disability is needed [43,45]. Comparing perceptions users with and without AT [43,45]. Exploration of user satisfaction, choice, and control in relation to MATs and its impact on overall outcomes [39]. Development of standards for testing AT effectiveness [50]. Additionally, research could explore the long-term effects of delayed services on individuals with disabilities [16]
Contextual Understanding and service evaluation	Importance of investigating in-country perspectives consideration of personal, social, economic, environmental, historical, and political factors [23]. Incorporating subjective measures in service evaluations [41]. Assessing the effects of new products on work environments and identifying the annually prescribed types of AT are essential undertakings [22].

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Theories, models and frameworks to understand barriers to the provision of mobility assistive technologies: A scoping review

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Abstract

Objectives There is strong evidence that mobility-assistive technologies improve occupational performance, social participation, educational and employment access, and overall quality of life in people with disabilities. However, people with disabilities still face barriers in accessing mobility products and related services. This review aims to summarise and synthesise: 1) theories, models, and frameworks that have been used to understand mobility-assistive technology access, 2) determinants of access, and 3) gaps in knowledge.

Design A Scoping review using the five-step Arksey and O'Malley Framework.

Data sources We searched the MEDLINE, EMBASE, CINAHL, and SCOPUS databases for publications published between 2000 and 2024. We searched for articles published up to 20 March 2024.

Eligibility criteria We included English-published literature in peer-reviewed journals that reported (a) barriers to the provision of mobility-assistive technologies, (b) including at least one theory, model, or framework, and (c) between 2000 and 2024.

Data extraction and synthesis We extracted the study characteristics, theories, models, framework usage, research recommendations, key findings on mobility-assistive technology barriers, and theoretical propositions. We conduct a theoretical synthesis guided by Turner's approach.

Results We included 18 articles that used eight theories, models, and frameworks, synthesised into nine propositions. The synthesised theory emphasises that mobility is essential for human flourishing, and that certain health conditions may impose restrictions on mobility. This impact can be alleviated by two direct determinants: (1) the provision of suitable services and (2) their comprehensive provision. Policies and costs influence these services indirectly. Environmental and personal factors also affect the use of these services. Ineffectively addressing these determinants can limit access to mobility-assistive technologies and subsequent disabilities.

Conclusion Our synthetic model describes the logic of providing evidence-based mobility-assistive technologies, and we identify the determinants of access which can act as targets for future work to improve mobility-assistive technologies provision.

Strengths and limitations of this study

- We used a comprehensive search strategy developed with an information specialist to identify relevant publications.
- We mapped reported barriers to a widely used conceptual framework - the Consolidated Framework for Implementation Research - for consistent terminology.
- We conducted a theoretical synthesis to generate new insights.
- We excluded non-English studies, potentially limiting the applicability of our findings.
- We exclude grey literature, which further narrows the scope of the review.

INTRODUCTION

Neurological conditions, musculoskeletal disorders, and ageing are associated with considerable human burdens, including decreased quality of life (QoL) [1,2], activity limitations [3], participation restrictions [4,5], increased dependence, and caregiver burden [6]. Mobility-assistive technologies (MATs) are vital for addressing the challenges posed by these conditions, as they can help improve QoL, promote independence, enhance occupational performance, increase participation, and alleviate the burden on individuals, families, and societies [7]. MATs encompass assistive products for mobility and related systems and services [7]. These assistive products include devices, software, or instruments specifically designed or widely available to enhance the functioning of an individual [8]. They support or substitute the ability to move, thereby facilitating movement from one location to another [8]. Examples include wheelchairs, walking frames, rollators, and prosthetic and orthotic products [8].

Wheeled mobility products, prosthetics, and orthotics are cost-effective for improving the QoL and independence of people with disabilities [9,10]. Despite being endorsed by the United Nations [11] and World Health Organization (WHO) [7], which are essential for creating equitable opportunities for people with disabilities, access to these MATs remains limited [7,12]. There is a considerable unmet need for MATs worldwide, with only a small percentage of those who require them having access [7,12]. Access to assistive technology (AT) is defined as the equitable and sustainable provision of assistive products and support services that adhere to six key principles: accessibility, affordability, availability, adaptability, acceptability, and quality [7]. These principles ensure that assistive products and services are reachable, cost-effective, adaptable to individual needs, culturally appropriate, widely available, and of high quality [7].

The reasons for the unmet need for MATs are poorly understood but include the absence of national policies, high costs, and insufficiently trained personnel [7]. Several pre-existing theories, models, and frameworks (TMFs) have been used to understand the determinants of access and uptake, each with different conceptual coverage and terminology, which could help plan corrective actions. A framework is a structure for organising concepts that enable the description of phenomena [13,14]. For instance, Levesque's conceptual framework defines five dimensions of healthcare accessibility: approachability, acceptability, availability, affordability, and appropriateness [15]. This framework builds upon Penchansky and Thomas' foundational work, which originally identified the key dimensions of access to healthcare services as availability, accessibility, accommodation, affordability, and acceptability. These dimensions define access by assessing how well healthcare systems are prepared to meet patients' needs [16]. The International Classification of Functioning, Disability, and Health framework (ICF) is a framework developed by the WHO that classifies the health and disability components of functioning and contextual factors [17]. These include multi-aspect concepts related to body functions, structures, activities, participation, and environmental factors [17].

A model is a simplified representation of reality that holds for a specific case or population [13,18,19]; models may describe the relationship between their components but tend to be descriptive rather than explanatory [13]. For example, the Human Activity Assistive Technology (HAAT) model describes the interaction between human activity, AT, and the physical, social, and cultural contexts in which it is used [20]. The integrated multi-intervention paradigm for the assessment and application of concurrent treatments (IMPACT^2) model describes the variables related to AT interventions [21]. The Matching Person and Technology (MPT) is a model that describes the interaction between environmental, personal, and technological factors in the success of AT uptake [22]. The Systemic Development Model (SDM), developed by the World Engagement Institute (WEI), describes four

interconnected pillars of sustainability—health, culture, economics, and politics—to enhance the understanding of capacities at the personal, organisational, and institutional levels [23].

A theory is an interconnected set of abstract statements that explain, predict, or prescribe phenomena, going beyond specific contexts to consider broader meanings and implications [13,14,18,24]. For instance, Gibson's theory proposes that the environment contains actionable (and therefore explanatory) properties, "affordances", that are directly perceived [25]. When a research area is characterised by theoretical incoherence, researchers must choose between rigid empiricism, selecting theories based on their virtues, developing their own theory, and theoretical synthesis [26]. Theoretical synthesis can amalgamate propositions from different theories into a propositional network, enabling researchers to extend the coverage, content validity, and document points of convergence [26]. Scoping reviews are ideal for uncovering key concepts and informing future research designs [27]. This paper presents a scoping review that summarises and synthesises the TMFs used to understand MAT access, identifies the determinants of access, and highlights the gaps in current knowledge.

METHOD

We report a five-stage scoping review based on the approach outlined by Arksey and O'Malley [28], in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) (online supplemental appendix 1) [29]. This study did not meet the eligibility requirements for registration using PROSPERO. The research questions were as follows: What theories, models, and frameworks have been used to understand the barriers to the provision of MATs for people with mobility issues? What are the determinants of access to MATs for people with mobility issues? What are the current knowledge gaps in access to MATs for people with mobility issues?

Eligibility criteria

The Behaviour of Interest, Health Context, Exclusion, Models, or Theories (BeHEMoTH) framework [30] was employed to formulate the search concepts (Table 1) and eligibility criteria (Table 2).

Table 1 Application of the BeHEMoTH framework to define search concepts

BeHEMoTH	Concept
Be – Behaviour of interest:	Barriers to access or provision
H – Health context	People with mobility issues AND MATs
E – Exclusions	NA
MoTh – Models or Theories	Models or Theories or Frameworks

Table 2 Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria	Rationale

Publications reporting on the barriers to the provision of MATs	Publication concentrates on aspects other than barriers to access, and there is no report on barriers	This review focuses on understanding barriers to the provision of MATs
Publications including at least a theory, model, or framework	Publications that did not employ a theory, model, or framework	To ensure that the articles concentrate on theory, model, or framework to understand the barriers
Publications in peer-reviewed journals	Other publications such as conference abstracts and theses	To ensure that studies had undergone rigorous evaluation
Publications published in the English language	Publications in other languages	Costs and time commitment associated with article translation
Publications between 2000 and 2024	Publication published before 2000	To ensure using the most relevant publications from the previous 24 years

Information sources and Searches

Literature searches were performed by (AA) on MEDLINE (Ovid), EMBASE (Ovid), CINAHL (EBSCO), and SCOPUS databases for studies published between 1 January 2000 and 20 March 2024. To identify the appropriate publications relevant to the research issue, a *priori* search strategy was established in collaboration with the authors (AA and DH) and an information specialist (FZ). The search terms combined the concepts of 'barriers to provision, mobility issues, AND 'MATs', and a theory/model/framework'. Free text terms, subject heading, use of the Boolean operators "AND" and "OR", and truncation were all used to ensure a successful search. The final search strategy was tested on MEDLINE via Ovid, and then translated into other databases. The full search strategy and results are presented in online supplemental appendix 2. We reviewed the reference lists of the included articles to identify additional relevant articles [28] but restricted the eligibility to peer-reviewed studies, excluding grey literature.

Study selection

The Rayyan platform (https://www.rayaan.ai) was used for study selection. Initial title and abstract screening were conducted by (AA), where the primary aim was to assess studies for potential relevance based on predefined inclusion and exclusion criteria. Given the subjective nature of this assessment, any uncertainties regarding study eligibility encountered by AA were systematically discussed with the other reviewers (DH, SR, and BF). Full-text screening involved consistent discussions among (AA, DH, SR, and BF), and the full texts of eligible articles were subsequently retrieved for a more detailed assessment.

Data charting process

To facilitate consistent data presentation and synthesis, we charted general and study-specific information from the studies in Microsoft Excel spreadsheets. Data items included country of origin, study population, aims, sample size, study design, data collection tool, TMF used, a brief description of its purpose, research recommendations, and key findings related to barriers to the provision of MATs. We extracted theoretical propositions from the TMFs, as discussed in the articles included in our review. In instances in which these articles did not provide a comprehensive explanation of TMFs, such as Gibson's affordances theory, the IMPACT^2 model, and the HAAT model, we referred to the foundational sources. The sources cited within the included articles are original materials in which TMFs were first introduced or explained thoroughly. This ensured that our understanding and coverage of TMFs was comprehensive, especially when the application of these TMFs in the reviewed articles lacked depth. Although these foundational sources were not directly included in our review as they did not meet our inclusion criteria, they were consulted for additional insights. We mapped the reported barriers to one of the updated constructs of the Consolidated Framework for Implementation Research (CFIR), a synthetic framework of constructs used in 19 implementation theories [31,32], using a codebook (https://cfirguide.org/). The CFIR provides a set of standardised constructs to guide researchers, creating a common language for explicitly and consistently describing aspects that may affect the provision [33].

Synthesis of results

Tabular summaries and narrative syntheses were completed for the included articles and their TMFs [34]. We conducted a theoretical synthesis to generate new insights that were unavailable for any TMF [35]. The synthesis was guided by Turner's [36] approach. In Step 1, the TMFs are summarised, and their shared themes are identified. In Step 2, the aspects of the TMF that pertain to core concepts by extracting the phrases used, their definitions, and their explicit and implicit relationships are identified. In Step 3, the TMFs are broken into simple propositions that can be compared and tabulated. In Step 4, the theories are compared and determined how they converge or diverge by combining similar elements. In Step 5, the convergent elements from the TMF are combined into a single conceptual model that focuses on the relationships between concepts. For example, during this stage, we examined how concepts from these TMFs—such as cost, services, and activity (mobility)—interacted and influenced each other within the synthesised theory to gain theoretical insight. We incorporated statements from the studies included in this review to strengthen the synthesis and support the resulting conceptual model (Step 6).

Gaps analysis

To identify knowledge gaps and areas for future research, we reviewed papers and tabulated explicit recommendations, which is a core function of scoping reviews [27].

Patients and public involvement

No patients or public were involved in the study.

RESULTS

Characteristics of the studies

The literature search yielded 306 citations after the removal of duplicates. A total of 246 citations were excluded after initial screening, and 60 potentially eligible articles were retrieved for full-text review. Of these, 45 were excluded because barriers were not reported (*n* =10), TMFs were not reported (*n*=27), and the citations were conference abstracts (*n*=7) or theses (*n*=1). Fifteen studies identified from the databases met all the eligibility criteria. After reviewing the reference lists and conducting manual searches, 25 additional studies were identified and examined for eligibility, and three studies were determined to be eligible (Figure 1) [37].

Figure 1 PRISMA flow diagram.

The final synthesis included 18 articles (online supplemental appendix 3) [16,22,23,38–52]. Eight studies addressed the challenges associated with the provision and use of MATs [16,22,23,38,39,42,44,47,49,50]. Four studies examined environmental barriers to participation [40,45,48,51,52]. Two studies explored the experiences of patients and caregivers and their rehabilitation needs [43,46]. One study drew attention to inconsistencies in AT provision schemes [41]. There were (*n*=5) secondary studies and (*n*= 13) primary research studies conducted between 2012 and 2023 in South Africa [49], Mongolia [48], Canada, India [46], Australia [38,41], Malaysia [44], New Zealand [40], Uganda [47], Brazil [43], United States [42], Iran [16], Sweden [22,45], Tanzania [51], Canada, and the United States [39]. The primary studies contained between one and 318 participants.

Eight TMFs, representing various perspectives, were identified. Two were biopsychosocial in orientation: the ICF [17] and HAAT [20], which focused on AT. Two other models that focus on AT are IMPACT^2 [21] and MPT [22]. Four other identified TMFs were applied to AT access: Penchansky and Thomas's framework [16], Levesque's theoretical framework [15], Gibson's affordances theory [25], and the SDM [53]. The most frequently used TMF was ICF (*n* = 12). All included studies applied one TMF, except for one [41], which used two in combination: ICF and IMPACT^2. There are three distinct applications of TMFs, as shown in Supplemental Figure 1. The majority were used as a basis for analysis and interpretation (*n* = 13) or as a guide for designing the surveys and interviews (*n* = 2). In addition, TMFs were used as a comprehensive framework to provide a context for reviewing the relevant literature (*n* = 3).

Barriers to MATs provision synthesised using CFIR

The key barriers in the innovation domain are cost concerns [16,23,38–42,44,46,48,49], intervention complexity [23,39,45,47], inadequate evidence of effectiveness [41,42], product-related factors such as comfort, durability, and fit [52]; and limited models and colour choices available [22] (Figure 2). The outer-setting domain highlights societal attitudes toward AT [22,47,48,50,52], geographic distance [16,41,43,49], a lack of supportive legislation [16,23,39,45,47,48,50,51], and environmental barriers [22,52]. Within the inner-setting domain, resource constraints [23,42,43,47,49], restricted knowledge, and information access hinder provision [23,38,39,42,47,50]. The characteristics of the individuals' domains revealed knowledge about the intervention [23,47,48,50] and low self-efficacy among healthcare professionals [16,42,49] as barriers to its adoption. In addition, within the

characteristics of individual domains, barriers include limited information access [16,38–40,43,45,49], such as a lack of access to training and instructions on the use and management of mobility products [16]. Furthermore, there is a lack of awareness among users [49,50], and insufficient inclusion of user preferences in prescriptions [22]. In the process domain, barriers include insufficient stakeholder engagement [39,42,50], absence of interdisciplinary standards [42], and limited strategic planning [39].

Figure 2 Barriers to the provision of MATs synthesised using the CFIR.

Theories, Models and Frameworks (TMF) Synthesis

The propositions derived from the theories, models, and frameworks are described in Supplemental Appendix 4, and the resulting synthetic model is presented in Figure 3.

Figure 3 Synthetic model.

Proposition 1: mobility is essential for human flourishing

The ICF framework highlights activity as a key component of health, with disabilities resulting from restricted activities, such as mobility issues [17]. This affects participation in everyday activities, such as work, socialisation, and healthcare access [17]. The HAAT model explains a similar concept, describing the 'activity' as the action of performing a task that represents the functional outcome of human performance [20]. Building on these insights, 'mobility' is viewed as an individual's ability to perform tasks that enable meaningful participation. The HAAT model and IMPACT^2 emphasise the importance of participation in everyday activities, such as working and socialising, for overall health [20,21], describing it as "necessary to human existence" [20]. According to the HAAT model, humans are defined based on their intrinsic physical, cognitive, and emotional abilities [20]. Accordingly, mobility is viewed more as a necessary means of meaningful participation than an end to the development of physical, cognitive, and psychosocial skills throughout life [38,46]

Proposition 2: health conditions and personal factors influence mobility

An individual's mobility is influenced by health and personal factors, which, in turn, affect their participation in social, work, and leisure activities. For example, the ICF framework clearly describes how health issues and personal factors can affect activities and participation [17] and describes health conditions as umbrella terms for diseases, disorders, injuries, or trauma [17]. Similarly, the HAAT model highlights the impact of a person's physical and cognitive abilities and personal elements, such as emotional and psychological factors, on their ability to perform activities [46]. Accordingly, 'personal factors' that encompass elements, such as psychological attributes, age, and coping style influence an individual's ability to perform activities [17]. For example, Dwyer and Mulligan [40] highlighted how emotional changes caused by spinal cord injury (SCI) could impede participation in rehabilitation services and other areas of reintegration, such as employment and leisure activities.

Proposition 3: appropriate services influence mobility

The ICF and HAAT models explicitly describe the relationships between the activities and their environments. Both emphasise the importance of activities for participating in and developing in life, and some interventions can improve a person's ability to engage in the desired activities [17,20]. For instance, in the ICF framework, AT services are considered to be an environmental factor, which is appropriate for helping individuals achieve their intended activities and participate in various situations [17]. Similarly, the MPT model was developed considering the ICF framework and focusing on the relationship between individuals and AT [54]. This suggests that AT is an essential means of bridging the gap between an individual's capabilities and the demands of tasks in their environment, thereby significantly enhancing their engagement in the desired activities [22]. Levesque's framework, building upon the foundational work of Penchansky and Thomas, identifies that 'the appropriateness of a service' is determined by its alignment with the needs of the client, whereas the HAAT and MPT models emphasise that with AT, an individual's capabilities are increased [15,16,20,22]. Consequently, to meet individual needs and maximise capabilities, we define the appropriateness of services based on the extent to which they are tailored. This demonstrates that MATs are vital for people with disabilities and for older people who require them, thus enhancing their independence and participation in daily life [38,46].

Proposition 4: service delivery must be comprehensive to influence human mobility

Institutional factors significantly influence individual activities, as explained by the HAAT model [20] and ICF frameworks [17]. Levesque's framework emphasises the importance of how services are provided to meet client needs [15], whereas Penchansky and Thomas highlight the necessity of adequate resources, including staff, to ensure that these needs are effectively met [16]. Similarly, the IMPACT^2 model is concerned with providing services and ensuring that outcomes are met, including QOL, participation, and satisfaction with the services provided [21]. The MPT model demonstrates that user satisfaction with service provision can be achieved by considering key features of products such as usability, quality, weight, stability, and safety [22]. Accordingly, the concept of 'comprehensive services' refers to providing clients with high-quality products and the necessary support services to meet their needs and achieve satisfaction. Providing comprehensive services encompassing assessment, training, and maintenance is crucial for enhancing personal mobility [23,39]. Effective delivery of AT services requires well-trained personnel [23]. These are critical components of service delivery systems that help individuals enhance their mobility.

Proposition 5: environmental factors influence individuals' decision to seek appropriate health care services

Assistive products for mobility and participation are influenced by environmental factors such as social, cultural, and physical environments, which affect individuals' health and well-being. The ICF framework views disability as a health experience arising from context and not solely within an individual [17]. It emphasises how society can create barriers such as inaccessible services or neglected facilitators, such as the lack of AT [17]. Furthermore, an individual's level of functioning is determined by their relationships with family, people, and healthcare providers, all of which can influence their decision to seek healthcare [17]. A similar concept of how society affects activities is highlighted by the HAAT model, which places particular emphasis on an individual's cultural context [20]. The MPT model also emphasises the role of sociocultural factors, acknowledging how a user's

social setting and cultural attitudes towards disability can influence their perception of and adoption of mobility products. This includes consideration of product-related social implications and stigmas [22]. For example, parents of children with disabilities oppose wheelchairs because of social stigma [46], and some older people perceive mobility products negatively because of stigmatising symbolism [50]. This demonstrates the significant influence of sociocultural factors, such as support and relationships from family, health professionals, and community on MAT accessibility and acceptance. Furthermore, the MPT model emphasises the importance of the physical environment, which includes both the built environment within the user's home and the external surroundings, in affecting use and acceptance [22]. For example, if a wheelchair does not fit the physical and psychosocial environment in which it is used, it is more likely to limit function rather than enhance it [22]. Therefore, the success of MAT is not measured solely by its technical features but also by its ability to fit into the user's psychosocial context [22].

Proposition 6: policies influence the provision of services

The SDM framework highlights how organisational service delivery policies influence appropriate service provision [53], whereas the ICF explains how policies affect participation and activities [17]. As part of the ICF, the term 'policy' is commonly used within the environmental factor domain as an external factor that can impact an individual's health and function [17]. This set of guidelines, rules, and regulations governs the range of services provided to individuals, including policies and standards that define the eligibility criteria for services [45]. For instance, prostheses are not considered to be life-saving medical devices or crucial components of the healthcare system [43]. However, they are life-changing for users and can quickly restore most functions [43]. Levesque's framework argues that the availability of health services should ensure those in need can access either the physical facilities or healthcare personnel [15]. However, barriers to access emerge when healthcare is unavailable in certain geographic areas or when individuals' insurance does not cover the necessary treatments [15,16]. Penchansky and Thomas further emphasised the need for a well-organised supply of resources, including the integration of telephone or remote service consultations [16]. The lack of such accommodations can prevent individuals from obtaining the required healthcare, potentially leading to adverse health outcomes. Disparities between government and institutional policies can result in confusion among AT providers and decrease service utilisation [23,47].

Proposition 7: cost influences the provision of appropriate services

The SDM framework [53] highlights the significant influence of economic factors on service delivery and reinforces the idea that costs can significantly influence access to healthcare services. The term ‘cost’ refers to the expenses incurred by individuals and healthcare systems to provide services [15,21]. This comprises the direct prices of services such as consultation fees, product costs, and related expenses [15]. For instance, the IMPACT^2 model underlines the role of cost implications in selecting intervention approaches and demonstrating the cost effects at each stage of AT provision [21]. Both Penchansky and Thomas [16] and Levesque et al. [15] emphasised the critical role of an individual's financial capacity, including income and willingness to pay, in accessing healthcare. Therefore, costs can significantly influence access to AT.

Proposition 8: personal factors influence healthcare utilisation

Healthcare utilisation is influenced by various 'personal factors' that represent an individual's internal aspects, such as psychological characteristics [17]. This concept is explained using Levesque's framework. It highlights factors such as an individual's need for care, awareness of these needs, and desire for treatment [15]. Gibson's affordance theory suggests that an individual's perception of their environment is based on its potential to fulfil their needs, thereby shaping their decisions [25]. Therefore, the individual is responsible for unravelling the utility presented by affordance. For instance, the client in Mairami et al. [44] adapted a chair from a home to a wheelchair. This demonstrates how the client's perception of their environment shaped their recovery when an existing structure was found to have assistive potential. The ICF model explains the significance of environmental factors, such as the visibility of services, in determining an individual's level of functioning [17], which is related to Gibson's affordance theory, in which environmental cues trigger actions [25]. Consequently, the lack of service limits the activities that can be conducted. Personal factors not classified within the ICF are acknowledged to have a significant impact on healthcare access [17]. The MPT model highlights that the choice of assistive products is deeply personal and shaped by individual aspirations, anticipated satisfaction of needs, and perceived personal value of these products [22]. These elements play a crucial role in influencing the uptake of MATs, as they are associated with the context of users' lives [22].

Proposition 9: limited access to healthcare services creates disability

The ICF acknowledges the influence of environmental factors on disability development and emphasises the limitations it imposes on individuals' abilities to access healthcare services and engage in social activities [17]. As defined by the ICF, disabilities include impairments, limitations in activity levels, and restrictions on participation [17]. Consequently, restricted AT accessibility impairs body function, hinders participation, and contributes to disabilities. The SDM framework explains the significance of economic factors, particularly the "lack of economic means", which limit access to services such as MAT [53]. Restricted access can trigger continuous cycles of disabilities and poverty [23]. Persistent mobility constraints, whether due to inadequate MAT service support or diminished participation in daily life, have been identified as significant factors leading to disability [47,48].

Gaps analysis

This review highlights key research areas in AT services that warrant further investigation (online supplemental appendix 5). Investigations should focus on AT access in remote regions [38,46,49], examine gender disparities in service accessibility [16], explore stakeholder perspectives on rehabilitation services and barriers to AT access [47,49,51], and address challenges related to funding, policy, and legislation [22,23,40,42,44,48,51]. Data collection and methodological enhancements are required, including standardised instruments for assessing functioning and disability [43,45], comparisons of user experiences with and without AT [39,41], and comprehensive evaluation tools combining objective and subjective measures [39,41]. Emphasis should also be placed on understanding the in-country perspectives, inclusive solutions, and the impact of contextual factors on AT access [23]. This involves evaluating how new products impact workplace settings and determining which types of AT are essential [22]. Future studies should examine product compatibility, enhance user skills, and improve accessibility to the built environment [52]. Addressing these research gaps could contribute to the development of more effective, inclusive, and accessible AT services for individuals with disabilities.

DISCUSSION

This scoping review offers a summary of the barriers to MAT provision and synthesis theories to guide future work based on 18 articles. The synthesised theory emphasises that mobility is essential for human flourishing (Proposition 1) and that certain health conditions may impose restrictions on mobility (Proposition 2). This impact can be ameliorated by two direct determinants: the provision of suitable services (Proposition 3) and their comprehensive provision (Proposition 4). Policies (Proposition 6) and costs (Proposition 7) indirectly influence these services. Furthermore, an individual's decision to access these services is determined by their environment (Proposition 5) and personal factors (Proposition 8). If these direct and indirect determinants are not effectively addressed, it could result in limited access to MATs and subsequent disability (Proposition 9). This synthesised theory integrates empirical and ethical dimensions and provides evidence-based approaches to solving problems [18].

To the best of our knowledge, this is the first report on the synthesis of TMFs and the barriers to MAT provision. Although De Alves and Matsukura's [55] literature review outlined the various theoretical models used in the AT literature, they did not attempt theoretical synthesis. TMFs organise concepts and thoughts to provide insights into different elements of practice and research [13]. Lakatos proposes that scientific enquiry should appraise a series of theories rather than a single theory, noting that "the members of such series of theories are usually connected by a remarkable continuity which welds them into research programmes" [56]. Lakatos advocated for a 'pluralistic model' of scientific theories, in which several theories, which are organised deductively to varying degrees, are brought together in a unified approach [56]. Unlike Lakatos, we view this study as an enhancement of problem-solving effectiveness [57]. By combining propositions from different theories, we increased the coverage of the resulting syntheses of individual theories. It should predict the range of barriers encountered in MAT access and provision.

The theory covers a socially significant issue given that it addresses the current research priorities identified by expert panels organised by government agencies and clinical speciality organisations [7,58–60]. It addresses the phenomenon of interest to rehabilitation scholars by filling the gaps in the existing TMFs. Although the MPT model does not explicitly discuss barriers to AT access, it provides valuable insights into the interactions between the personal, technological, and environmental factors that influence successful AT adoption [22]. The MPT model, developed based on the ICF framework [54], highlights the importance of aligning assistive products with user needs, preferences, and contexts to optimise functionality and satisfaction. Future research should further explore how the MPT model can inform strategies to address barriers to access and provision of MAT.

An adequate specification was achieved by providing a clear and concise overview of the theoretical synthesis. In addition, we establish linkage adequacy by defining the concepts and their relationships [61]. The theory is testable because it contains observable concepts and propositions that can be operationalised and corroborated in empirical research. A limitation of the scoping review was the exclusion of non-English language studies, which could limit the applicability of the findings; research from other languages could have offered additional valuable insights [62]. Another limitation is that the review's focus on studies from 2000 to 2024 potentially omitted earlier relevant research on barriers and TMF. However, a broader historical scope may have reduced the relevance of the findings to contemporary decision-making in the provision of AT. The exclusion of grey literature, including government reports and policy documents, further narrowed the scope of the review. This exclusion may have resulted in the omission of relevant non-peer-reviewed TMFs. In addition, the processes of data extraction, coding using CFIR, and synthesis inherently involve subjectivity. Our search strategies and the databases selected may not have captured all relevant literature pertaining to

other important TMFs that have been used to understand barriers to MAT access, such as the Student, Environment, Tasks, and Tools (SETT) [63] and the Wisconsin Assistive Technology Initiative (WATI) [64]. Despite using SETT and WATI as search terms, these terms yielded no results in the databases we explored. This could indicate a lack in the literature where these frameworks are applied or reported in relation to barriers to MAT access, which requires further investigation. Search terms such as 'service delivery,' 'service*,' 'deliver*,' and additional or alternative terms for older people, such as 'older person*' or 'older adult*,' may have identified additional studies.

Our review highlights several key knowledge gaps regarding MAT access and provision. These include the need for research on AT access in remote regions, stakeholder perspectives on barriers and enablers, funding and policy challenges, and the impact of contextual factors [23,38,40,42,44,46,47,49,51]. Methodological improvements such as the adoption of standardised instruments and the incorporation of user satisfaction measures are also needed to advance the field [39,41,43,45]. Importantly, the widely used ICF framework does not include personal factors that play a crucial role in MAT access [17]. Future research should address these gaps to provide a more comprehensive understanding of the determinants of access to MAT. Figures 2 and Supplemental Figure 1 provide overviews of the identified barriers and the TMFs used in the included studies, respectively. Although no single model can fully capture the complexity of MAT access, researchers and practitioners should consider the strengths and limitations of each TMF and select the most appropriate one(s) based on specific research questions and contexts.

The insights from this review and the resulting integrated model have the potential to influence clinical practice and policymaking in line with the ethical imperatives outlined by the WHO and the UN [7,11]. These organisations have emphasised the necessity of AT to meet individual needs and enable equitable opportunities for people with disabilities. The synthesised theory aligns with the principles of access to AT as advocated by the WHO and UNICEF, highlighting the necessity for assistive products and services to be reachable, affordable, adaptable to individual needs and environments, culturally appropriate, and of high quality. By addressing the direct and indirect determinants of access, as identified in the theory, including service provision, policies, costs, personal preferences, and physical, social, and cultural factors, we can align better with these global principles [7]. These factors are important and have also been linked to the abandonment or discontinuance of using mobility products [65–67]. For example, difficult interactions between users and their products, as well as difficulties with the environment in which users live, could contribute to product discontinuance [65]. Therefore, this review proposes a theoretical basis for reforming the existing system to align it with international standards, thus addressing the pressing and unmet needs more equitably and personally to ensure successful access to and use of AT. To achieve this, future research must examine these determinants, understand the barriers to MAT provision, and plan and evaluate strategies to enhance its provision. Having a set of determinants organised around the CFIR [32] allows the creation of local implementation strategies to suit different policy jurisdictions.

There is a consensus [68,69] and evidence-based approach [70] to overcome the barriers to effective AT provision found in this review. The barriers identified by the CFIR can be linked to Expert Recommendations for Implementing Change (ERIC) strategies [71]. These strategies guide the selection of implementation methods to mitigate barriers and include (1) activating local clinical leaders or champions, (2) providing educational materials, (3) organising meetings, and (4) implementing outreach or ongoing training. The implementation of these strategies can assist decision-makers in making informed choices regarding the selection of strategies for MAT provision.

CONCLUSION

The synthesised theory emphasises that mobility is a crucial aspect of human life and certain health conditions may restrict mobility. Providing comprehensive and appropriate services can reduce this impact; however, cost and policy decisions regarding these services affect their provision. Accessibility to these services is also affected by environmental and personal factors. This knowledge can be used to develop strategies to enhance provision.

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CONTRIBUTORS

All authors contributed to the conceptualisation and design of the study. Initial title and abstract screening were conducted by AA, with regular consultations with DH, SR, and BF. AA performed the data extraction independently, with regular discussions with DH, SR, and BF. The initial data synthesis was conducted by AA and refined by DH, SR, and BF. The manuscript was drafted by AA, and major revisions were made by DH, SR, and BF. All the authors (AA, DH, SR, and BF) have read and approved the final manuscript.

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COMPETING INTERESTS

The authors report there are no competing interests to declare.

DATA AVAILABILITY STATEMENT

The authors confirm that the data supporting the findings of this study are available in the article and supplementary materials.

RIGHTS RETENTION STATEMENT

SUPPORTING MATERIALS

Supplemental Appendix 1, Checklist. Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR)
Supplemental Appendix 2, Table. Systematic search conducted in MEDLINE, EMBASE, CINAHL, and SCOPUS
Supplemental Appendix 3, Table. Characteristics of included papers
Supplemental Appendix 4, Table. Propositions derived from the theories, models, and frameworks
Supplemental Appendix 5, Table. Gaps analysis
Supplemental Figure 1. Theories, models, frameworks, and their purpose of application in eligible studies

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Ethical Approval and Dissemination:

Ethical approval was not required for this scoping review. The dissemination plan includes publishing in peer-reviewed journals and presenting at academic conferences.

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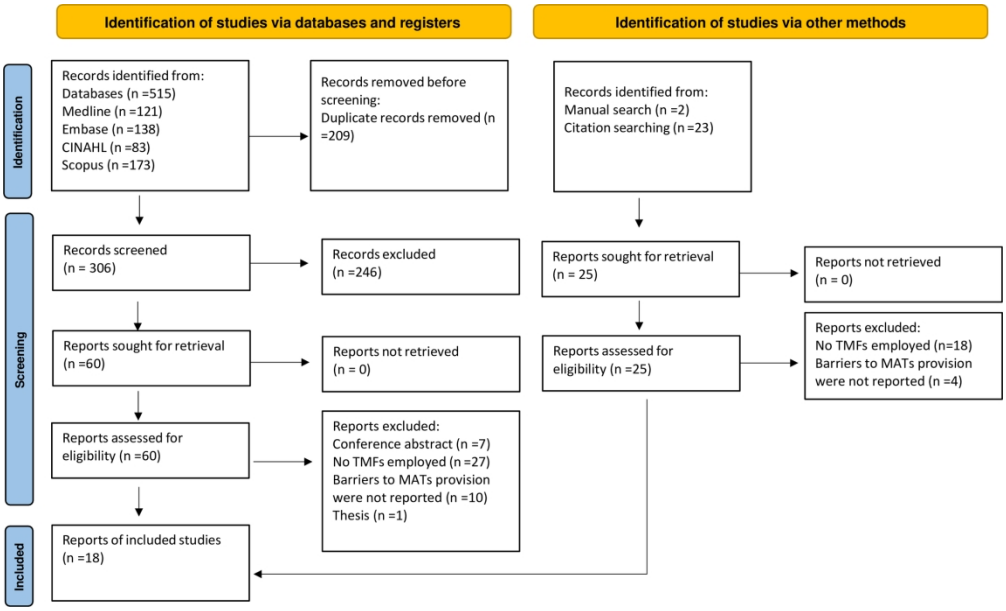
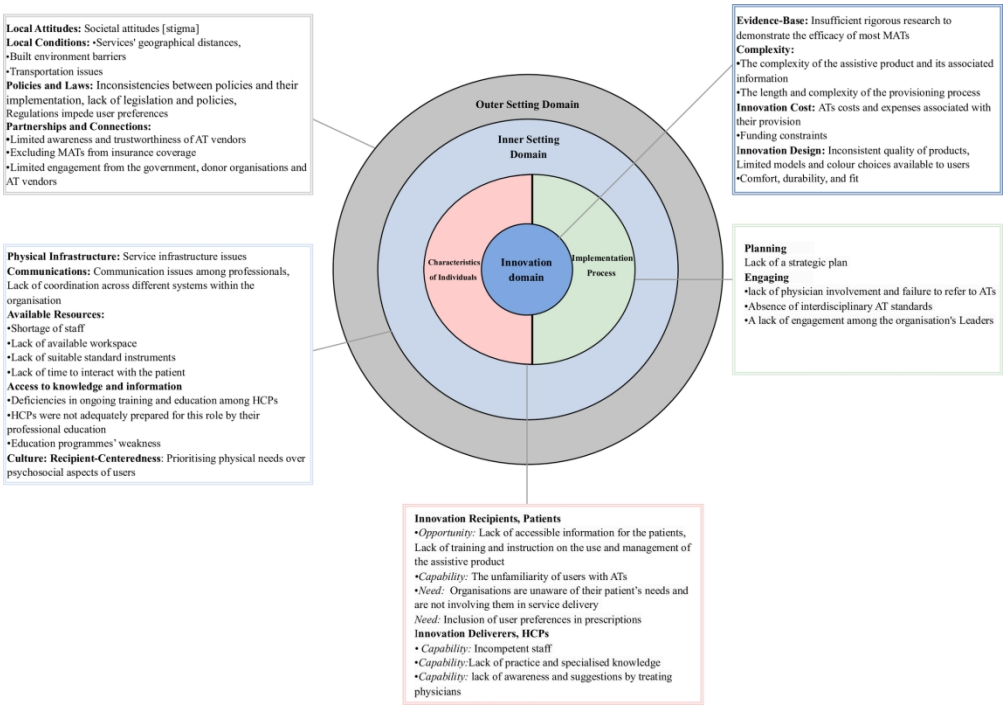


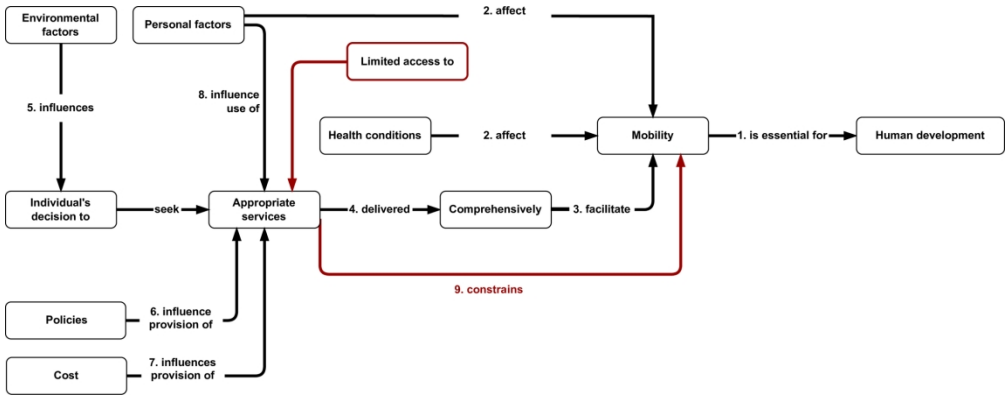
PRISMA flow diagram

190x114mm (300 x 300 DPI)



Barriers to the provision of MATs synthesised using the CFIR

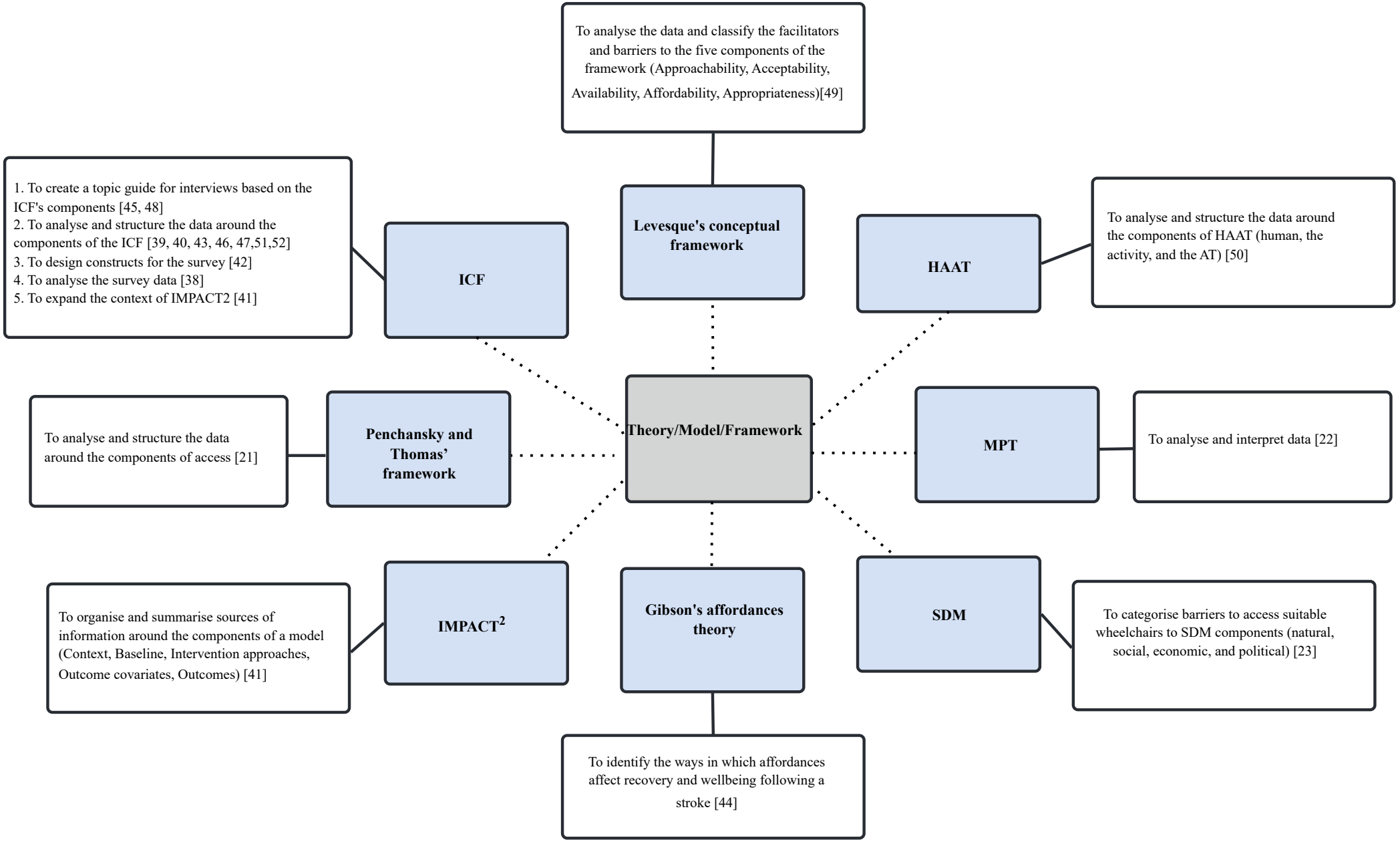
190x133mm (300 x 300 DPI)



Synthetic model

190x74mm (300 x 300 DPI)

Supplemental Figure 1. Theories, models, frameworks, and their purpose of application in eligible studies



Theories, models and frameworks to understand barriers to the provision of mobility assistive technologies: A scoping review

Appendix 1. Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
TITLE			
Title	1	Identify the report as a scoping review.	#1
ABSTRACT			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	#2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	#4-5
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	#5
METHODS			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	#5 (not registered)
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	#5-6
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	#6
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	Appendix 2
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	#6
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	#7
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	#7

Theories, models and frameworks to understand barriers to the provision of mobility assistive technologies: A scoping review

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	NA
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	#7
RESULTS			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	#8
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	#8 and Appendix 3
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	NA
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	#8-9, Figure2, Supplemental Figure 1, Appendix 3
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	#8-12
DISCUSSION			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	#13
Limitations	20	Discuss the limitations of the scoping review process.	#13
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	#14
FUNDING			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	#15

JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.

* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.

† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).

‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.

§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more

applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

From: Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMAScR): Checklist and Explanation. Ann Intern Med. 2018;169:467–473. doi: 10.7326/M18-0850

Appendix 2. Systematic search conducted in MEDLINE, EMBASE and CINAHL, SCOPUS

Database(s): **Ovid MEDLINE(R)** Search Strategy:

#	Query	Results from 29 Apr 2024
1	(Access* adj10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)).ab,ti.	66,790
2	(Provision* adj10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)).ab,ti.	8,055
3	(Provide* adj10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)).ab,ti.	106,675
4	(Adoption* adj10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)).ab,ti.	7,844
5	Wheelchairs/	5,537
6	Orthotic Devices/	7,015
7	Exoskeleton Device/	1,640
8	Mobility device*.ab,ti.	545
9	Mobility technolog*.ab,ti.	55
10	Wheelchair*.ab,ti.	8,976
11	Scooter*.ab,ti.	865
12	Walker*.ab,ti.	15,558
13	Prosthetic*.ab,ti.	64,965
14	prosthesis/	50,410
15	orthotic*.ab,ti.	3,776
16	Self-Help Devices/	5,878
17	Exoskeleton*.ab,ti.	4,856
18	Orthos*.ab,ti.	26,556
19	power mobility.ab,ti.	135
20	Prosthe* device*.ab,ti.	2,437
21	(Assistive technolog* adj10 mobility).ab,ti.	137
22	(Assistive device* adj10 mobility).ab,ti.	217
23	assistive product*.ab,ti.	114
24	mobility product*.ab,ti.	24
25	Disabled Persons/	48,730
26	Mobility Limitation/	5,333
27	Elder*.ti,ab.	312,960
28	Physical* Disable*.ab,ti.	951
29	Disable*.ab,ti.	29,789
30	Disabilit*.ab,ti.	253,216
31	Walking difficult*.ab,ti.	697
32	Handicap*.ab,ti.	26,114
33	physical* impair*.ab,ti.	3,224
34	physical* Challeng*.ab,ti.	714
35	Ambulat* Difficult*.ab,ti.	90
36	Mobility difficult*.ab,ti.	255

37	Mobility impair*.ab,ti.	1,413
38	Mobility limit*.ab,ti.	1,503
39	Amput*.ab,ti.	54,578
40	Motor difficult*.ab,ti.	553
41	Amputation/	24,235
42	Geriatrics/	31,638
43	(theor* or framework* or model* or taxonom* or classifi* or concept*).ab,ti.	5,908,724
44	(Matching Person and Technology).ab,ti.	22
45	(("abandonment" or "discontinuance") and "model").ab,ti.	665
46	("SETT " or "Student Environment Tasks Tools").ab,ti.	92
47	("WATI" or "Wisconsin Assistive Technology Initiative").ab,ti.	21
48	("ATOMS" or "Assistive Technology Outcomes Measurement System").ab,ti.	113,166
49	1 or 2 or 3 or 4	181,073
50	25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42	703,079
51	5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24	179,179
52	43 or 44 or 45 or 46 or 47 or 48	5,978,819
53	49 and 50 and 51 and 52	129
54	limit 53 to english language	123
55	limit 54 to dt=20000101-20240320	**121**
56	limit 55 to dt=20230615-20240320	7
57	45 or 46 or 47 or 48	113,944
58	49 and 50 and 51 and 57	1

Database(s): **Ovid Embase** Search Strategy:

#	Query	Results from 29 Apr 2024
1	(Access* adj10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)).ab,ti.	90,641
2	(Provision* adj10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)).ab,ti.	10,610
3	(Provide* adj10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)).ab,ti.	133,811
4	(Adoption* adj10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)).ab,ti.	9,176
5	Wheelchairs/	11,508
6	Orthotic Devices/	7,508
7	Exoskeleton Device/	1,477
8	Mobility device*.ab,ti.	661
9	Mobility technolog*.ab,ti.	63
10	Wheelchair*.ab,ti.	13,489
11	Scooter*.ab,ti.	1,053
12	Walker*.ab,ti.	18,160
13	Prosthetic*.ab,ti.	77,740
14	prosthesis/	34,227
15	orthotic*.ab,ti.	5,449
16	Self-Help Devices/	3,100
17	Exoskeleton*.ab,ti.	5,373
18	Orthos*.ab,ti.	36,813
19	power mobility.ab,ti.	165
20	Prosthe* device*.ab,ti.	2,852
21	(Assistive technolog* adj10 mobility).ab,ti.	170
22	(Assistive device* adj10 mobility).ab,ti.	311
23	assistive product*.ab,ti.	123
24	mobility product*.ab,ti.	24
25	Disabled Persons/	31,998
26	Mobility Limitation/	15,084
27	Elder*.ti,ab.	443,632
28	Physical* Disable*.ab,ti.	1,219
29	Disable*.ab,ti.	38,656
30	Disabilit*.ab,ti.	357,400
31	Walking difficult*.ab,ti.	1,272
32	Handicap*.ab,ti.	31,880
33	physical* impair*.ab,ti.	4,567
34	physical* Challeng*.ab,ti.	982
35	Ambulat* Difficult*.ab,ti.	136
36	Mobility difficult*.ab,ti.	350
37	Mobility impair*.ab,ti.	1,873
38	Mobility limit*.ab,ti.	1,986
39	Amput*.ab,ti.	68,468
40	Motor difficult*.ab,ti.	767
41	Amputation/	27,148
42	Geriatrics/	34,606

43	(theor* or framework* or model* or taxonom* or classifi* or concept*).ab,ti.	7,279,458
44	(Matching Person and Technology).ab,ti.	32
45	(("abandonment" or "discontinuance") and "model").ab,ti.	827
46	("SETT " or "Student Environment Tasks Tools").ab,ti.	156
47	("WATI" or "Wisconsin Assistive Technology Initiative").ab,ti.	45
48	("ATOMS" or "Assistive Technology Outcomes Measurement System").ab,ti.	80,470
49	1 or 2 or 3 or 4	233,091
50	25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42	958,285
51	5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24	189,829
52	43 or 44 or 45 or 46 or 47 or 48	7,328,459
53	49 and 50 and 51 and 52	143
54	limit 53 to english language	140
55	limit 54 to dc=20000101-20240320	**138**
56	limit 55 to dc=20230615-20240320	10
57	45 or 46 or 47 or 48	81,498
58	49 and 50 and 51 and 57	0

Database(s): **EBSCO CINAHL** Search Strategy:

#	Query	**Results from 29 Apr 2024**
S58	S49 AND S50 AND S51 AND S57	0
S57	S45 OR S46 OR S47 OR S48	587
S56	(S54 AND EM 20230620-20240320) AND (S45 OR S46 OR S47 OR S48)	0
S55	S54 AND EM 20230620-20240320	4
S54	S53 AND EM 20000101-20240320	**83**
S53	(S43 OR S44 OR S45 OR S46 OR S47 OR S48) AND (S49 AND S50 AND S51 AND S52) Limiters - Language: English	87
S52	S43 OR S44 OR S45 OR S46 OR S47 OR S48	1,068,868
S51	S25 OR S26 OR S27 OR S28 OR S29 OR S30 OR S31 OR S32 OR S33 OR S34 OR S35 OR S36 OR S37 OR S38 OR S39 OR S40 OR S41 OR S42	295,657
S50	S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21 OR S22 OR S23 OR S24	42,403
S49	S1 OR S2 OR S3 OR S4	73,674
S48	(TI " ATOMS " OR AB " ATOMS " OR TI " Assistive Technology Outcomes Measurement System" OR AB " Assistive Technology Outcomes Measurement System")	325
S47	(TI " WATI " OR AB " WATI " OR TI " Wisconsin Assistive Technology Initiative" OR AB " Wisconsin Assistive Technology Initiative")	13
S46	(TI "SETT" OR AB "SETT" OR TI "Student Environment Tasks Tools" OR AB "Student Environment Tasks Tools")	42
S45	TI (("abandonment" or "discontinuance") and "model") OR AB (("abandonment" or "discontinuance") and "model")	207
S44	TI "Matching Person and Technology" OR AB "Matching Person and Technology"	23
S43	TI (theor* OR framework* OR model* OR taxonom* OR classifi* OR concept*) OR AB (theor* OR framework* OR model* OR taxonom* OR classifi* OR concept*)	1,068,584
S42	(MH "Geriatrics")	6,059
S41	(MH "Amputation")	7,629
S40	TI "Motor difficult*" OR AB "Motor difficult*"	246
S39	TI Amput* OR AB Amput*	15,087
S38	TI "Mobility limit*" OR AB "Mobility limit*"	973
S37	TI "Mobility impair*" OR AB "Mobility impair*"	802
S36	TI "Mobility difficult*" OR AB "Mobility difficult*"	162
S35	TI "Ambulat* Difficult*" OR AB "Ambulat* Difficult*"	25
S34	TI "physical* Challeng*" OR AB "physical* Challeng*"	389
S33	TI "physical* impair*" OR AB "physical* impair*"	1,734
S32	TI Handicap* OR AB Handicap*	6,460
S31	TI "Walking difficult*" OR AB "Walking difficult*"	238
S30	TI Disabilit* OR AB Disabilit*	128,095
S29	TI Disable* OR AB Disable*	12,965
S28	TI "Physical* Disable*" OR AB "Physical* Disable*	711
S27	TI Elder* OR AB Elder*	114,587
S26	(MH "Physical Mobility")	7,823
S25	(MH "Persons with Disabilities")	37,595
S24	TI "mobility product*" OR AB "mobility product*"	6
S23	TI "assistive product*" OR AB "assistive product*"	69

S22	TI ("Assistive device*" n10 mobility) OR AB ("Assistive device*" n10 mobility)	157
S21	TI ("Assistive technolog*" n10 mobility) OR AB ("Assistive technolog*" n10 mobility)	131
S20	TI "Prosthet* device*" OR AB "Prosthet* device*"	406
S19	TI "power mobility" OR AB "power mobility"	136
S18	TI Orthose* OR AB Orthose*	2,498
S17	TI Exoskeleton* OR AB Exoskeleton*	813
S16	(MH "Assistive Technology Devices")	6,771
S15	TI orthotic* OR AB orthotic*	2,702
S14	(MH "Limb Prosthesis")	3,007
S13	TI Prosthetic* OR AB Prosthetic*	12,814
S12	TI Walker* OR AB Walker*	3,878
S11	TI Scooter* OR AB Scooter*	453
S10	TI Wheelchair* OR AB Wheelchair*	5,824
S9	TI "Mobility technolog*" OR AB "Mobility technolog*"	40
S8	TI (“Mobility device*”) OR AB (“Mobility device*”)	428
S7	(MH "Exoskeleton Devices")	347
S6	(MH "Orthoses")	7,176
S5	(MH "Wheelchairs")	5,140
S4	TI ((Adoption* n10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*))) OR AB ((Adoption* n10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)))	3,272
S3	TI (Provide* n10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*))) OR AB (Provide* n10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)))	40,826
S2	TI ((Provision* n10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*))) OR AB ((Provision* n10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)))	5,221
S1	TI ((Access* n10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*))) OR AB ((Access* n10 (barrier* or challeng* or restrict* or obstacle* or impediment* or difficult* or issue*)))	29,525

Database(s): **Scopus** Search Strategy:

(((TITLE-ABS (access* W/10 (barrier* OR challeng* OR restrict* OR obstacle* OR impediment* OR difficult* OR issue*)))) OR ((TITLE-ABS (provision* W/10 (barrier* OR challeng* OR restrict* OR obstacle* OR impediment* OR difficult* OR issue*)))) OR ((TITLE-ABS (provide* W/10 (barrier* OR challeng* OR restrict* OR obstacle* OR impediment* OR difficult* OR issue*)))) OR ((TITLE-ABS (adoption* W/10 (barrier* OR challeng* OR restrict* OR obstacle* OR impediment* OR difficult* OR issue*))))) AND (TITLE-ABS ("Disabled Person*" OR "Mobility* Limitation*" OR elder* OR "Physically Disabled" OR disable* OR disabilit* OR "Walking difficult*" OR handicap* OR "physically impair*" OR "Physically Challeng*" OR "Ambulat* difficult*" OR "Mobility difficult*" OR "Mobility impair*" OR "Mobility limit*" OR "Amput*" OR "Motor difficult*" OR amputation*)) AND (TITLE-ABS (theor* OR framework* OR model* OR taxonom* OR classifi* OR concept* OR "Matching Person and Technology" OR (abandonment OR discontinuance AND model))) AND (TITLE-ABS (wheelchair* OR "power mobility*" OR "Mobility device*" OR "Mobility technolog*" OR ("Assistive technolog*" W/10 mobility) OR ("Assistive device*" W/10 mobility) OR orthotic* OR exoskeleton* OR scooter* OR walker* OR prosthet* OR orthos* OR prosthetic* OR "Prosthe* device*" OR orthotic* OR "mobility product*" OR "assistive product*")) AND PUBYEAR > 1999 AND PUBYEAR < 2025 AND (LIMIT-TO (LANGUAGE , "English")) 173 documents

(((TITLE-ABS (access* W/10 (barrier* OR challeng* OR restrict* OR obstacle* OR impediment* OR difficult* OR issue*)))) OR ((TITLE-ABS (provision* W/10 (barrier* OR challeng* OR restrict* OR obstacle* OR impediment* OR difficult* OR issue*)))) OR ((TITLE-ABS (provide* W/10 (barrier* OR challeng* OR restrict* OR obstacle* OR impediment* OR difficult* OR issue*)))) OR ((TITLE-ABS (adoption* W/10 (barrier* OR challeng* OR restrict* OR obstacle* OR impediment* OR difficult* OR issue*))))) AND (TITLE-ABS ("Disabled Person*" OR "Mobility* Limitation*" OR elder* OR "Physically Disabled" OR disable* OR disabilit* OR "Walking difficult*" OR handicap* OR "physically impair*" OR "Physically Challeng*" OR "Ambulat* difficult*" OR "Mobility difficult*" OR "Mobility impair*" OR "Mobility limit*" OR "Amput*" OR "Motor difficult*" OR amputation*)) AND (TITLE-ABS ("sett" OR "student environment tasks tools" OR "wati" OR "Wisconsin assistive technology initiative" OR "atoms" OR "assistive technology outcomes measurement system" OR ("abandonment" OR "discontinuance" AND "model"))) AND (TITLE-ABS (wheelchair* OR "power mobility*" OR "Mobility device*" OR "Mobility technolog*" OR ("Assistive technolog*" W/10 mobility) OR ("Assistive device*" W/10 mobility) OR orthotic* OR exoskeleton* OR scooter* OR walker* OR prosthet* OR orthos* OR prosthetic* OR "Prosthe* device*" OR orthotic* OR "mobility product*" OR "assistive product*")) AND PUBYEAR > 1999 AND PUBYEAR < 2025 AND (LIMIT-TO (LANGUAGE , "English"))

Theories, models and frameworks to understand barriers to the provision of mobility assistive technologies: A scoping review

Appendix 3, Table. Characteristics of included papers

Authors and Year	Study design	Aims of the study	Population (n, characteristics	Country
McIntyre, Cleland and Ramklass (2021) [49]	Qualitative, Semi-structured interviews	To explore facilitators and barriers to accessible wheelchair services	11(8 occupational therapists and 3 physiotherapists)	South Africa
Dorjbal et al. (2020) [48]	Qualitative, Semi-structured interviews	To identify environmental barriers and their influence on daily life	16(SCI patients)	Mongolia
Jindal et al. (2018) [46]	Qualitative, Semi-structured interviews	To investigate parents' perceptions of rehabilitation and their information needs for their child with cerebral palsy (CP)	18 (parents of children with CP)	India and Canada
Bhidayasiri et al. (2022) [50]	Review article	To present clinical viewpoints on the unfulfilled needs of wearable technology, such as exoskeletons and orthoses	N/A	N/A
Layton (2012) [38]	Mixed method	To identify barriers and facilitators to optimal mobility from the perspective of AT users	100 (AT users. Neurological conditions)	Australia, Survey, Open-ended responses
Mairami et al. (2017) [44]	Qualitative, case study, Semi-	1. To illustrate how AT influences stroke recovery and how the	1(Stroke patient)	Malaysia

	structured interview	environment might be altered to facilitate recovery 2. To examine the issues of AT affordability and accessibility		
Dwyer and Mulligan (2015) [40]	Literature review	To determine the obstacles and enablers for community reintegration as experienced by individuals with SCI	A total of 373 participants in the 7 included studies	New Zealand
Seymour, Geiger and Scheffler (2019) [47]	Qualitative, Focus group	To identify the issues associated with wheelchair provision and the elements that contribute to or mitigate these challenges	21 (Community rehabilitation workers)	Uganda
Gonçalves Junior, Knabben and Luz (2017) [43]	Qualitative, Semi-structured interviews	To demonstrate how people with lower limb amputation function and express their limitations	6 (patients with amputation)	Brazil
Arthanat, Elsaesser and Bauer (2017) [42]	Quantitative, Survey	To explore how AT providers perceive their education and training, the use of evidence and guidelines, financing policies.	318 (AT providers)	US
Gowran et al. (2021) [23]	Position Paper	To examine the global challenges related to wheelchair accessibility	N/A	N/A
Steel and Layton (2016) [41]	Feature Article	An exploration of the complexities of AT provision in Australia	N/A	Australia
Widehammar et al. (2020) [45]	Qualitative, Semi-structured interviews	An exploration of how users' experiences of power mobility products	14(AT users)	Sweden

		are influenced by environmental factors		
Hammel et al. (2013) [39]	Qualitative, multiple case study, Focus groups	Multiple stakeholders' perspectives, issues, and priorities related to accessing, using, and evaluating MATs	65(45 AT users, 10 caregivers, 10 service providers)	USA and Canada
Serres-Lafontaine et al. (2023) [51]	Qualitative, photovoice method	To study how peer training affects social involvement	10 Wheelchair users (SCI patients)	Tanzania
Oskar et al. (2011) [22]	A postal questionnaire	To explore and assess the experiences of active wheelchair prescribers under the regulations and provisions set by local Swedish governments	278 prescribers	Sweden
Smith et al. (2016) [52]	Review article	To investigate the determinants influencing participation among wheelchair users	35 studies were included	N/A
Nabizadeh et al., (2023) [16]	Qualitative, Semi-structured interviews	To explore barriers and facilitators to prosthetic services for lower limb amputees	29 individuals with lower limb amputation	Iran

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Appendix 4 Table. Propositions identified in the theories, models and frameworks

Name of the theory, model or framework	Propositions
International Classification of Functioning, Disability, and Health (ICF)	1. A health condition can affect both the mental and physical body functions. 2. An individual's activities are impacted by their health condition. 3. Health conditions affect an individual's engagement in activities, determining their level of participation. 4. External factors, for example, social factors, can either inhibit or facilitate an individual's level of functioning. 5. Society may create barriers, for example, inaccessible services or lack of facilitators, such as the unavailability of AT, which can affect an individual's performance. 6. An individual's functioning is affected by the presence or absence of services, for example, equipment, products, and technologies in their environment.

7. External elements like systems and policies that regulate and facilitate the provision of services can impact a person's functional capacity.
8. An individual's level of functioning can also be influenced by external factors such as support and relationships, including family, people in positions of authority, and health professionals.
9. Personal factors of an individual represent their internal aspects, including psychological factors, that can affect their level of functioning.
10. Individuals' functioning and disabilities are influenced by their health status as well as contextual factors, such as environmental and personal factors.
11. Functioning is defined as encompassing body functions, body structures, activities, and participation.

	12. An impairment, an activity limitation, or a restriction on participation constitutes a disability.
Levesque's conceptual framework	1. The concept of approachability is related to the ability of individuals with health needs to recognise the existence of available services, access them, and receive effective healthcare that can improve their health. 2. Cultural and social factors determine the acceptability of health services within their context. 3. The reachability of health services depends on their physical presence and timeliness. 4. Factors like personal mobility, transportation availability, adaptability in occupation, and knowledge of accessible health services are interconnected and contribute to an individual's capacity to access healthcare providers physically.

5. The concept of affordability in healthcare refers to the ability of people to pay for services without causing undue financial hardship or affecting their ability to afford basic necessities.
6. The ability to afford healthcare services is connected to a person's financial resources, including income, savings, and borrowing capacity.
7. Appropriateness in healthcare refers to the fit between the services provided and the needs and preferences of clients, as well as the quality and safety of those services.
8. Engaging in healthcare involves the active participation of clients in decision-making and treatment planning, which helps to ensure that care is aligned with their goals and values.
9. Accessibility of health services is affected by the availability of information.

	10. Personal autonomy and the ability to choose care-seeking are linked to the ability to access health care.
The Human Activity Assistive Technology model (HAAT)	1. AT enhances an individual's capabilities to complete desired tasks. 2. Human activities are essential, learnable, and influenced by societal and cultural contexts. 3. The use of desired technology is influenced by human skills and abilities (physical, cognitive, emotional). 4. An individual's ability to perform activities is affected by their skills and abilities (physical, cognitive, emotional). 5. The use of AT to perform an activity is influenced by various factors in the environment, including physical, social, cultural, and institutional elements.

	6. Choosing and implementing the right AT requires considering the interaction between different elements, including the activity being performed, the user's needs and abilities, and the broader environmental context in which the technology will be used. 7. The process of performing an activity leads to a functional result of human performance.
Gibson's affordances theory	1. Cognition: Affordances exist as a cognitive process which comes through people and organisations interacting with material entities. 2. Perception: Affordances need to be perceived or recognised by the person or organisation. 3. Behaviour: the affordance is actualised as the behaviour that people/organisations adopt acting on the perceived opportunity for action.

	4. Evaluation: Evaluating the effects of this behaviour. 5. Environmental factors and structures can impact disabilities.
Systemic development model (SDM)	1. Understanding personal, organisational, and institutional capacity requires consideration of factors such as health, culture, economics, and politics. 2. It is crucial to provide appropriate services to improve the health, well-being, and fundamental freedoms of individuals in need. 3. Limited access to services can create a cycle of poverty and disability. 4. Service delivery systems that are tailored to specific contexts play a significant role in ensuring appropriate service provision. 5. Economic factors impact the availability of products and services

	and can affect the viability of service provision. 6. Evaluation of the quality, development, performance, and procurement standards of products is crucial for improving service delivery systems and individual health outcomes. 7. Political governance also plays a role in ensuring access to appropriate services.
Multi Intervention Paradigm for Assessment and Application of Concurrent Treatments (IMPACT^2)	1. The results of interventions can be outlined by examining the six phases, including: 1) Pre-Intervention, 2) Context, 3) Baseline, 4) Intervention Strategies, 5) Outcome Covariates, and 6) Outcomes. 2. Personal and contextual factors influence the products and services used by individuals to perform activities.

3. Universal design and health promotion are two methods that can be utilised to enhance functional performance.
4. The context in which AT is used to perform a task within an environment is crucial for improving participation and QoL.
5. Intervention approaches, such as reducing the impairment, compensating for the impairment, using AT, and redesigning the activity, are used to support the use of AT and optimise an individual's functioning.
6. Consumer satisfaction is a desirable outcome of AT provision.
7. Outcome(function) is defined as participation, QoL, and engagement.
8. Cost influences the Intervention approaches therefore affecting Outcomes.

Matching Person and Technology (MPT)	1. AT serves as a bridge between individual capabilities and the demands of tasks within their environment. 2. Personal autonomy and the performance of everyday activities are enhanced by integrating technology that matches individual needs. 3. The compatibility of assistive products with the user's lifestyle is crucial for successful adoption and satisfaction. 4. The user's physical, cognitive, and emotional dimensions must be considered to optimise the functionality of AT. 5. AT should empower individuals, promoting independence and self-efficacy in their desired roles and activities. 6. The design and functionality of assistive technology must reflect the

	user's self-image and socio-cultural identity to foster acceptance. 7. AT should assist and elevate the user's ability to engage in social roles and activities with confidence and ease. 8. The choice of AT is personal, influenced by individual preferences, aspirations, and the context of their lives. 9. Effective AT integrates into the user's environment, enhancing their capabilities without introducing new barriers. 10. The success of an assistive product is measured not only by its technical features but also by its ability to align with the user's psychosocial context and enhance their QoL.
Penchansky and Thomas' framework of access	1. Access is defined by the degree to which healthcare systems are

equipped to meet the requirements of patients

2. Affordability assesses whether the costs imposed by the provider align with the client's financial capacity and willingness to pay for the services offered.
3. Availability refers to the provider's capacity to meet the client's needs through adequate resources, including staff and technology.
4. Accessibility concerns the ease with which clients can physically reach the provider's location.
5. Accommodation evaluates the extent to which the provider's operational procedures, such as hours of operation and telephone communication, are convenient for the client.
6. Acceptability pertains to the degree of comfort the client experiences with the provider's fixed characteristics and encompasses considerations of the client's

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	health condition and type of health coverage.

Theories, models and frameworks to understand barriers to the provision of mobility assistive technologies: A scoping review

Appendix 5, Table. Gaps analysis

Gaps	**Recommendations for future research**
Remote Regions and Accessibility	Key areas for future investigation included examining access to AT in remote regions [38, 49, 46] by investigating challenges and barriers faced in remote regions [49], and explore the differences between men and women in accessing services [16], and concentrating on modifiable elements like wheelchair skills and ease of access [51]
Stakeholder Perspectives	The included papers in this review draw attention to several issues, such as investigating policymakers' and HCPs' views on rehabilitation services [46]. Understanding the challenges faced by people with disabilities [51]. This includes understanding stakeholder perspectives on the various aspects of access by identifying the enablers and barriers that might aid in planning to increase access to AT services [47,49].
Funding, Policy, and Legislation	Future research should investigate funding and policy-related barriers [22, 40, 42, 48], the impact of legislation on accessibility and participation for powered mobility product users [45], fostering low-cost approaches in low- and middle-income countries [44], and promoting inclusive solutions for wheelchair service provision [23,51].

Theories, models and frameworks to understand barriers to the provision of mobility assistive technologies: A scoping review

Data Collection and methodological improvements	Adoption of standardised instruments to assess functioning and disability is needed [43,45]. Comparing perceptions users with and without AT [43,45]. Exploration of user satisfaction, choice, and control in relation to MATs and its impact on overall outcomes [39]. Development of standards for testing AT effectiveness [50]. Additionally, research could explore the long-term effects of delayed services on individuals with disabilities [16]
Contextual Understanding and service evaluation	Importance of investigating in-country perspectives consideration of personal, social, economic, environmental, historical, and political factors [23]. Incorporating subjective measures in service evaluations [41]. Assessing the effects of new products on work environments and identifying the annually prescribed types of AT are essential undertakings [22].