



This is a repository copy of *Assistive technology needs, access and coverage, and related barriers and facilitators in the WHO European region: a scoping review*.

White Rose Research Online URL for this paper:

<https://eprints.whiterose.ac.uk/194373/>

Version: Published Version

Article:

Mishra, S., Laplante-Lévesque, A., Barbareschi, G. et al. (5 more authors) (2024) Assistive technology needs, access and coverage, and related barriers and facilitators in the WHO European region: a scoping review. *Disability and Rehabilitation: Assistive Technology*, 19 (2). pp. 474-485. ISSN 1748-3107

<https://doi.org/10.1080/17483107.2022.2099021>

Reuse

This article is distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivs (CC BY-NC-ND) licence. This licence only allows you to download this work and share it with others as long as you credit the authors, but you can't change the article in any way or use it commercially. More information and the full terms of the licence here: <https://creativecommons.org/licenses/>

Takedown

If you consider content in White Rose Research Online to be in breach of UK law, please notify us by emailing eprints@whiterose.ac.uk including the URL of the record and the reason for the withdrawal request.



eprints@whiterose.ac.uk
<https://eprints.whiterose.ac.uk/>



Assistive technology needs, access and coverage, and related barriers and facilitators in the WHO European region: a scoping review

Satish Mishra, Ariane Laplante-Lévesque, Giulia Barbareschi, Luc De Witte, Sarah Abdi, Alice Spann, Chapal Khasnabis & Michael Allen

To cite this article: Satish Mishra, Ariane Laplante-Lévesque, Giulia Barbareschi, Luc De Witte, Sarah Abdi, Alice Spann, Chapal Khasnabis & Michael Allen (2022): Assistive technology needs, access and coverage, and related barriers and facilitators in the WHO European region: a scoping review, *Disability and Rehabilitation: Assistive Technology*, DOI: [10.1080/17483107.2022.2099021](https://doi.org/10.1080/17483107.2022.2099021)

To link to this article: <https://doi.org/10.1080/17483107.2022.2099021>



© 2022 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.



[View supplementary material](#)



Published online: 29 Jul 2022.



[Submit your article to this journal](#)



Article views: 1624








[View related articles](#)



[View Crossmark data](#)

Assistive technology needs, access and coverage, and related barriers and facilitators in the WHO European region: a scoping review

Satish Mishra^a , Ariane Laplante-Lévesque^a , Giulia Barbareschi^b , Luc De Witte^c , Sarah Abdi^c, Alice Spann^c, Chapal Khasnabis^d  and Michael Allen^e

^aWorld Health Organization Regional Office for Europe, Copenhagen, Denmark; ^bGlobal Disability Innovation Hub, London, United Kingdom; ^cCentre for Assistive Technology and Connected Healthcare, University of Sheffield, Sheffield, United Kingdom; ^dWorld Health Organization, Geneva, Switzerland; ^eUnited States Agency for International Development, Washington, DC, United States of America

ABSTRACT

Purpose: Globally, assistive technology (AT) is used by over 1 billion people, but the prevalence of needs and access to AT in specific countries or regions is largely unknown. This scoping review summarises the evidence available on the prevalence of needs, access and coverage of AT in the World Health Organisation European Region and the barriers and facilitators to its use.

Methods: Relevant publications were identified using a combination of two strategies: 1) a systematic search for AT publications in five scientific literature databases; and 2) consultations with 76 of the Region's AT experts.

Result: The search strategies yielded 103 publications, 62 of them identified by the systematic search. The included publications were predominantly from six countries, and 18 countries were unrepresented. Information on AT use for specific functional impairments was present in 57 publications: AT for hearing impairment in 14 publications; vision in 12; mobility, 12; communication, 11; self-care, 6; and cognition, 2. AT needs for vision and hearing impairment were more likely to be met (1–87% and 5–90%, respectively) compared with communication and cognition impairments (10–60% and 58%, respectively). The barriers and facilitators to AT access described were linked to accessibility, affordability and acceptability.

Conclusion: Data on AT prevalence and coverage are limited in both quantity and quality. Agreed-upon definitions of functional impairment and assistive product categories and standards for data collection are needed to facilitate data comparisons and to build a more representative picture of AT needs and coverage.

ARTICLE HISTORY

Received 19 January 2022
Revised 12 May 2022
Accepted 3 July 2022

KEYWORDS

Assistive technology;
scoping review; need;
coverage; Europe

► IMPLICATIONS FOR REHABILITATION


- Comprehensive and disaggregated data concerning the prevalence of needs and coverage of AT is needed to enable the development of responsive policies and actions.
- The literature available on the prevalence of needs and coverage of AT in the WHO European Region is primarily focussed on a small subset of countries and comparisons between studies are limited due to the use of different data collection strategies.
- Evidence concerning barriers and facilitators to AT access across countries is more consistent and can be organised across the key themes of accessibility, affordability and acceptability of AT.
- There is a need for consensus among multiple AT actors on standardised definitions for functional impairment and assistive product categories and standards for data collection to enable a more representative picture to be built of AT needs and coverage across the WHO European Region and globally.

Introduction

Assistive products (APs), which include physical devices and digital software or any combination of the two, are essential tools that supports the health and wellbeing of over 1 billion people across the world, and enable independence and full participation in family life and society [1]. Access to APs is only possible through the “*application of organized knowledge, skills, procedures and policies relevant to [their] provision, use and assessment*” –

generally summarised as “assistive technology” (AT) [2]. People who need APs include older people; people with disabilities; people with noncommunicable diseases; people with mental health conditions, including dementia and autism; and people with gradual functional decline [3]. The COVID-19 pandemic has also demonstrated that AT is an essential health service for infectious as well as chronic diseases, as some people who have recovered from COVID-19 experience long-term functional impairments and

CONTACT Satish Mishra  mishras@who.int  Health Workforce and Service Delivery, Division of Country Health Policies and Systems, WHO Regional Office for Europe, Marmorvej 51, Copenhagen, 2100, Denmark

 Supplemental data for this article can be accessed online at <https://doi.org/10.1080/17483107.2022.2099021>.

© 2022 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.

This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivatives License (<http://creativecommons.org/licenses/by-nc-nd/4.0/>), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited, and is not altered, transformed, or built upon in any way.



Figure 1. Map showing the 53 countries in the World Health Organization European Region.

can benefit from AT use [4]. AT is important to allow individuals to exercise their human rights such as education, employment, healthcare and transport. In addition, accessible AT is vital to reducing public health and welfare expenditures at national and international levels [5–7]. Taking into consideration the increased education and employment opportunities that AT use provides individuals along with the reduced costs across their lifetimes, the return on investment on AT is estimated at 9:1; that is, for every currency unit invested in AT, 9 currency units are gained [8]. Global estimates are that only 1 in 10 people in need have access to AT. This level of unmet need is expected to increase as the number of people with functional limitations is predicted to increase to 2 billion globally by 2050 [3]. However, the data that are currently available on AT needs lack the disaggregation necessary to allow the development of responsive local and national policies and actions [9,10]. The recent review by Danemayer et al. [11] describes that the indicators used by researchers to measure the need and coverage of AT are extremely heterogeneous, which can lead to substantial overestimation and/or underestimation of need and coverage hindering the ability to develop and implement effective strategies to increase access to AT.

The World Health Organisation (WHO) European Region, which stretches from the Atlantic to the Pacific Oceans (Figure 1), is a vast and diverse territory. Its 53 countries differ greatly with respect to resource availability, the geopolitical situation, population size and socioeconomic factors. The Region has a total population of over 900 million people, of whom an estimated 135 million could benefit from access to appropriate AT [12]. The number of people in need of AT in the Region is expected to double by 2050, primarily because of the expected ageing of the

population and the subsequent increases in the prevalence of noncommunicable diseases [12].

Throughout this paper, and in line with previous research by Boggs et al. [13], we use the term AT coverage to indicate the proportion of the number of people in need of AT (which we indicate using the term “total need”) and the number who are currently able to access AT (which we indicate using the term “met need”). Lack of AT coverage, which is the number of people in need of AT but who are unable to access it, is indicated by the term “unmet need.”

The evidence available on the current level of AT coverage in the WHO European Region is unclear. In addition, there are methodological differences between studies analysing quantitative data on AT provision and the proportions of met and unmet AT needs [14,15], and studies using qualitative methods to explore the barriers and facilitators affecting the experiences of AT access for users and providers [16–18]. These differences result in a disconnect between studies portraying situations of insufficient AT coverage, and the empirical evidence investigating the factors responsible for the shortcomings of AT provision, thus further complicating the development of effective policies and strategies to address existing difficulties. There are also significant gaps in the data available for some countries and for specific functional impairments and types of APs.

In May 2018, the Seventy-first World Health Assembly adopted a resolution urging WHO Member States to develop, implement and strengthen policies and programmes to improve access to AT [19]. In support of this resolution, the WHO Regional Office for Europe has launched a series of activities, including this scoping review, to support countries in strengthening their AT systems.

This scoping review gathers the available evidence on the AT needs of people in WHO European Region countries, and its coverage and use. Additionally, the review summarises the barriers to accessing AT and the facilitators to accessing AT. The summary of this evidence will allow recommendations to be made for future research to help AT policy-makers, providers and users.

Methods

A scoping review follows an exploratory yet systematic approach to synthesising and summarising evidence from the diverse source material, with the aim to inform policy, practice and future research [20]. Although a scoping review does not engage in a formal quality assessment of the evidence gathered, it can help to identify the strengths and weaknesses of the available literature [21,22]. This review was designed based on Arksey and O'Malley's five-stage framework [21], with consideration of the recommendations of Levac et al. [23]. The five steps are: defining the research question; identifying relevant publications; selecting the publications; charting the data; and organising, summarising and reporting the findings [21]. In addition, Arksey and O'Malley [21] recommend the inclusion of a "consultation exercise" with experts in the field with the twin goals of increasing the reach of the scoping review, as experts might be able to recommend additional references missed by the original search, and fostering awareness and interest amongst practitioners who are most likely to benefit from the completion of the review. In light of this recommendation, the current review used this approach in the phase focussed on identifying relevant publications. Detailed explanations about the methodology employed for the consultation with experts are provided in the Methods section.

Defining the research question

The aim of the current review was to gather and synthesise the available evidence on the prevalence of needs for AT and the coverage of AT in the WHO European Region. The review was intended to be combined with other WHO Regional Office for Europe initiatives supporting the development of appropriate services and policies across governments and other relevant stakeholders. To fulfil these requirements, we defined the research question as:

What is the prevalence of need, access and coverage of assistive technology and what are the facilitators and barriers to access and coverage in the WHO European Region?

Identifying relevant publications

We used a two-step strategy to identify relevant publications. Firstly, a systematic search of scientific literature databases was

conducted using pre-defined keywords. This search was restricted to publications written in either English or German, as the two members of the research team who extracted the data from the relevant publications are fluent in these two languages. Secondly, experts from the Region were consulted remotely to identify additional publications, in particular grey literature, and publications in languages other than English or German.

Systematic search

Search strings were developed for the review. Boolean logic was used to combine keywords from the concepts of interest, which were defined based on the scope of the review. The five concepts of interest were:

1. AT;
2. functional category: vision, hearing, mobility, self-care, cognition, communication, using the Washington Group Questions [24] and the WHO International Classification of Functioning, Disability and Health [25];
3. WHO European Region countries;
4. access and coverage; and
5. barriers and facilitators.

For the AT concept, a series of specific keywords was developed based on the 50 APs listed in the WHO Priority Assistive Product List [3]. Five databases were used: CINAHL, Google Scholar, MEDLINE, PsycINFO and Scopus. An example of the search string used to search the five databases is provided in [Supplementary Appendix 1](#).

Expert consultations

Evidence relevant to this review was likely to have been published in the "grey" literature that is not catalogued in scientific literature databases. This evidence takes the form of reports, policy notes and websites and is presented in English as well as other languages. We contacted experts from the Region to identify any other publications that should be included in the review. These experts included members of the Association for the Advancement of Assistive Technology, people in the research teams' professional networks, people found using targeted searches and other experts identified through snowballing. Experts were contacted *via* email with an explanation of the purpose of the review and a request for them to suggest potential publications (academic and grey literature publications) to be considered for inclusion. The experts were given a checklist designed to support the identification of publications and the extraction of relevant information. The checklist was developed by the research team based on the template developed and used to extract relevant information from the academic publications identified

Table 1. Inclusion and exclusion criteria for the publications of the scoping review.

	Inclusion criteria	Exclusion criteria
Population Concept	<ul style="list-style-type: none"> • People who need assistive technology • Assistive technology that can be assigned to one or several of the following six functional categories (vision, hearing, mobility, cognition, communication and self-care) 	<ul style="list-style-type: none"> • Assistive technology that falls outside of the six functional domains defined • Rehabilitation technologies and other therapeutic technologies • Implantable devices
Context	<ul style="list-style-type: none"> • Publications from any location within the WHO European Region • Publications in English, German or for which experts provided a translation • Publication year 2010 and onwards • Publication with an accessible abstract 	

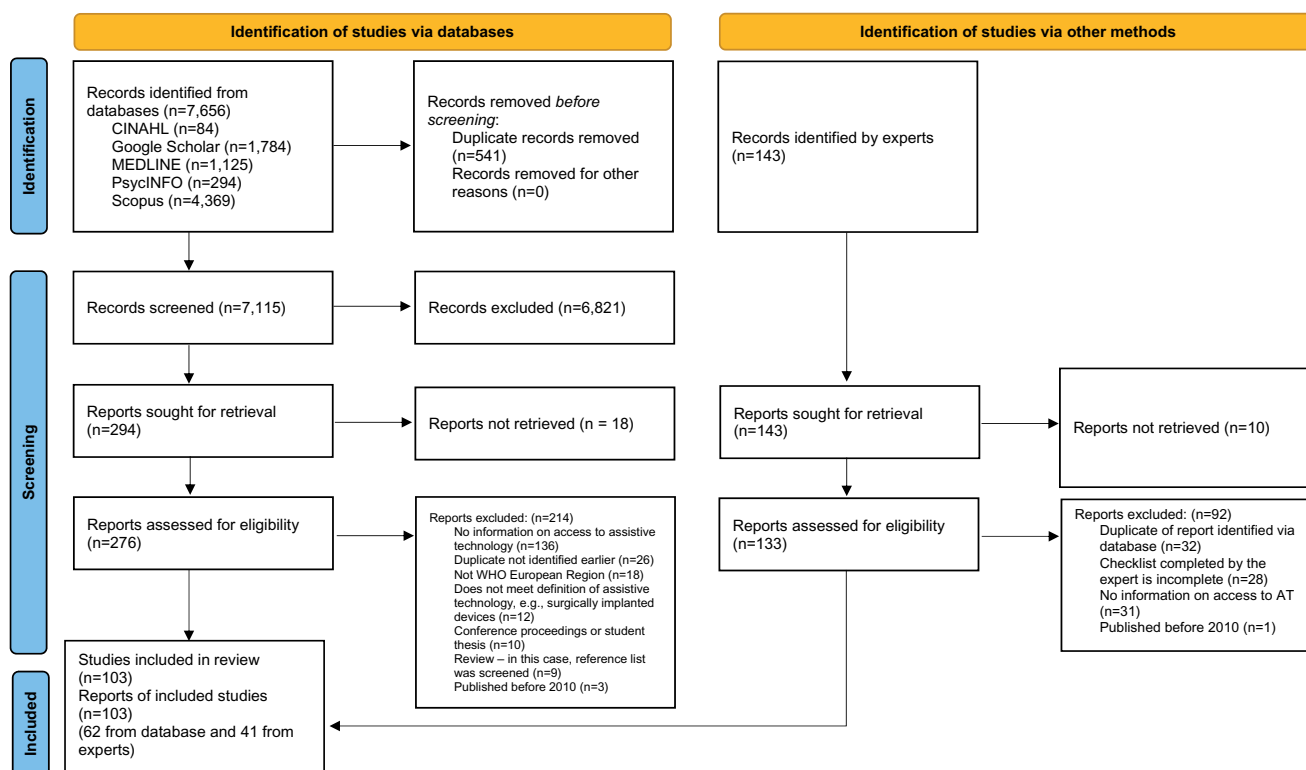


Figure 2. Flow chart depicting the number of publications identified, screened, assessed for eligibility and included at each stage of the selection process, according to the PRISMA guidelines [22].

through the systematic search. The checklist shared with the AT experts is in [Supplementary Appendix 2](#).

In total, the team contacted 245 AT experts from 46 of the 53 countries in the Region. We were, unfortunately, unable to identify any experts for Andorra, Belarus, Bosnia and Herzegovina, Kosovo, Monaco, North Macedonia or San Marino. Of those contacted, 76 replied and a total of 114 checklists were provided describing potentially relevant publications; an additional 30 publications were suggested for which no checklist was provided.

Selecting the publications

The inclusion and exclusion criteria for screening and selecting the publications were developed using the Population, Concept and Context framework (Table 1) [26]. Author X and Author Y (removed for anonymization) independently screened a random sample of 600 publications to iteratively refine the eligibility criteria, which the same authors then used to screen the remaining publications.

Publications were evaluated using the inclusion and exclusion criteria (Table 1) in two consecutive steps. Firstly, titles and abstracts of the identified publications were screened for inclusion. Secondly, the full text was screened. Cohen's kappa coefficient was calculated to assess inter-rater reliability and showed moderate agreement ($\kappa = 0.518$) between Author X and Author Y (removed for anonymization). Disagreements between the two authors were solved through consensus meetings. The selection process was performed according to the PRISMA guidelines (Figure 2) [27].

Charting the data

Relevant information was extracted from the publications into a table designed to organise the information for analysis. For

consistency, the table fields matched the checklist provided to the experts during the publication identification phase. The extracted data included the year of publication, authors/authoring organisation, type of publication, study design, participant characteristics and publication language. In addition, data were extracted on the type of APs investigated, the prevalence, needs and coverage of AT, and any reported barrier or facilitator to AT access.

Organising, summarising and reporting the findings

The findings of the scoping review are summarised in the Results section. Firstly, we provide a summary of the dataset comprising all the included publications. Secondly, we present findings on the prevalence of needs, access and coverage of AT organised according to the six functional domains, i.e., vision, hearing, mobility, self-care, communication and cognition. Finally, we describe the reported barriers and facilitators to AT access organised under the themes of access, affordability and acceptability.

Results

Summary of publications included in the scoping review

A total of 103 publications were included in this scoping review, 62 of which were identified by the systematic search of scientific literature databases, and 41 identified by the experts. (When a publication was identified by both the systematic literature review and an expert, the publication was listed as being identified in the systematic search.) [Supplementary Appendix 3](#) lists the publications included in the scoping review.

More than half of the publications included in the review (54%; 56 publications) described research carried out in one of six countries in the Region (United Kingdom, 30; Sweden, 7; Ireland,

6; Netherlands, 5; Germany, 4; and Cyprus, 4). Eighteen of the 53 European Region countries (34%) were not represented in any of the publications. Eighty-two publications were published in English, and 21 were published in another language (including Armenian, Azerbaijani, Dutch, Estonian, French, German, Greek, Portuguese, Romanian, and Swedish). The publications included in the review had been published as journal articles (61), nongovernmental reports (29), governmental reports (10) and conference proceedings (3).

The studies reported in the publications had a large range of sample sizes: 28 publications reported data from national surveys or nationally representative samples and 48 publications reported on studies with samples of fewer than 200 individuals. The study designs used were quantitative studies (41), qualitative studies (24), mixed-method studies (21), reviews (9) and case studies (2). Six of the included publications did not specifically report primary research but presented government policy or frameworks for strengthening AT systems.

Prevalence of needs and coverage of AT

Only 45 publications reported on the prevalence of needs or coverage of AT. Thirty-seven publications reported on the prevalence of needs for AT, 30 on the prevalence of AT coverage and 17 on the prevalence of unmet needs for AT. Some publications focussed on data for one specific AP, some focussed on several APs for one specific functional domain and others on multiple APs used for several functional domains. The number of publications providing data on the prevalence of needs and coverage of AT across the six functional domains can be summarised as follows: hearing (14), vision (12), mobility (12), communication (11), self-care (6) and cognition (2). Publications on AT use for multiple functional domains were counted once for each relevant domain described. [Supplementary Appendix 4](#) summarises the information from the publications analysed in relation to each functional domain.

Hearing

The 14 publications providing information on hearing-related AT needs and coverage included data from 13 countries (Armenia [28], Czechia [29], Denmark [28,29], France [30], Germany [31,32], Ireland [33], Russia [32], Spain [28], Sweden [34–36], Tajikistan [37], Ukraine [28], United Kingdom [38–40] and Uzbekistan [41]). Six publications focussed on older adults, three on adults, two on all age groups, and three did not specify participant age. Sample sizes ranged from 184 [30] to 132,028 participants [30]. All publications reported on needs for hearing AT, and 12 of the 14 had information on coverage or unmet needs for hearing AT.

Hearing aids were the focus of 12 publications, with only two publications including other types of hearing APs [33,40]. The prevalence of hearing difficulties ranged from 10.5% [40] to 60.8% [34] for all 12 publications and between 10.6% [30] and 42.0% [29] in the publications featuring nationally representative samples. The prevalence of met needs for hearing aids ranged from 1.2% [41] to 87.0% [36].

Vision

The 12 publications on vision-related AT needs, and access to vision-related AT and coverage had data from 12 countries (Armenia [28], Czechia [29], Denmark [28,29], France [29], Germany [42], Ireland [33], Spain [28], Sweden [29], Tajikistan [29], Ukraine [28], United Kingdom [43–48] and Uzbekistan [41]). Four publications focussed on children and adolescents, three

publications focussed on older adults, one on young adults, one on all age groups, and two publications did not specify participant age. Sample sizes ranged from 37 [46] to 499,375 participants [43]. All publications reported data on needs for vision AT, and eight provided information about coverage or unmet needs for vision AT.

Spectacles or contact lenses were the focus of nine publications, with only two publications including other types of APs [28,33]. The prevalence of visual difficulties ranged from 5.0% [41] to 50.0% [48], and the prevalence of met needs for spectacles and contact lenses ranged from 29.0% [41] to 74.4% [46] in children and/or adolescents and, overall, from 59.1% [44] to 90.0% [43]. The reported prevalence of unmet needs for spectacles and contact lenses was between 20.0% [37] and 25.2% [45].

Mobility

The 12 publications on mobility-related AT needs and coverage included data from 13 countries (Armenia [28], Denmark [28], Germany [49,50], Ireland [33], Netherlands [51], Republic of Moldova [52], Spain [28], Switzerland [53,54], Tajikistan [37], Turkmenistan [55], Ukraine [28], United Kingdom [56] and Uzbekistan [41]). Three publications focussed on adults, four focussed on all age groups, and five did not specify participant age. Sample sizes ranged from 105 [56] to 14,518 participants [33]. Seven publications reported data on needs for mobility AT, and then provided information about coverage or unmet needs for mobility AT.

The APs described were wheelchairs, lower-limb prostheses, orthoses, canes, crutches, home adaptations, stair lifts, walkers, braces and ramps. The prevalence of needs for mobility AT varied depending on the type of AP and the characteristics of the study population and ranged from 3.75% across all mobility APs, in a nationally representative sample of 14,518 people [33], to 68.3% of 492 people with spinal cord injury requiring manual wheelchairs [53]. The reported coverage for mobility AT ranged from 64.3% [49] to 80% [52], with large variations depending on the type of AP and the characteristics of the sample.

Self-care

The six publications on self-care-related AT needs and coverage had data from six countries (Netherlands [51], Sweden [57], Switzerland [54], Tajikistan [35], United Kingdom [58] and Uzbekistan [41]). One publication focussed on older adults, three on adults, one on all age groups, and one publication did not specify participant age. Sample sizes ranged from 200 [37] to 511 participants [58]. Three publications reported data on needs for self-care AT, and all six provided information about coverage or unmet needs for self-care AT.

The APs discussed included a shower and bath chairs, hand-rails, pressure-relief cushions, incontinence products and home adaptations, such as accessible showers. The prevalence of people in need of self-care-AT ranged from 10.9% overall [41], to 21% for incontinence products [37], and 66% for bathroom adaptations [51]. The range of AT coverage varied greatly depending on the type of self-care AP from 10% [57] to 94% [51] for bathroom adaptations compared with 2.1% to 6.4% for incontinence products [41]. The reported unmet needs ranged from 2% for bathroom adaptations [57] to 19.2% across all types of self-care AP [58].

Communication

The 11 publications on communication-related AT needs and coverage included data from seven countries (Germany [49], Italy

Table 2. Summary of barriers and facilitators identified from included publications organised across the three themes of access, affordability and acceptability.

Theme	Barriers	Facilitators
Access	<ul style="list-style-type: none"> • AT providers lack of knowledge • Scarce evidence of positive outcomes of AT • Inadequate assessment procedures • High turnout of AT staff • Fragmented and bureaucratic systems • Lack of information about AT for users • Procurement difficulties • Lack of standards and guidelines for AT 	<ul style="list-style-type: none"> • Appropriate training for AT providers • Coordination between AT services • Single point-of-access for AT services • Availability of relevant information for users • Formulation of national/international standards and procurement guidelines for AT
Affordability	<ul style="list-style-type: none"> • High financial cost of AT • Inability to expense AT through private insurance or public welfare • Maintenance and repair cost for AP 	<ul style="list-style-type: none"> • Decreased financial cost of AT • Large scale government procurement processes • Long-term loaning schemes • Support and provision of AT from nongovernmental organisations
Acceptability	<ul style="list-style-type: none"> • Fear of stigmatisation • Inappropriate design and fit of AP • Previous negative AP experiences • Lack of interest and awareness of AT benefits 	<ul style="list-style-type: none"> • Ability to trial different APs • Positive portrayal of AP users • Access to psychological and advocacy support for users

[59], Ireland [33], Netherlands [60], Sweden [57], United Kingdom [61–65] and Uzbekistan [41]). Three publications focussed on service providers or healthcare professionals, one on older adults, one on children, two on all age groups, and four publications did not specify participant age. Sample sizes ranged from 73 [59] to 14,518 participants [33]. Nine publications reported data on needs for communication AT, and eight provided information about coverage or unmet needs for communication AT.

Four publications focussed on alternative and augmentative communication including speech-generating devices, and the other publications covered multiple types of communication APs. The reported prevalence of needs for communication aids ranged from 0.02% [64] to 10.5% of the general population [41]. The prevalence of access to communication AT across the general population was reported at between 0.014% [63] and 0.08% for all AP types [64]. But among people with specific needs, access rates ranged from 10% for nonpowered communication devices [62] to 60% for various types of communication aids [49]. Finally, the prevalence of unmet needs for communication aids was reported at between 1.9% [41] and 74.2% depending on the specific type of AP [33].

Cognition

The two publications on cognition-related AT needs and coverage included data from Ireland [33] and the United Kingdom [66]. Both publications focussed on all age groups. Sample sizes ranged from 111 [66] to 14,518 participants [33]. Both publications focussed on multiple types of cognition APs and gave information on AT coverage and unmet need. One of the publications provided information on the prevalence of needs. The prevalence of memory and concentration difficulties was estimated at 2.3% and intellectual disabilities at 1.5% [33]. One publication reported AP coverage of 57.6% and unmet needs of 39.6% [66], and the other reported unmet AP needs ranging from 36.2% to 49.0% depending on the type of AP [33].

Barriers and facilitators to at coverage

In total, 77 publications discussed barriers to AT access and 42 publications presented facilitators that could strengthen AT systems and support increased coverage. As the barriers and facilitators to AT coverage reported in the different countries in the Region mostly overlapped, evidence was pooled across countries

and organised into three themes: access, affordability and acceptability (Table 2).

Access

The barriers and facilitators to AT coverage were often of a systemic nature. For example, lack of knowledge and awareness of AT among health and social care staff was identified as a key barrier to AT access [15,32,35,52,63,67–80]. Furthermore, the lack of specific training for health and social care staff and lack of evidence on the positive outcomes of AT on the individual and society contributed to AT not being recommended early [69].

Inadequate assessment procedures and high levels of staff turnover, preventing the creation of a progressive and mutual understanding between potential and current AT users and health and social care staff, were also mentioned as barriers to access to high-quality AT services [68,81]. In contrast, the provision of adequate training for health and social care staff and the creation of proactive and collaborative relationships between users and health and social care professionals were described as important facilitators [32,55,63,70,75,81].

The high level of fragmentation of AT systems and complex procurement processes were also mentioned as major barriers to AT access [15,32,48,70,71,74,80–83]. Users felt that they lacked the knowledge required to navigate AT provision systems [57,71,76,84,85]. Procurement processes were described as too long and were affected by lack of funding, limiting AT availability, especially for uncommon and specialised APs [15,32,63,68,75,86–88]. However, increased coordination between services and the option of offering a single point-of-access for multiple APs and their related services were mentioned as facilitators to AT access, especially when services were provided close to an individual's home or workplace; for example, through home visits or an easy-to-access primary care setting [15,32,46,56,68,70,89,90].

With respect to the barriers and facilitators of AT use from the perspective of users, major barriers included limited availability of information about APs, lack of training and lack of follow-up services for the APs currently being used [15,57,63,69–71,73,76,85,89,90]. In contrast, increased awareness and the provision of relevant information to users were described as essential facilitators of increasing AT coverage [15,55,57,67,68,70,72,83]. Support and information were delivered effectively *via* several channels, including online resources, peer-support groups and community-based initiatives [15,70,78,89].

The lack of national and international standards for AT procurement and recommendation was raised as a major barrier to AT access, with a lack of relevant policies and dedicated government bodies overseeing AT seen as contributing factors [15,69,72,80,85,86,91,92]. The formulation of appropriate guidelines for recommending AT and the development and implementation of dedicated policies were both seen as key elements in improving AT coverage in the WHO European Region [15,18,86,89].

Affordability

The high financial cost for the individual was reported as one of the most important barriers to AT access, especially when combined with the lack of available funding for AT [15,18,30,32,35,46,56,72,84,85,93–95]. The high costs of AT mean that users have limited choices of APs and must rely on APs that may not adequately meet their needs [30,89,96]. Users found that many APs were not funded, either partially or in full, by national health systems or private insurance schemes, leading to increased personal financial costs for users and further constraining their options [32,77,81,97]. Even relatively low-cost APs, such as spectacles, were unaffordable for some users who had to pay for them out of pocket [30,37,54,98].

Affordability concerns were mentioned in relation to the APs themselves, and in connection to repair and maintenance, transport and shipping, specific modifications and/or rental expenses [30,55,88,92]. Reducing the personal cost of AT was described as key to improving affordability [57,69,87,89]. Centralised procurement systems and government-run long-term loaning schemes of APs could reduce the personal cost of AT [15,89]. Loan schemes are considered to be more cost-effective than other options, as these enable refurbishment and repair of existing APs which helps to control expenses for both providers and users [70,99].

Financial support from governments, in the form of complete or partial subsidies, was the most favourable option to ensure that individuals could access the AT they need [18,63,99]. However, financial assistance, or outright provision, from nongovernment organisations and private donors was often described as an essential facilitator of AT coverage in current systems [52,55,61,70,77,99].

Acceptability

Fear of stigmatisation due to AP use was reported as a key barrier to AT acceptability [15,35,46,55,96,100–102]. Claesen and Pryce highlighted how this could be a concern when the AP in question was perceived to be drawing attention to an otherwise invisible functional limitation [100]. In addition, previous negative experiences with AT, either directly or indirectly through family members or friends, could limit willingness to adopt new APs, even if these were of a different nature from the one previously trialled or witnessed [30,37,102,103].

Low levels of acceptability were also reported for APs that users perceived as inappropriate because they caused discomfort or pain when used, were difficult to use, were badly fitted or had unattractive designs [32,37,46,55,94,104]. Some potential AP users, especially individuals with hearing impairments, were not interested in adopting APs as they did not feel their impairment was sufficiently severe, had limited interest in improving their condition or perceived AT use as something that was forced upon them by family members rather than being a personal choice [76,100–102].

Allowing users to trial different APs was suggested as effective in enabling people to find products that matched their needs

while allowing them to independently evaluate the benefits they might derive from AP use and thereby increase the acceptability of the AP in question [30,63,80,105]. Furthermore, increasing awareness and promoting more positive images of functional limitations and AP users were mentioned as key strategies to improve acceptability [57,76,100–102]. Increased positive awareness was seen as essential not only among users but also within their families and social circles [76,94]. Finally, providing better psychological and advocacy support was considered a key facilitator to increasing the acceptability of AT, improving the ability to access AT and benefitting individual wellbeing overall [76,103,106].

Discussion

At needs, access and coverage: the available evidence

The scoping review identified publications reporting evidence on AT needs, access to AT and AT coverage, and included evidence on the barriers to and facilitators of AT coverage in the WHO European Region. Over 7,000 publications were screened, of which 103 were included in this review, making an average of fewer than ten publications released for every year included in our research (2010–2020).

These 103 publications included evidence from only 39 of the 53 (54, when including Kosovo) countries in the WHO European Region, and there was a disproportionate representation of evidence from six countries, all of which the World Bank classified as high-income countries for the fiscal year 2020–2021 [107]. For seven of these 15 countries that were unrepresented in the publications (Andorra, Belarus, Bosnia and Herzegovina, Kosovo, Monaco, North Macedonia and San Marino), we were unable to contact any AT expert who could help source existing publications in languages other than English, which could be due to the limitation of the network of connections available to the research team. Experts from Belgium, Czechia, Israel, and Luxemburg were contacted by the research team but provided no response to the enquiry. AT experts in Iceland, Malta, Lithuania, and Slovakia forwarded a number of resources that were subsequently discarded as they did not fit the inclusion criteria of the review. This highlights how the lack of evidence highlighted by the review in a significant number of countries was due to a number of different reasons ranging from difficulties in locating and reaching experts and the limited availability of publications containing information pertinent to the specific research question addressed by this study.

It is also important to note that, certain types of APs were reported on more frequently than others. For example, for publications with data on the prevalence of needs and coverage of ATs for hearing and vision impairments, most publications were concerned exclusively with hearing aids and spectacles, respectively.

The publications in the review reporting on AT needs and coverage used different methods for assessing the need for AT, employed different sampling techniques to select participants, included individuals with various levels of severity of functional impairment and focussed on different subsets of APs, even when looking at the same functional domain. These differences make it very difficult to compare studies and reduce our ability to paint a comprehensive picture of AP needs and coverage. Most studies included featured relatively small participant samples which tended not to be representative of the general population they were drawn from; this also hinders the generalisability of findings.

Data on the barriers and facilitators of AT coverage were more comprehensive and showed similarities across countries. However,

the extent to which each of these barriers and facilitators might affect an individual is highly dependent on the context of individual countries in the Region.

Recommendations for research and practice

This scoping review shows that more evidence is needed to assess the status of AT provision and coverage across the WHO European Region. This is particularly true in some countries. This evidence is necessary to enable the continued assessment of progress toward the global AT goals established by the 2018 resolution on increasing access to AT that the Seventy-first World Health Assembly adopted [19].

Baseline data should be collected on the current needs for AT in the general population and the corresponding level of AT coverage among people with functional limitations in all countries, including the lower-resourced ones. The rapid Assistive Technology Assessment (rATA) tool, an interviewer-administered tool developed by WHO, can be used to collect such estimates [108]. A broader assessment of national AT systems can be achieved using WHO's Assistive Technology Capacity Assessment (ATA-C) tool [109]. These data will provide an updated understanding of AT needs, supply and demand which could form the basis of appropriate action plan to strengthen AT systems.

To better capture the AT needs across the WHO European Region, the evidence available indicates a need to establish comprehensive and consistent guidelines for the data collection on the measurement of AT needs and coverage to produce datasets and evidence that can easily be aggregated and compared [110–112]. Globally available tools designed through international consultative processes, such as the rATA and the ATA-C, could significantly help in this effort, and further guidance is needed to support the collection and sharing of data across countries. Data should also be collected in nationally representative samples and include information enabling disaggregation across functional impairment categories and different types of APs to portray national AT systems in an accurate and detailed manner. Combining evidence from population-based surveys with pragmatic assessments of the national resources available can support the interactive development of policies, measures and initiatives to effectively strengthen AT systems [10,113,114].

The creation of more comprehensive and consistent datasets on the prevalence of AT needs and coverage would allow larger comparative studies, reviews and meta-analyses to be undertaken. These systematic investigations could help identify the scope for collective actions across the whole Region, develop blueprints for effective AT systems that could be adapted to different contexts and, over time, build evidence to showcase the impact of appropriate AT on the individual and society, supporting the case for further investment.

Finally, the evidence that this scoping review has synthesised suggests that countries should investigate the existing barriers and facilitators to AT coverage within their territories. These barriers could be mapped using the individual elements of the 5P framework for AT (people, personnel, policy, products and provision) [115] to help establish country-specific maps of responsibilities and establish cross-disciplinary multi-stakeholder collaborations to address existing barriers and improve AT coverage [116].

Strengths and limitations of the review

This scoping review summarised the current evidence, including its nature and range, identified the gaps in evidence, highlighted

areas of interest for future research and suggested collaborative approaches to increase the value of future evidence. The scoping review aimed to capture and analyse all relevant publications with evidence on the prevalence of needs and access to AT in the WHO European Region. Given the breadth of the research question, it is possible that some relevant publications were missed despite the two-pronged publication identification strategy of scientific literature searches and expert consultations. Expanding the number of keywords used, increasing the number of databases searched and contacting a wider group of experts are valid strategies that could identify other relevant publications. Two of the authors carried out the publication screening and data extraction, which could have introduced some selection bias. However, the screening procedure was well documented and the procedures used are common in many scoping and systematic reviews.

The scope of the review was limited to the analysis of evidence published in academic or grey literature, which presented data on AT needs, coverage and unmet need. Seeking to gain direct access to primary datasets sources such as the member states' Department of Statistics, Ministry of Health, or Ministry of Labour was beyond the scope of this study. The assumption was that evidence available on government portals would have been identified through the recommendations from in-country experts. However, relevant sources of information might still have been missed in some countries, in particular where we were unable to obtain support from any local AT experts.

Finally, new evidence, including the use of telehealth and other technology-mediated processes for AT provision, could emerge in response to the COVID-19 pandemic, other health emergencies, climate change and other imperatives for change and innovation [117–119]. Therefore, it would be relevant to reproduce this scoping review in the future.

Conclusion

To meet the goal of universal access to appropriate AT, the AT systems of the 53 countries in the WHO European Region must be able to meet the needs of the 135 million people with functional limitations currently living in the Region. This scoping review was conducted to summarise the evidence on AT needs and coverage across multiple countries, specific functional limitations, and individual APs, including an analysis of barriers and facilitators that affect people's ability to access the AT they need, to assess the strengths and weaknesses of current AT systems and to develop appropriate strategies to increase their effectiveness and reach.

Results show that the available evidence on the prevalence of AT needs and coverage came largely from a small subgroup of countries, with only a few studies leveraging datasets from nationally representative samples. Rates of met AT needs were generally higher for sensory impairments, such as hearing and vision (between 1.2–87% and 5–90%, respectively), compared with communication and cognitive impairments (10–60% and 57.6%, respectively). However, prevalence data varied greatly across functional impairment categories and age groups, and for different types of APs, mainly due to the different data collection strategies across studies.

Finally, the publications presenting barriers and facilitators to AT coverage were more comprehensive and these publications consistently had similar results regardless of the specific country setting. The three key elements significantly affecting the capacity of AT systems to deliver appropriate services to potential users were the relative accessibility of the systems themselves, their

financial affordability for users and the acceptability of different APs.

Acknowledgements


The authors acknowledge the valuable support of the national experts who contributed to the review.

Disclosure statement

No potential competing interest was reported by the authors.

ORCID

Satish Mishra  <http://orcid.org/0000-0002-2520-5892>

Ariane Laplante-Lévesque  <http://orcid.org/0000-0002-4170-2426>

Giulia Barbareschi  <http://orcid.org/0000-0001-9036-3566>

Luc De Witte  <http://orcid.org/0000-0002-3013-2640>

Chapal Khasnabis  <http://orcid.org/0000-0003-1824-2334>

References

- [1] WHO. World report on disability. Geneva (Switzerland): World Health Organization; 2011. [cited 2021 Nov 22]. Available from: http://www.who.int/disabilities/world_report/2011/report.pdf.
- [2] Khasnabis C, Mirza Z, MacLachlan M. Opening the GATE to inclusion for people with disabilities. *Lancet*. 2015; 386(10010):2229–2230.
- [3] Desmond D, Layton N, Bentley J, et al. Assistive technology and people: a position paper from the first global research, innovation and education on assistive technology (GREAT) summit. *Disabil Rehabil Assist Technol*. 2018; 13(5):437–444.
- [4] Layton N, Mont D, Puli L, et al. Access to assistive technology during the COVID-19 global pandemic: voices of users and families. *IJERPH*. 2021;18(21):11273.
- [5] Borg J, Lindström A, Larsson S. Assistive technology in developing countries: national and international responsibilities to implement the convention on the rights of persons with disabilities. *Lancet*. 2009;374(9704):1863–1865.
- [6] Borg J, Larsson S, Östergren P-O. The right to assistive technology: for whom, for what, and by whom? *Disabil Soc*. 2011;26(2):151–167.
- [7] MacLachlan M, McVeigh J, Cooke M, et al. Intersections between systems thinking and market shaping for assistive technology: the SMART (systems-market for assistive and related technologies) thinking matrix. *IJERPH*. 2018; 15(12):2627.
- [8] ATscale. The case for investing in assistive technology. Geneva: ATscale, 2020. [cited 2021 Nov 22]. Available from: <http://atscale2030.org/investment-case>.
- [9] Abualghaib O, Groce N, Simeu N, et al. Making visible the invisible: why disability-disaggregated data is vital to “leave no-one behind.” *Sustainability*. 2019;11(11):3091.
- [10] MacLachlan M, Banes D, Bell D, et al. Assistive technology policy: a position paper from the first global research, innovation, and education on assistive technology (GREAT) summit. *Disabil Rehabil Assist Technol*. 2018; 13(5):454–466.
- [11] Danemayer J, Boggs D, Ramos VD, et al. Estimating need and coverage for five priority assistive products: a systematic review of global population-based research. *BMJ Glob Health*. 2022;7(1):e007662.
- [12] WHO Regional Office for Europe: facts on disability. Copenhagen: WHO Regional Office for Europe [cited 2021 Nov 22]. Available from: <http://www.euro.who.int/en/health-topics/Life-stages/disability-and-rehabilitation/data-and-statistics/facts-on-disability>.
- [13] Boggs D, Kuper H, Mactaggart I. Estimating assistive technology need through population-based surveys: an analysis of data from Cameroon and India. In: WHO. Global perspectives on assistive technology: proceedings of the GReAT Consultation, et al. 2019. Geneva: World Health Organization. Volume 1. Available from: <http://apps.who.int/iris/handle/10665/330371>.
- [14] Federici S, Meloni F, Borsci S. The abandonment of assistive technology in Italy: a survey of national health service users. *Eur J Phys Rehabil Med*. 2016;52(4):516–526.
- [15] Cullen K, McAnaney D, Dolphin C, et al. Research on the provision of assistive technology in Ireland and other countries to support independent living across the life cycle. Dublin, Ireland: Work Research Centre; 2012.
- [16] Parkin C, Hatzidimitriadou E, Manship S, et al. A survey of assistive technology (AT) knowledge and experiences of healthcare professionals in the UK and France: challenges and opportunities for workforce development. In: AAATE 2019 Conference. *Tech Disabil*. 31: Special issue [cited 2021 Nov 22]. Available from: http://aaate2019.eu/wp-content/uploads/sites/24/2019/08/AAATE2019_Proceedings.pdf.
- [17] Kylberg M, Löfqvist C, Tomsone S, et al. A European perspective on the service delivery systems for assistive technology – differences and similarities between Latvia and Sweden. *J Cross Cult Gerontol*. 2015;30(1):51–67.
- [18] Henschke C. Provision and financing of assistive technology devices in Germany: a bureaucratic odyssey? The case of amyotrophic lateral sclerosis and Duchenne muscular dystrophy. *Health Policy*. 2012;105(2–3):176–184.
- [19] World Health Assembly. Seventy-first World Health Assembly. Improving access to assistive technology; 2018.
- [20] Grant MJ, Booth A. A typology of reviews: an analysis of 14 review types and associated methodologies. *Health Info Libr J*. 2009;26(2):91–108.
- [21] Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *Int J Soc Res Methodol*. 2005;8(1): 19–32.
- [22] Peters MDJ, Godfrey CM, Khalil H, et al. Guidance for conducting systematic scoping reviews. *Int J Evid Based Healthc*. 2015;13(3):141–146.
- [23] Levac D, Colquhoun H, O'Brien KK. Scoping studies: advancing the methodology. *Implement Sci*. 2010;5:69.
- [24] Washington Group on Disability Statistics. Washington Group Short Set of Disability Questions. Hyattsville (MD): Washington Group on Disability Statistics. [cited 2021 Dec 14]. Available from: <http://www.washingtongroup-disability.com/question-sets/wg-short-set-on-functioning-wg-ss>.
- [25] WHO. International classification of functioning, disability and health. Geneva, Switzerland: World Health Organization; 2001.
- [26] Booth A, Sutton A, Papaioannou D. Systematic approaches to a successful literature review. Washington (DC): Sage Publications; 2016.
- [27] Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. 2021;372:n71.

- [28] Al-Tayar R, Humbert T, Di Pietro L, et al. A rapid assessment on access to assistive technology in the World Health Organization's European Region. In: Layton N, Borg J (ed.). *Global perspectives on assistive technology: proceedings of the GReAT Consultation 2019*. Geneva, Switzerland: World Health Organization; 2019.
- [29] Dupraz J, Andersen-Ranberg K, Fors S, et al. Use of health-care services and assistive devices among centenarians: results of the cross-sectional, international 5-COOP study. *BMJ Open*. 2020;10(3):e034296.
- [30] Abdellaoui A, Tran Ba Huy P. Success and failure factors for hearing-aid prescription: results of a French National Survey. *Eur Ann Otorhinolaryngol Head Neck Dis*. 2013; 130(6):313–319.
- [31] Bisgaard N, Ruf S. Findings from EuroTrak surveys from 2009 to 2015: hearing loss prevalence, hearing aid adoption, and benefits of hearing aid use. *Am J Audiol*. 2017; 26(35):451–461.
- [32] Chupina K. Constraints in access to assistive technologies – and communication – for hard-of-hearing people in the Russian Federation and in Germany. *Disabil Stud Quart*. 2011;31(4).
- [33] National Disability Authority: assistive technology usage and unmet need amongst people with disabilities in Ireland. Dublin: National Disability Authority; 2015.
- [34] Ingo E, Brännström KJ, Andersson G, et al. Measuring motivation using the transtheoretical (stages of change) model: a follow-up study of people who failed an online hearing screening. *Int J Audiol*. 2016;55(Suppl. 3):S52–S58.
- [35] Öberg M, Marcusson J, Nägga K, et al. Hearing difficulties, uptake, and outcomes of hearing aids in people 85 years of age. *Int J Audiol*. 2012;51(2):108–115.
- [36] Turunen-Taheri S, Carlsson P-I, Johnson A-C, et al. Severe-to-profound hearing impairment: demographic data, gender differences and benefits of audiological rehabilitation. *Disabil Rehabil*. 2019;41(23):2766–2774.
- [37] Mishra S, Pupulin A, Ekman B, et al. National priority assistive product list development in low resource countries: lessons learned from Tajikistan. *Disabil Rehabil Assist Technol*. 2021;16(8):857–864.
- [38] Benova L, Grundy E, Ploubidis GB. Socioeconomic position and health-seeking behavior for hearing loss among older adults in England. *GERONB*. 2015;70(3):443–452.
- [39] Davis A, Smith P. Adult hearing screening: health policy issues – what happens next? *Am J Audiol*. 2013;22(1): 167–170.
- [40] Sawyer CS, Armitage CJ, Munro KJ, et al. Biopsychosocial classification of hearing health seeking in adults aged over 50 years in England. *Ear Hear*. 2020;41(5):1215–1225.
- [41] UNICEF. Situation analysis on children and adults with disabilities in Uzbekistan. Tashkent, Uzbekistan: United Nations; 2019.
- [42] Brandt M, Truckenbrod C, Meigen C, et al. Impaired visual acuity caused by uncorrected refractive errors and amblyopia in a German Paediatric Cohort. *Ophthalmic Physiol Opt*. 2021;41(1):42–52.
- [43] Dawes P, Dickinson C, Emsley R, et al. Vision impairment and dual sensory problems in middle age. *Ophthalmic Physiol Opt*. 2014;34(4):479–488.
- [44] Donaldson LA, Karas M, O'Brien D, et al. Findings from an opt-in eye examination service in English special schools. Is vision screening effective for this population? *PLOS One*. 2019;14(3):e0212733.
- [45] Pilling RF, Outhwaite L. Are all children with visual impairment known to the eye clinic? *Br J Ophthalmol*. 2017; 101(4):472–474.
- [46] Shickle D, Griffin M. Why don't older adults in England go to have their eyes examined? *Ophthalmic Physiol Opt*. 2014;34(1):38–45.
- [47] Toufееq A, Oram AJ. School-entry vision screening in the United Kingdom: practical aspects and outcomes. *Ophthalmic Epidemiol*. 2014;21(4):210–216.
- [48] Woodhouse JM, Davies N, McAvinchey A, et al. Ocular and visual status among children in special schools in Wales: the burden of unrecognised visual impairment. *Arch Dis Child*. 2014;99(6):500–504.
- [49] Funke A, Grehl T, Großkreutz J, et al. [Provision of assistive devices in amyotrophic lateral sclerosis. Analysis of 3 years case management in an internet-based supply network]. *Nervenarzt*. 2015;86(8):1007–1017.
- [50] Funke A, Spittel S, Grehl T, et al. Provision of assistive technology devices among people with ALS in Germany: a platform-case management approach. *Amyotroph Lateral Scler Frontotemporal Degener*. 2018;19(5–6): 342–350.
- [51] Creemers H, Beelen A, Grupstra H, et al. The provision of assistive devices and home adaptations to patients with ALS in The Netherlands: Patients' perspectives. *Amyotroph Lateral Scler Frontotemporal Degener*. 2014;15(5–6): 420–425.
- [52] Ebel J, Focsa T, Grigoras S, et al. Mapping of wheelchair provision and usage in Moldova. Chisinau: Government of Moldova; 2020.
- [53] Florio J, Arnet U, Gemperli A, et al. Need and use of assistive devices for personal mobility by individuals with spinal cord injury. *J Spinal Cord Med*. 2016;39(4):461–470.
- [54] Hertig-Godeschalk A, Gemperli A, Arnet U, et al. Availability and need of home adaptations for personal mobility among individuals with spinal cord injury. *J Spinal Cord Med*. 2018;41(1):91–101.
- [55] UNICEF. Turkmenistan survey and situation analysis of the boys and girls with disabilities in Turkmenistan. 2015. [cited 2021 Nov 22]. Available from: <http://p4ec.ru/wp-content/uploads/2019/03/Report-Disability-Survey-FINAL.pdf>.
- [56] Furtado S, Briggs T, Fulton J, et al. Patient experience after lower extremity amputation for sarcoma in England: a national survey. *Disabil Rehabil*. 2017;39(12):1171–1190.
- [57] Löfqvist C, Slaug B, Ekström H, et al. Use, non-use and perceived unmet needs of assistive technology among Swedish People in the third age. *Disabil Rehabil Assist Technol*. 2016;11(3):195–201.
- [58] Finlayson J, Jackson A, Mantry D, et al. The provision of aids and adaptations, risk assessments, and incident reporting and recording procedures in relation to injury prevention for adults with intellectual disabilities: cohort study. *J Intellect Disabil Res*. 2015;59(6):519–529.
- [59] Corradi F, Antonelli F. Progetto PCT – percorso di counselling con tecnologia per persone con disabilità [PCT project – counselling path with technology for people with disabilities]. Rome, Italy: Leonarda Vaccari Institute; 2014.
- [60] Pels EGM, Aarnoutse EJ, Ramsey NF, et al. Estimated prevalence of the target population for brain-computer interface neurotechnology in The Netherlands. *Neurorehabil Neural Repair*. 2017;31(7):677–685.
- [61] Creer S, Enderby P, Judge S, et al. Prevalence of people who could benefit from augmentative and alternative

- communication (AAC) in the UK: determining the need. *Int J Lang Commun Disord.* 2016;51(6):639–653.
- [62] Elliott E, Newton J, Rewaj P, et al. An epidemiological profile of dysarthria incidence and assistive technology use in the living population of people with MND in Scotland. *Amyotroph Lateral Scler Frontotemporal Degener.* 2020; 21(1–2):116–122.
- [63] Enderby P, Judge S, Creer S, et al. Beyond the anecdote: examining the need for, and provision of, AAC in the United Kingdom. UK: Communication Matters; 2013. [cited 2020 Jul 30]. Available from: http://www.communicationmatters.org.uk/sites/default/files/downloads/projects/aac_evidence_base/2013_AAC_Evidence_Base_Beyond_the_Anecdote.pdf.
- [64] Judge S, Enderby P, Creer S, et al. Provision of powered communication aids in the United Kingdom. *Augment Altern Commun.* 2017;33(3):181–187.
- [65] Judge S, Johnson V. Local service provision of augmentative and alternative communication and communication aids in England. *TAD.* 2017;29(3):121–128.
- [66] McNicholl A, Desmond D, Gallagher P. Assistive technologies, educational engagement and psychosocial outcomes among students with disabilities in higher education. *Disabil Rehabil Assist Technol.* 2020;0:1–9.
- [67] Zakaryan G, Yeritsyan M, Davtyan S, et al. Evaluation of rehabilitation services for children in Armenia: rapid assessment analysis and mapping. UNICEF; 2019. [cited 2021 Nov 22]. Available from: <http://www.unicef.org/armenia/media/7421/file/Report%20on%20Evaluation%20of%20Rehabilitation%20Services%20for%20Children%20in%20Armenia.pdf>.
- [68] Boot FH, MacLachlan M, Dinsmore J. Are there differences in factors influencing access and continued use of assistive products for people with intellectual disabilities living in group homes? *Disabil Rehabil Assist Technol.* 2020; 15(2):173–182.
- [69] Demain S, Burridge J, Ellis-Hill C, et al. Assistive technologies after stroke: self-management or fending for yourself? A focus group study. *BMC Health Serv Res.* 2013;13:334.
- [70] WHO. Assistive technology in Tajikistan: situational analysis. Geneva (Switzerland): World Health Organization; 2019.
- [71] Goriainova A, Pishnyak A, Khabirova E. The determinants of the development of Russian assistive technologies market: analysis of experts' interviews. *Qualitative Rep.* 2020; 25:3019–3044.
- [72] Blanchard P, Strohl-Maffesoli H, Vincent B. Evaluation de la prise en charge des aides techniques pour les personnes âgées dépendantes et les *personnes handicapées* [Assessment of assistive technology coverage for older adults with decreased autonomy and persons with disabilities]. Paris (France): Inspection générale des affaires sociales; 2013.
- [73] McCabe C. Situation assessment: people with disabilities in Azerbaijan. Baku: UNICEF; 2011.
- [74] Mishra S, DeMuth S, Sabharwal S, et al. Disability and rehabilitation in Tajikistan: development of a multisectoral national programme to leave no one behind. *Public Health Panor.* 2018;4:202–209.
- [75] Morrow E, Bowers R. Post-stroke ankle-foot orthoses: examining referral trends in the Scottish Multi-Disciplinary Team. *Int J Health Plann Manage.* 2019;34(2):521–533.
- [76] Newton L, Dickinson C, Gibson G, et al. Exploring the views of GPs, people with dementia and their carers on assistive technology: a qualitative study. *BMJ Open.* 2016; 6(5):e011132.
- [77] Nugraha B, Tani K, Gutenbrunner C. Rehabilitation service assessment and workforce capacity building in Albania – a civil society approach. *IJERPH.* 2020;17(19):7300.
- [78] Nyberg T, Johansson S. *Framtidens hjälpmedel i Skåne*. Malmö (Sweden): Funktionsrätt Skåne; 2020. [cited 2021 Nov 23]. Available from: <http://funktionsrattskane.se/framtidens-hjalpmedel-i-skane>.
- [79] Ocepek J, Prosic Z, Vidmar G. *Vloga medicinsko tehnicnih pripomočkov pri starostnikih – rezultati ankete* [assistive technology and its role among the elderly – a survey]. *Informatica Medica Slovenica.* 2012;17:9–15.
- [80] Pedersen H, Kermit PS, Söderström S. You have to argue the right way”: user involvement in the service delivery process for assistive activity technology. *Disabil Rehabil Assist Technol.* 2021;16(8):840–850.
- [81] Gallagher A, Cleary G, Clifford A, et al. “Unknown world of wheelchairs.” A mixed methods study exploring experiences of wheelchair and seating assistive technology provision for people with spinal cord injury in an Irish context. *Disabil Rehabil.* 2022;44:1946–1958.
- [82] Disability Human Rights Observatory. Implementation of the Convention on the Rights of Persons with Disabilities in Portugal. Submission to the Committee on the Rights of Persons with Disabilities of the responses to the list of issues by the Disability and Human Rights Observatory. Lisbon (Portugal); 2016. [cited 2021 Nov 22]. Available from: <http://www.ohchr.org/EN/newsEvents/Pages/DisplayNews.aspx?NewsID=18543&LangID=E>.
- [83] Tuikka A-M, Sachdeva N. Experiences from assistive technology services and their delivery in Finland. In Kar AK, Ilavarasan PV, Gupta MP, et al. editors. *Digital nations – smart cities, innovation, and sustainability*. Cham: Springer International Publishing; 2017. p. 16–22.
- [84] Campling NC, Pitts DG, Knight PV, et al. A qualitative analysis of the effectiveness of telehealthcare devices (ii) barriers to uptake of telehealthcare devices. *BMC Health Serv Res.* 2017;17(1):466.
- [85] Menich N. Challenges in access to assistive technology in Hungary. In: Layton N, Borg J (ed.). *Global perspectives on assistive technology: proceedings of the GReAT Consultation 2019*. Geneva, Switzerland: World Health Organization; 2019.
- [86] Adolfsson P, Lindstedt H, Pettersson I, et al. Perception of the influence of environmental factors in the use of electronic planning devices in adults with cognitive disabilities. *Disabil Rehabil Assist Technol.* 2016;11(6):493–500.
- [87] Gowran RJ, Clifford A, Gallagher A, et al. Wheelchair and seating assistive technology provision: a gateway to freedom. *Disabil Rehabil.* 2020;44:370–381.
- [88] WHO. Provision of wheelchairs in Tajikistan: economic assessment of alternative options. Geneva, Switzerland: World Health Organization; 2019.
- [89] Enable Ireland. *Assistive technology for people with disabilities and older people*. Dublin: Enable Ireland; 2016.
- [90] Hosking J, Gibson C. Impact of the single point of access referral system to reduce waiting times and improve clinical outcomes in an assistive technology service. *J Med Eng Technol.* 2016;40(5):265–269.
- [91] Social Insurance Board. *RFK-kasutamine meditsiinilises, sotsiaalses ja tööalases rehabilitatsioonis ning abivahendi vajaduse hindamisel, Piloottprojekt 2016–2020* [Implementation

- of ICF in medical, social and vocational rehabilitation and assistive technology assessment, pilot project 2016–2020]. Tallin (Estonia): Republic of Estonia Social Insurance Board; 2020. [cited 2021 Nov 22]. Available from: http://www.sotsiaalkindlustusamet.ee/sites/default/files/content-editors/Projektid/rfk_loppraport_aprill2020.pdf.
- [92] Tedesco Triccas L, McLening B, Hendrie W, et al. Is there a standard procedure for assessing and providing assistive devices for people with neuro-disabling conditions in United Kingdom? A nation-wide survey. *Disabil Health J*. 2019;12(1):93–97.
- [93] Kayabaşoğlu G, Kaymaz R, Erkorkmaz Ü, et al. Study of hearing aid effectiveness and patient satisfaction. *Kulak Burun Bogaz Ihtis Derg*. 2015;25(3):158–162.
- [94] Laplante-Lévesque A, Knudsen LV, Preminger JE, et al. Hearing help-seeking and rehabilitation: perspectives of adults with hearing impairment. *Int J Audiol*. 2012;51(2):93–102.
- [95] Leamon S, Hayden C, Lee H, et al. Improving access to optometry services for people at risk of preventable sight loss: a qualitative study in five UK locations. *J Public Health*. 2014;36(4):667–673.
- [96] Ravneberg B. Usability and abandonment of assistive technology. *J Assist Technol*. 2012;6(4):259–269.
- [97] Artikova V. Central Asia Region: desk review on disability, part 2. Falls Church (VA): New Edition Consulting; 2015.
- [98] Patiëntenfederatie Nederland. *Rapport meldactie hulpmiddelen. Ervaringen met keuze, aanvraag, levering en gebruik van hulpmiddelen* [Report action assistive technology. Experiences with choice, request, delivery and use of assistive technology devices]. Utrecht (Netherlands): Patient Federation Netherlands; 2019. [cited 2021 Nov 22]. Available from: <http://www.patiëntenfederatie.nl/downloads/rapporten/155-rapport-meldactie-hulpmiddelen/file>.
- [99] Panteli D, Henschke C, Kroneman M, et al. Assistive devices: regulation and coverage in five European countries. *Rapid Review* (No. 8). Toronto, Canada: North American Observatory on Health Systems and Policies; 2018.
- [100] Claesen E, Pryce H. An exploration of the perspectives of help-seekers prescribed hearing aids. *Prim Health Care Res Dev*. 2012;13(3):279–284.
- [101] Bennion A, Forshaw MJ. Insights from the experiences of older people with hearing impairment in the United Kingdom: recommendations for nurse-led rehabilitation. *Int J Older People Nurs*. 2013;8(4):270–278.
- [102] Rolfe C, Gardner B. Experiences of hearing loss and views towards interventions to promote uptake of rehabilitation support among UK adults. *Int J Audiol*. 2016;55(11):666–673.
- [103] Sansam K, O'Connor RJ, Neumann V, et al. Clinicians' perspectives on decision making in lower limb amputee rehabilitation. *J Rehabil Med*. 2014;46(5):447–453.
- [104] McCaughan D, Booth A, Jackson C, et al. Orthotic management of instability of the knee related to neuromuscular and central nervous system disorders: qualitative interview study of patient perspectives. *BMJ Open*. 2019;9(10):e029313.
- [105] Mycielski J, Turczyn P, Tarnacka B. Compliance with prescriptions for wheelchairs, walking aids, orthotics, and pressure-relieving devices in patients with traumatic spinal cord injury. *Eur J Physic Rehabil Med*. 2020;56:160–168.
- [106] De-Rosende-Celeiro I, Torres G, Seoane-Bouzas M, et al. Exploring the use of assistive products to promote functional independence in self-care activities in the bathroom. *PLOS One*. 2019;14(4):e0215002.
- [107] World Bank. World Bank country and lending groups – World Bank Data Help Desk. Washington (DC): World Bank; 2021. [cited 2021 Nov 23]. Available from: <http://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups>.
- [108] WHO. Rapid assistive technology assessment tool (rATA). Geneva (Switzerland): World Health Organization; 2021.
- [109] WHO. Assistive technology capacity assessment (ATA-C): instruction manual. Geneva (Switzerland): World Health Organization; 2021.
- [110] Smith RO. The emergence and emergency of assistive technology outcomes research methodology. *Assist Technol Outcomes Benefit*. 2016;10:19–37.
- [111] Matter R, Harniss M, Oderud T, et al. Assistive technology in resource-limited environments: a scoping review. *Disabil Rehabil Assist Technol*. 2017;12(2):105–114.
- [112] Khasnabis C, Holloway C, MacLachlan M. The digital and assistive technologies for ageing initiative: learning from the GATE initiative. *Lancet Health Longev*. 2020;1(3):e94–e95.
- [113] Ebuenyi ID, Kafumba J, Smith EM, et al. Empirical research and available data on assistive technology for persons with disabilities in Malawi: a review. *Assist Technol*. 2021.
- [114] Black N. Evidence based policy: proceed with care. *BMJ*. 2001;323(7307):275–279.
- [115] WHO. Global research, innovation and education in assistive technology: great summit 2017 report. Geneva (Switzerland): World Health Organization; 2017.
- [116] Hästbacka E, Nygård M, Nyqvist F. Barriers and facilitators to societal participation of people with disabilities: a scoping review of studies concerning European Countries. *Alter*. 2016;10(3):201–220.
- [117] Smith EM, Toro Hernandez ML, Ebuenyi ID, et al. Assistive technology use and provision during COVID-19: results from a rapid global survey. *Int J Health Policy Manag*. 2022;11(6):747–756.
- [118] Puli L, Layton N, Mont D, et al. Assistive technology provider experiences during the COVID-19 pandemic. *IJERPH*. 2021;18(19):10477.
- [119] Irgens I, Bach B, Rekan T, et al. Optimal management of health care for persons with disability related to spinal cord injury: learning from the Sunnaas model of telerehabilitation. *Spinal Cord Ser Cases*. 2020;6(1):88.