

Systematic Review

Access to assistive technology for people with intellectual disabilities: a systematic review to identify barriers and facilitators

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Abstract

Background The World Health Organisation has launched a programme to promote Global Cooperation on Assistive Technology. Its aim is to increase access to high-quality affordable assistive products (AP) for everybody in need. People with intellectual disabilities (ID) are a specific group that could benefit from AP, but use less AP compared to their non-intellectual disabled peers.

Method A systematic literature search was carried out to identify barriers and potential facilitators for access to AP for people with ID globally. The search strategy terms were 'Intellectual Disability' and 'Assistive Technology' with the following electronic literature databases PubMed, Embase, ASSIA, Web of Science, Medline, CINAHL complete, PsycInfo, Scopus and ERIC. The quality and relevance of the studies were assessed. Factors associated with access were identified thematically, categorised into barriers and facilitators and mapped into themes.

Results In all, 22 key studies were retrieved, describing 77 barriers and 56 facilitators. The most frequently reported barriers were related to lack of funding and cost of AP, lack of awareness about AP and inadequate assessment. An increase of knowledge and awareness about AP and the need of AP for people with ID were most often extracted as factors that could potentially facilitate access.

Conclusions This review proposes actions linked to the barriers and facilitators that have a particular importance for people with ID to access AP. Yet, only limited research is available describing factors that influence access to AP for people with ID in low and middle income countries and rural areas.

Keywords access, assistive products, assistive technology, intellectual disability, review

Introduction

Although the United Nations Convention on the Rights of Persons with Disabilities stipulates access to assistive technology (AT) is essential for all individuals, currently only 10% of the people in need of assistive

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products (AP) worldwide has access to AP (UN 2006; WHO 2016a). AP are any external products (including devices, equipment, instruments or software), especially produced or generally available, the primary purpose of which is to maintain or improve an individual's functioning and independence, and thereby promote their well-being. AT is the application of organised knowledge and skills related to AP, including systems and services (WHO 2013; Khasnabis *et al.* 2015). To improve access to AP globally, the World Health Organisation (WHO) launched a programme called Global Cooperation on Assistive Technology (GATE) in 2014 (WHO 2013). As a first step, the GATE programme has developed a priority Assistive Product List (APL), see Data S1. The APL represents a minimum list and includes 50 priority AP, selected on the basis of widespread need and impact on a person's life (WHO 2016b). The 50 priority AP are both low-tech and high-tech AP in the domains of vision, hearing, mobility, environment and personal care, communication and cognition. Examples are (motorised) wheelchairs, spectacles, hearing aids, portable ramps, communication software and pill organisers. The WHO encourages countries to develop their own list according to needs and context. Following the APL, the GATE programme has embarked on the development of more tools such as an AT policy framework, an AP service delivery model and an AP training package for personnel (WHO 2016b).

People with intellectual disabilities (ID) are a specific group who can benefit from AP. AP can improve daily functioning, community living and inclusion in society for people with ID (Owuor *et al.* 2017). AP may enhance independence, education, employment and social activities. People with ID also have a higher prevalence of comorbidities compared to the general population that could be better managed with AP, such as motor disabilities, sensory impairments and dementia (Haveman *et al.* 2011; Jansen & Kingma-Thijssen 2011; Hatton & Emerson 2015). Studies carried out so far have shown the positive impact of AP on the quality of life for people with ID. For example, when people with ID who have speech and language impairments have an alternative to speech, this has a great impact on their ability to express basic wants and needs and on social interaction (James 2014). Another example is given by McShea *et al.* who published a case study where a person with ID showed improved communication and less frequent episodes of

challenging behaviour after a successful implementation of hearing aids (McShea *et al.* 2014).

However, studies also show that people with ID use less AP compared to other populations in need. Inadequate access to AP negatively influences the health inequalities already present for people with ID (Wehmeyer 1995; Carey *et al.* 2005; Kaye *et al.* 2008; Hatton & Emerson 2015). It is known that biological factors influence health inequalities, but people with ID also have to face health inequity. Differences in health status are being caused by economic, social or environmental factors beyond the control of individuals. People with ID are still generally regarded as a devalued and stigmatised group, where cultural perception can play an important role (Hatton & Emerson 2015).

Barriers for people with ID to access services are well documented in the literature, such as challenging behaviour, fear, lack of support, previous negative experiences, assumptions that service eligibility assessments will fail and communication difficulties (Alborz *et al.* 2003; Mencap 2004; Alborz *et al.* 2005). However, it is currently unknown how many people with ID exactly have access to relevant AP and which factors influence this. Access to and use of AP by people with ID should be promoted to ensure that these people also benefit from the exceptional pace of (particular high-tech) AP developments worldwide.

There are different dimensions of access to services and AP, such as awareness, availability, affordability, adaptability, acceptability, quality, utilisation, relevance and effectiveness (Penchansky & Thomas 1981; Levesque *et al.* 2013). These must be born in mind when writing about access to AP. The focus of this systematic review was the availability of AP and utilisation of AP services for assessment and acquisition of AP. This includes recognising the need for AP and getting the assessment. Various terminologies have been used within literature to represent AP, such as AT, devices, technology and equipment. This systematic review combined all those terminologies into one focus. The aim of this review was to answer the following research question:

- What factors influence access for people with ID to the 50 AP included in the WHO's priority APL? These factors include but are not limited to cultural, political, social and economic considerations.

Methods

A systematic review was carried out to identify barriers and facilitators for access to AP for people with ID globally. The review protocol is registered at PROSPERO International prospective register of systematic reviews, registration number CRD42017057254 (PROSPERO 2017). The Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines for systematic reviews were applied (Liberati *et al.* 2009).

Search and selection strategy

The literature search was conducted in February 2017, with updates until May 2017, using the electronic literature databases PubMed, Embase, ASSIA, Web of Science, Medline, CINAHL complete, PsycInfo, Scopus and ERIC. The search strategy covered 'Intellectual Disability' and 'Assistive Technology'. See Table 1 for the search strategy in PubMed. The search strategies for all electronic databases are available in Data S2. After removing duplicates, records were judged by title and abstract on their relevance and selected for full text reading. References of reviews, email alerts of search strategies and databases such as Rehab Data and the Coleman Institute were also used

to identify relevant studies. The first and second author read the studies selected for full text screening, applying the inclusion and exclusion criteria outlined below. In consultation, consensus was reached for the studies to be included for the quality assessment.

Inclusion and exclusion criteria

Inclusion criteria were based on the aim rather than on the study design or method used. All studies whose aim was to (partly) explore access to AP included in the APL, and that included participants with ID. Studies were eligible to be included in the review if they reported on P (Population) = People with ID; from borderline to profound; all ages; who use or do not use AP; E (Exposure) = dimension of access to one or more of the 50 APL products; O (Outcome) = cultural, political, social and economic factors as outcomes that influence access to AP. Inclusion and exclusion criteria are outlined in Table 2.

Data extraction and synthesis

Data were extracted using an extraction table identifying the authors and publication year, the aim (or aims) of the study, the study design, the study population, the country, the AP included in the study

Table 1 Search strategy

	Intellectual disability	Assistive technology
Pubmed	((((((((((((((((Intellectual Disab*[Title/Abstract]) OR Intellectually Disab*[Title/Abstract]) OR Development Disorder*[Title/Abstract]) OR Intellectual Impairment*[Title/Abstract]) OR Intellectual Retard*[Title/Abstract]) OR Intellectually Retard*[Title/Abstract]) OR Handicap*[Title/Abstract]) OR Intellectually Handicap*[Title/Abstract]) OR Intellectual Defici*[Title/Abstract]) OR Mental Disab*[Title/Abstract]) OR Mentally Disab*[Title/Abstract]) OR Mental Impairment*[Title/Abstract]) OR Mental Retard*[Title/Abstract]) OR Mentally Retard*[Title/Abstract]) OR Mental Handicap*[Title/Abstract]) OR Mentally Handicap*[Title/Abstract]) OR Mental Defici*[Title/Abstract]) OR Idiocy [Title/Abstract]) OR Learning Disabilit*[Title/Abstract]) OR Developmental Disab*[Title/Abstract]) OR Developmentally Disab*[Title/Abstract])	((((((((Equipment and Supplies [Mesh]) OR Computing Methodologies [Mesh]) OR Assistive Technolog*[Title/Abstract]) OR Assistive Product*[Title/Abstract]) OR Device*[Title/Abstract]) OR Aid*[Title/Abstract]) OR Equipment [Title/Abstract]) OR Rehabilitation Technolog*[Title/Abstract]) OR Universal Design [Title/Abstract])

Final search performed on 14 February 2017; plurals were allowed by including wildcards (*). Columns were combined by the use of the Boolean operator AND.

Table 2 Inclusion and exclusion criteria for systematic review

Inclusion criteria	
Publication year	No restriction.
Language	No restriction.
Types of research	Searching will be conducted in English, with any non-English titles to be translated. Qualitative, quantitative and mixed methods Research and development studies Programme evaluations Theoretical
Types of documents	Journal articles, book chapters, policy reports, technical reports, conference proceedings and reports and accessible dissertations. Commentaries/editorials.
Research focus	Availability of assistive products and utilisation of assistive technology services in different resource settings for people with intellectual disabilities. The whole process for people with intellectual disabilities to have assistive products available to them, including recognising the need and getting the correct assessment for assistive products.
Exclusion criteria	
Types of research	Review studies, protocols, inaccessible dissertations.
Types of documents	Book reviews, abstracts, bibliographies.
Research focus	Customizations of assistive products to make it accessible for people with intellectual disabilities. Training or support of the care system or user to know how to use assistive products. Follow-up and maintenance of the assistive product.
Exclusion codes	People Cannot specifically be applied on people with ID ID is not present or unknown Data of people with ID cannot be derived Acquired brain injury Products Does not relate to one of the APL products Access Does not relate to access Factors Does not relate to cultural, political, social and economic factors Research Research method does not fit inclusion criteria Document Document type does not fit inclusion criteria

and analysis. The data extracted from the articles were presented descriptively. The identified results (i.e. factors associated with access) were also extracted. Factors associated with access were identified thematically. These were then categorised into barriers and facilitators, keeping track of frequency counts. Barriers were defined as factors that limit or inhibit persons with ID to get the AP they need. Facilitators were defined as factors that potentially facilitate, encourage or enable persons with ID to get the AP they need. The first and second author independently

classified the barriers and facilitators by mapping these into themes. In consultation, consensus was reached for the classification.

Quality assessment

The first and second author independently assessed the quality of the papers and discussed the outcome using the Standard Quality Assessment Criteria with checklists for both qualitative and quantitative studies (Kmet *et al.* 2004). A summary score, between 0 and

I, was calculated for each paper by summing the total score obtained across relevant items and dividing by the total possible score. The average and standard deviation of the summary scores were calculated in Excel 2016. If the document did not include a qualitative or quantitative study design, e.g. a perspective article, no quality assessment was applied.

Relevance score

In addition to the quality score, we categorised each study according to its relevance (low, middle or high relevance). This was to indicate the relation of the study to the objective of this systematic review: (1) Low relevance contained little ID-specific data (wider population included in study) and little data on access to AP of the APL (e.g. the study was more about use of AP than access); (2) middle relevance contained either little ID-specific data or little data on access to AP of the APL; and (3) high relevance contained both exclusively ID-specific data and specific data on access to AP of the APL.

The combination of the average quality assessment score and relevance category determined the final score. A key study scored a minimum of 0.7 for the quality assessment score in combination with any relevance score and was used as a basis for drawing main conclusions. For those studies with a quality assessment score below 0.7 or where no quality assessment could be applied, in combination with a low relevance, it was classified as a complementary study. These complementary studies were used to confirm or sharpen the main conclusions.

Results

Search and selection strategy

After the first author identified the records through database searches, excluded duplicates, and screened title and abstract, 97 full text articles were to be selected for assessment, see Fig. 1. In total, 27 studies ultimately met the inclusion criteria.

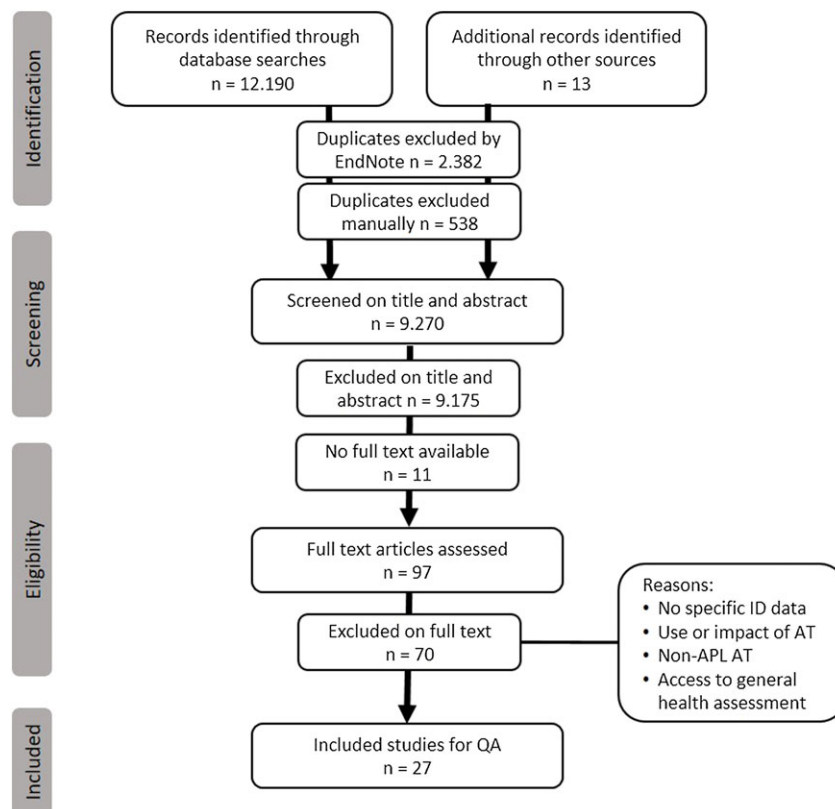


Figure 1 Flow diagram of the search, screening, selection and inclusion process of studies. APL, Assistive Product List; AT, assistive technology; ID, intellectual disabilities.

Study characteristics

The characteristics of the 27 included studies are presented in Table 3. Twenty-two studies were scored as a key study, following the quality assessment and relevance score (Parette Jr & Vanbiervliet 1992; Wehmeyer 1995; Brodin 1998; Wehmeyer 1998; Wehmeyer 1999; Laki 2002; Carmeli *et al.* 2004; Carey *et al.* 2005; Nelson Bryen *et al.* 2007; Saloojee *et al.* 2007; Barnard & Beyer 2009; Siu *et al.* 2010; Holman 2012; Palmer *et al.* 2012; Tanis *et al.* 2012; Ault *et al.* 2013; Codling 2013; Davis 2013; Haynes 2013; McShea *et al.* 2014; Lersilp *et al.* 2015; Boot *et al.* 2017). Five studies were scored as a complementary study (Parette 1997; Kemp & Parette 2000; Hourcade & Parette 2001; Wallace 2002; Braddock *et al.* 2004). The majority of the studies included were quantitative studies (13/27), followed by perspective articles (7/27), studies that included mixed methods design (3/27), case studies (2/27) and qualitative studies (2/27). Twenty-four studies were from high income countries, according to the World Bank Data and three from upper middle income countries (World Bank 2017). The majority of the studies were from the USA, with a total of 16 studies. The ID population included both adults and children, but none of the studies reported specific characteristics of the people with ID, e.g. level of ID or comorbidities. The studies included a variety of AP, including both high-tech and low-tech products; some referred to AP in general without mentioning a specific product being studied. Data collection methods varied for the qualitative studies. The majority used interviews, while some used field notes. All quantitative studies were based on data collected using surveys (i.e. questionnaires and quiz). Twenty-four out of the 27 studies identified barriers of access to AP, and 21 studies identified facilitators. Quality ratings for the quantitative designs ranged between 0.55 and 0.86 (average: 0.75; standard deviation: 0.07). The qualitative designs scored on quality from 0.2 to 1.0 (average: 0.69; standard deviation: 0.27; without outlier Barnard & Beyer 2009, average: 0.78; standard deviation: 0.17). Five studies showed a high relevance to the review objective, 14 studies a middle relevance and eight studies a low relevance, of which five from the eight were scored as a complementary study.

Barriers for access to assistive products for people with intellectual disabilities

In total, 77 barriers were extracted from the 22 key studies. See Fig. 2 for an overview of the themes and number of barriers classified per theme. Most barriers (23 in total) were classified under *Policy and Funding*, of which 12 barriers were 'Lack of funding/costs'. Saloojee *et al.* (2007) gives some examples of explanations why caregivers did not receive grants: 'I have lost hope – I have been waiting for so long'; 'I applied and they said I had the wrong forms. I am still waiting for the forms'; 'I have heard about this grant but I don't know where to go'. The second highest number of barriers were classified under *Unawareness*, with a total of 19 barriers. 'Lack of awareness about AP' was most often extracted ($n = 12$), followed by 'Lack of awareness about the need of AP for people with ID' ($n = 4$). An example was reported in Codling (2013): 'I have never had my eyes tested. My Mum said I don't need it'. The third most frequently classified theme was *Assessment*, of which seven barriers were 'inadequate assessment', e.g. the assessment was not adjusted to the person with ID. One of these barriers was reported in Codling (2013) page 41: 'She cannot read the letters on the eye chart so it would be pointless'.

Facilitators for access to assistive products for people with intellectual disabilities

Regarding the facilitators, a total of 56 potential facilitators were extracted from the 22 key studies, see Fig. 2. The facilitators were documented either as a studied intervention or as a recommendation. The most extracted facilitators were classified under the theme *Capacity Building*, with a total of 19 facilitators. Within this theme, the facilitators 'Increase knowledge and awareness about AP' ($n = 11$), and 'Increase knowledge and awareness about the need of AP for people with ID' ($n = 4$), were extracted most often. The second highest number of facilitators were classified under the themes *Policy and Funding* and *Systems*, both with a total number of 13 facilitators. The main facilitator for *Policy and Funding* was to decrease cost or increase funding possibilities, like state grant AT programmes mentioned in both Parette Jr and Vanbiervliet (1992) and Saloojee *et al.* (2007). An example of a facilitator for *Systems* was outlined in Barnard and Beyer (2009) who reports

Table 3 Study characteristics, overview of studies included No. 1-22 were scored as key studies. No. 23-27 were scored as complementary studies

Key studies									
No. Study	Aim (s)	Document type; study design	Country	ID population (age, level of ID, setting), informants	Assistive products	Analysis	Qualitative QA score	Quantitative QA score	Relevance
1 Ault <i>et al.</i> (2013)	To investigate the current state of the practice of AT services delivered in rural school districts in the USA. The specific research questions were as follows: (1) What and how many AT devices are used by students in rural school districts and how does that compare to all students nationwide? (2) Who attends and participates in IEP meetings in rural districts? (3) What are the strengths and barriers of AT service delivery identified by teachers in rural school districts?	Article. Qualitative & quantitative study. (1) Field notes & interviews. (2) Survey.	USA	Students with disabilities, aged 3-21 years, of which 12.17% with ID. Total: n = 699. Rural: n = 56; informants: 45 rural special education teachers.	AP that students used, divided into seven functional areas, including existence; communication; body support, alignment, and positioning; travel and mobility; environmental interaction; education and transition; and sports, fitness and recreation.	Descriptive analysis: frequencies and percentages. Qualitative analysis.	0.85	0.72	Middle
2 Barnard and Beyer (2009)	To give some examples of how personalised technology can help people with ID, to highlight the barriers to greater acceptance of the technology for people with ID and to stimulate debate.	Commentary article and case studies.	UK	People with ID in general, no specifications. Case studies are adults.	Personalised technology, e.g. medication dispenser, PDA, mobile phone, bed or door sensor, staff pager, epilepsy sensor.	n/a	0.2	n/a	Middle
3 Boot <i>et al.</i> (2017)	To present a framework for understanding the complex interaction between ID, health and wellbeing and AT. To	Perspective article.	Ireland	People with ID in general, no specifications.	AP in general, referring to the AP.	n/a	n/a	n/a	High

Table 3. (Continued)

No.	Study	Aim (s)	Document type; study design	Country	ID population (age, level of ID, setting), informants	Assistive products	Analysis	Qualitative	Quantitative	Relevance
								QA score	QA score	
		highlight that without a concerted and systematic approach to consider the challenges that ID presents, for the users, caregivers and providers of AP, profound inequities in the quality of life for people with ID will persist.								
4	Brodin (1998)	To Survey what kind of knowledge day centre staff has on assistive devices and new technology, as well as their attitudes towards usage of new technology for persons with ID.	Article, Quantitative study, Questionnaire.	Sweden	People with ID in general, no specifications. Informants: day centre staff. N = 493 in the experiment group and n = 74 in the control group (participated in an earlier project from 1992 to 1995).	Mainly time control devices and communication devices.	Descriptive analysis: percentages.	n/a	0.72	Middle
5	Carey <i>et al.</i> (2005)	To fill in some gaps in research on technology use with individuals who have ID by exploring the following questions: (1) what technologies are adults with ID using on a regular basis? (2) What factors affect technology use? (3) How do the factors that affect use vary by type of technology? (4) How	Article, Quantitative study, Survey (face to face interviews)	USA	Informants: adults with ID, capable of communicating answers to simple, closed-ended questions. Flash cards were used. Different sites and settings. N = 83.	Electronic organisers, cell phone, computer and internet use.	Descriptive analysis: frequencies. Statistical analysis.	n/a	0.82	Middle

Table 3. (Continued)

Key studies										
No.	Study	Aim (s)	Document type; study design	Country	ID population (age, level of ID, setting), informants	Assistive products	Analysis	Qualitative QA score	Quantitative QA score	Relevance
6	Carmeli <i>et al.</i> (2004)	and why are individuals using computers, the internet, and electronic organisers? (5) What problems are experienced by the users? (6) What barriers are reported by those who do not use electronic technologies? To examine the nature of the relationship between involvement of the physiotherapists' team and the degree to which AP was used in residential care centres for persons with ID in Israel.	Article, Quantitative study, Questionnaire.	Israel	People with ID in residential care setting, no further specifications. Informants: physiotherapists. <i>N</i> = 65.	Mobility AP.	Statistical analysis, e.g. multiple regression analysis.	n/a	0.86	Middle
7	Codling (2013)	To explore the factors that were preventing people with ID in Wokingham from accessing the optometrist and compare the findings within existing literature. And to conduct a pilot study to improve access to optometrist for people with ID to find out whether the change in service delivery results in an increase in access and uptake of eye tests for people with ID.	Article, Qualitative study, Interviews and pilot study.	UK	People with ID in general, no specifications. Informants: people with ID, carers and optometrists.	Glasses.	Descriptive analysis.	0.6	n/a	High

Table 3. (Continued)

No.	Study	Aim (s)	Document type; study design	Country	Key studies				Quantitative QA score	Quantitative QA score	Relevance
					ID population (age, level of ID, setting), informants	Assistive products	Analysis	Assistive products			
8	Davis (2013)	To study educators' experiences with AP use: (1) What are educators' experiences regarding the use of AP for students with severe or multiple disabilities (SMD)? (2) What are educators' perceptions of AP use for students with SMD? (3) What strategies do educators use to match AP to students with SMD?	Thesis. Qualitative study including interviews and Individualised Education Programs (IEPs).	USA	Children with ID (SMD). Informants: Educators. N = 10. Individualised Education Programs (IEPs) of students with SMD. N = 82.	Mainly communication AP.	Qualitative analysis, phenomenological approach.	I	n/a	Middle	
9	Haynes (2013)	To test knowledge and gauge attitudes and behaviours of the case managers related to the provision of AP for individuals with ID.	Article. Quantitative study. Training course evaluations (quiz and questionnaire).	USA	People with ID in general, no specifications. Informants: case managers. N = 224–245 (depending on which course) who filled in both the quiz as the questionnaire.	A broad range of devices and accommodations that include both high-tech and low-tech solutions.	Statistical analysis: ANOVA and chi-square.	n/a	0.73	High	
10	Holman (2012)	To address the current situation in the UK and the lack of eye test within people with ID.	Perspective article.	UK	People with ID in general, no specifications.	Glasses.	n/a	n/a	n/a	High	
11	Laki (2002)	To determine present conditions and needs of AP in homes for people with developmental disorders: how frequently AP are used; what kind of	Article. Quantitative survey.	Hungary	Young persons with ID, no specifications. Informants: care staff.	AP grouped in: communication; household; combined operations; time; money; sport; game; stimulation;	Descriptive analysis: percentages.	n/a	0.55	Middle	

Table 3. (Continued)

Key studies										
No.	Study	Aim (s)	Document type; study design	Country	ID population (age, level of ID, setting), informants	Assistive products	Analysis	Qualitative QA score	Quantitative QA score	Relevance
		AP is available for the users, and what quality they represent; to identify relations between the experienced differences and the varieties of service types or providers (government vs non-government, day care centres vs large institutions vs small homes).				music instr.; craft-work; colours.				
12	Lersilp <i>et al.</i> (2015)	To survey provision, frequency of use and needs for using AP, and analyse a model of providing them to disabled students in special education schools from the perspectives of key informants. The above can answer the following research questions: What kinds of AP were needed and provided for use by students with disabilities in special education schools and what was the organised system for providing them?	Article. Qualitative & quantitative study.	Thailand	Students with disabilities. Participants were divided in 4 groups: visual disability, hearing disability, physical disability and intellectual disability. Informants: students with disabilities ($n = 120$), parents or caregivers of the students ($n = 12$), teachers ($n = 4$), school therapists ($n = 4$) and principals ($n = 4$) of special education schools.	AP with shortcuts and easier steps, e.g. communication cards.	Descriptive analysis: percentages. Qualitative analysis.	0.7	0.73	Low
13	McShea <i>et al.</i> (2014)	To discuss current barriers for people with ID to get proper hearing tests and aids if needed. Presentation	Perspective article and a case study.	UK	People with ID in general, no specifications.	Hearing aids.	n/a	0.6	n/a	High

Table 3. (Continued)

Key studies										
No.	Study	Aim (s)	Document type; study design	Country	ID population (age, level of ID, setting), informants	Assistive products	Analysis	Qualitative QA score	Quantitative QA score	Relevance
14	Nelson-Bryen <i>et al.</i> (2007)	of a new care pathway for the audiology department. To (a) explore the extent and scope of cell phone use by adults with ID, (b) determine reasons for non-use, and (c) delineate factors that predict the use of cell phones.	Article. Quantitative survey.	USA	Informants: Adults with ID, capable of communicating answers to simple, closed-ended questions. N = 83.	Mobile phones.	Descriptive analysis: percentages. Statistical analysis: Chi-square analyses.	n/a	0.82	Middle
15	Palmer <i>et al.</i> (2012)	To find out the degree to which people with ID use: (1) available electronic and information technology; (2) assistive or universally designed technology; and (3) emerging state of the art electronic and information technology. And to identify ongoing barriers to technology use.	Article. Quantitative survey.	USA	People with ID in general, all ages, no specifications. Informants: family members of people with ID. N = 1617	AP for mobility, hearing or vision, communication, and independent living, and computers.	Descriptive analysis: frequencies and percentages.	n/a	0.82	Middle
16	Parette Jr and Vanbiervliet (1992)	To report the technology needs of persons with ID in Arkansas. The study also focused on a variety of technology utilisation patterns for persons with ID, including travel practices, expenditures for technology, technology acquisition strategies and levels of satisfaction	Article. Quantitative survey.	USA	Informants: People with ID (all ages), capable of self-reports. N = 680.	Variety of AP, e.g. hearing aids, wheelchairs.	Descriptive analysis: percentages.	n/a	0.73	Middle

Table 3. (Continued)

Key studies									
No. Study	Aim (s)	Document type; study design	Country	ID population (age, level of ID, setting), informants	Assistive products	Analysis	Qualitative QA score	Quantitative QA score	Relevance
17	Saloojee <i>et al.</i> (2007)	with technology currently being used. To establish whether children with disabilities in a peri-urban township had access to education, rehabilitation (including the provision of AP) and social grants, and to describe support systems available to caregivers of these children.	South Africa	Disabled children under 18 years of age, including children with ID (39%). Informants: caregivers. N = 156.	AP, e.g. wheelchairs, communication aids, specialised seating, standing frames.	Descriptive analysis: frequencies and percentages. Qualitative analysis.	0.9	0.68	Low
18	Siu <i>et al.</i> (2010)	To show current status of AAC provision and services in Hong Kong. (1) to identify the number of AAC providers in the Hong Kong area; (2) to determine the availability of AAC devices and AAC resources at different service delivery settings, in particular, at special preschool training centres (for children under 6 years old) and special schools (children aged 6 years to 16 years); and (3) to explore the availability and status of current training for local AAC service providers.	China	Children and adults with disabilities including people with ID, no specifications. Respondents: S&L therapist (65.4%), OT (14%), social worker (12.1%), centre-in-charges (4.7%), nurses (1.9%) one physiotherapist and one health/welfare worker. N = 105 (special schools for ID n = 29; adult ID services n = 33).	AAC (communication AP)	Descriptive analysis: frequencies and percentages.	n/a	0.77	Low

Table 3. (Continued)

No.	Study	Aim (s)	Document type; study design	Country	Key studies			Quantitative QA score	Qualitative QA score	Relevance
					ID population (age, level of ID, setting), informants	Assistive products	Analysis			
19	Tanis <i>et al.</i> (2012)	To gather information from people with intellectual and developmental disabilities with regard to their self-perceived technology use, needs and barriers: (1) device use; (2) assessment procedures; (3) knowledge of available devices; (4) training; (5) device cost; (6) on-going support; and (7) barriers to technology use in the areas of mobility, vision and/or hearing; computer use; communication; and independent living.	Article, Quantitative survey.	USA	Informants: youth or adults identified as having intellectual or developmental disabilities. <i>N</i> = 180. No specifications.	AP in the areas of mobility, vision and/or hearing; computer use; communication; and independent living.	Descriptive analysis: frequencies.	n/a	0.77	Middle
20	Wehmeyer (1995)	To better understand the extent to which AP is currently used by people with ID and to document the existing barriers to further usage.	Article, Pilot study, Quantitative survey.	USA	People with ID, 2–55 years. No other specifications. Informants: parent or caregiver. <i>N</i> = 80.	AP in general: mobility, hearing and vision, communication, home adaptation and access, environmental control, independent living, common household appliances, and computers.	Descriptive analysis: frequencies.	n/a	0.77	Middle
21	Wehmeyer (1998)	To test the hypothesis that AP are generally underutilised by people with ID and to	Article, Quantitative survey following the pilot study of Wehmeyer 1995.	USA	Adults with ID, no further specifics. Informants: parent or caregiver. <i>N</i> = 1218.	AP in general: mobility, hearing and vision, communication,	Descriptive analysis: frequencies.	n/a	0.77	Middle

Table 3. (Continued)

Key studies										
No.	Study	Aim (s)	Document type; study design	Country	ID population (age, level of ID, setting), informants	Assistive products	Analysis	Qualitative QA score	Quantitative QA score	Relevance
22	Wehmeyer (1999)	examine barriers to such use. To test the hypothesis that AP are generally underutilised by people with ID and to examine barriers to such use.	Article, Quantitative survey following the pilot study of Wehmeyer 1995.	USA	People with ID; school-age students, no further specifications. Informants: parent or caregiver. N = 516	home adaptation and access, environmental control, independent living, common household appliances, and computers. AP in general: mobility, hearing and vision, communication, home adaptation and access, environmental control, independent living, common household appliances, and computers.	Descriptive analysis: frequencies.	n/a	0.73	Middle
23	Braddock <i>et al.</i> (2004)	To highlight that despite the potential of emerging technologies to assist persons with cognitive disabilities, significant practical impediments remain to be overcome in commercialisation, consumer abandonment and in the design and development of useful products.	Perspective article.	USA	Complementary studies People with cognitive disabilities of which 22% ID. No specifications.	Personal support technologies (e.g. PDA), assisted care systems technologies, and virtual technologies.	n/a	n/a	n/a	Low
24	Hourcade and Parette (2001)	To outline several primary informational needs of professionals, and the primary informational	Perspective article.	USA	People with ID and/or developmental disabilities, no specifications.	AP in general, e.g. AAC.	n/a	n/a	n/a	Low

Table 3. (Continued)

Key studies										
No.	Study	Aim (s)	Document type; study design	Country	ID population (age, level of ID, setting), informants	Assistive products	Analysis	Qualitative QA score	Quantitative QA score	Relevance
25	Kemp and Parette (2000)	needs of families of students with ID and/or developmental disabilities, for effective use of AP. To examine systemic barriers faced by minority families in the AP decision-making process, focusing particularly on racism and prejudice, equity of resources and professionals' perspectives. It will also describe implications for minority families of students with ID and developmental disabilities and professionals working with these individuals.	Perspective article.	USA	Children or students with ID and/or developmental disabilities, no specifications.	AP in general.	n/a	n/a	n/a	Low
26	Parette (1997)	To explain and support the policy statement on AP and AT approved by the Board of Directors of CEC-MRDD in the Spring of 1996.	Perspective article.	USA	Persons with ID and/or developmental disabilities, no specifications.	High and low tech AP, e.g. communication boards.	n/a	n/a	n/a	Low
27	Wallace (2002)	To discuss the importance of successful acquisition and integration of AP for people with developmental disabilities. Presenting a guideline and legislations for AT in the USA.	Book chapter. Perspective piece.	USA	People with Down syndrome and other developmental disabilities. No specifications.	AP in general: devices for mobility, sensory disabilities, communication, community integration and approach to learning.	n/a	n/a	n/a	Low

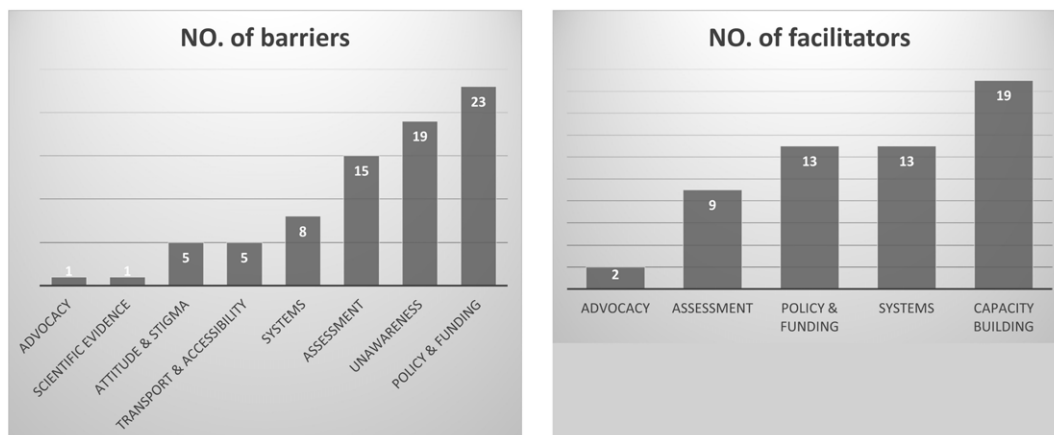


Figure 2 Number of extracted barriers and facilitators per theme.

that AP should be part of the support plan of a person with ID (Barnard & Beyer 2009).

Complementary studies

Two out of the five complementary studies confirm that cost is a main barrier for access to AP and mention as facilitators to reduce costs or apply alternative funding options (Parette 1997; Braddock *et al.* 2004). Three out of the five complementary articles describe family values and involvement as factors influencing AP access and use (Parette 1997; Kemp & Parette 2000; Hourcade & Parette 2001). For example, one of the studies identified as a barrier that little or no family involvement in AP processes may prevent the person with ID getting the AP he or she needs (Kemp & Parette 2000).

Barriers and facilitators specific to people with intellectual disabilities

Of all 77 barriers and 56 facilitators extracted from the studies, the majority reflect the general state of healthcare and could apply to people with all types of disabilities. Figure 3 describes those barriers and potential facilitators that have a particular importance for people with ID in accessing AP judged by the authors; factors that specifically influence people with ID and are of less relevance to other groups accessing AP. In addition, we have linked the potential actions to these factors. These are suggestive actions with increased research need to determine the most

appropriate targeted actions for each barrier or facilitator.

Discussion

Ensuring that no one is left behind, we need to understand the barriers and facilitators to access AP for people with ID and provide global evidence as a foundation for future work.

This systematic review of a sample of 22 key studies identifies 133 factors that limit or facilitate access to AP for people with ID. The most frequently reported barriers were related to lack of funding and cost of AP, lack of awareness about AP and inadequate assessment. The most frequent factors that potentially facilitate access to AP for people with ID were an increase of knowledge and awareness about AP and the need for AP for people with ID. Overall, the studies vary in types of AP presented (some mentioning AP in general, others focusing on one AP specifically), and none of the studies provided specifics with regard to the ID population. Therefore, it is difficult to draw specific conclusions for this population. There is a specific gap within research regarding people with ID and access to AP in low income countries; no studies were found with this systematic review.

The barriers and facilitators that have a particular importance for people with ID can be translated into actions, as shown in the results section. While these actions are suggested by the authors, it is advised that further research is required to determine the most

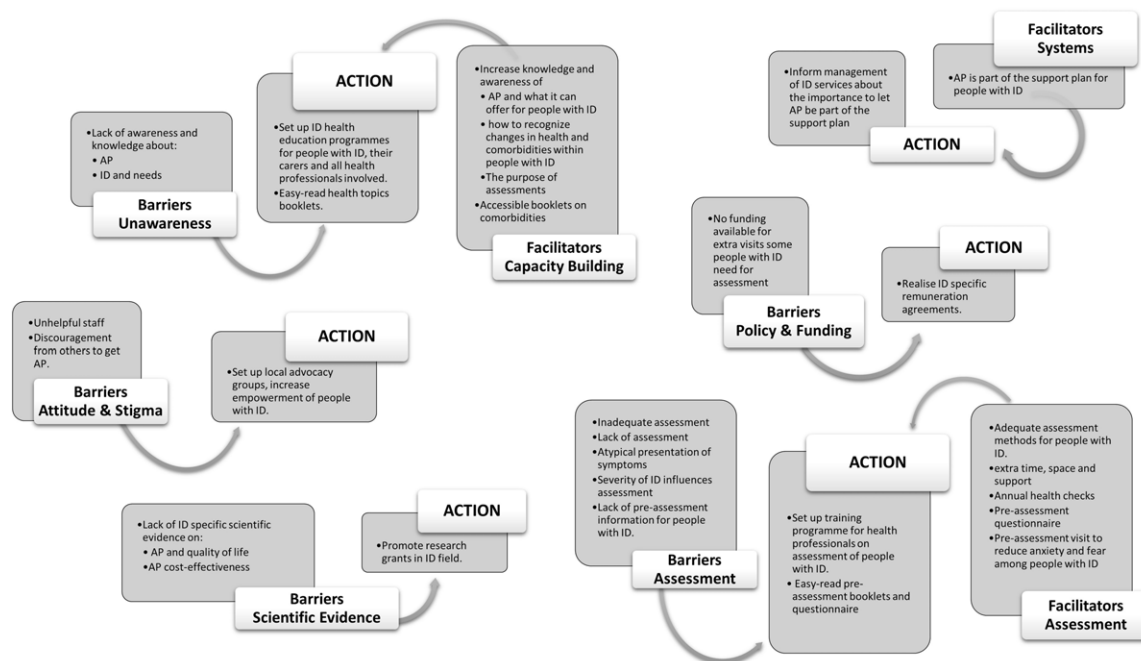


Figure 3 ID specific barriers and facilitators and suggestive actions linked to these factors. AP, assistive products; ID, intellectual disabilities.

appropriate targeted actions for each listed barrier or facilitator. One suggested action is to set up new local or national AP advocacy groups for people with ID to ensure that services have a clear, representative link to the voices of individuals with ID. Another is to introduce the importance of AP in existing advocacy (including self-advocacy) groups for people with ID. In recent years, there has been an increase in the number of self-advocacy groups for people with ID, and studies have shown the positive impacts of these groups for people with ID (Gilmartin & Slevin 2010; Clarke *et al.* 2015). Self-advocacy groups promote and enhance the participants' personal development and empowerment, giving a greater sense of self-determination and autonomy (Gilmartin & Slevin 2010, Clarke *et al.* 2015). Being part of a self-advocacy group can positively change one's self-concept, which includes feeling more confident and speaking up for oneself (Beart *et al.* 2004). Self-advocacy groups can have a positive impact on the stigma that is attached to people with ID and may even enhance social inclusion (Anderson & Bigby 2017). The results of these self-advocacy groups could influence the interaction people with ID have with others,

providing a critical voice with regard to the use of and importance of AP.

Another recommended action is to set up education and training programmes for health professionals, people with ID and their carers concerning ID-related health topics and AP needs. The aim is to increase knowledge and awareness of AP needs for people with ID, which might also have a positive influence on attitudes towards people with ID. Training related to AP assessment and acquisition should be included within national health education programmes. Present literature suggests dedicated health education programmes for people with ID can lead to an increase in confidence for people with ID to explain their health problems and ask questions if they do not understand the health professional (McPherson *et al.* 2017). Promoting the end users voice towards their needs is key to overcoming barriers to the introduction of tailored AP for those in need. We must also note that education programmes for people with ID alone will probably not be enough for sustainability: the support system, e.g. family members and care staff, also needs to be included (Codling & Macdonald 2011). Educating

family and care staff about AP and getting them more proactive in the AP process must not be overlooked. If the person depends on the carer to access AP services, the carer needs to be convinced that it is necessary (Alborz *et al.* 2005).

With regard to the financial theme, access to funding has also been listed as a common barrier to the timely acquisition of AP. Dedicated policy programmes on AT can play a part to overcome this barrier and make AP accessible to everyone in need (Andrich *et al.* 2013; Sund 2016). For countries to make AP financially accessible, service delivery systems must be set up (Andrich *et al.* 2013). Current AT policy programmes are mainly situated in high income countries. A good example is the AT policy programme in Norway which states that people in need of AP are entitled to receive financial support for AP under the national insurance scheme (Sund 2016). Borg *et al.* (2011) stipulates the need for further developing national AT policies in low and middle income countries that take into account the current variations in access to AP across genders, ages and disabilities, in order to achieve equitable access and provision of AP (Borg *et al.* 2011). Further scientific evidence is required from low and middle income settings in order to develop the appropriate policies (Borg *et al.* 2011).

Unfortunately, research on AP provision and use in low and middle income countries is limited (Matter *et al.* 2017). Despite acknowledgement of the importance of affordable and accessible AP in low and middle income countries, there is a lack of scientific evidence on the specific ways in which this can be achieved (Rohwerder 2018). Reported barriers to access AP in low and middle income countries include high costs, limited availability, lack of awareness, lack of suitably trained personnel and inadequate governance and financing of AP (Rohwerder 2018). In addition, research in low and middle income countries is mainly restricted to AP for mobility and vision (Matter *et al.* 2017). Another gap within research is access to AP in rural areas. In this review, there was only one study reporting specifically on a rural area within the USA. Research has shown that for people with ID in rural areas, access and use of healthcare comes with considerable additional challenges such as limited services, long waiting times and mismatch between needs and services (Hussain & Tait 2015).

The first limitation of this review is the variation of the studies, addressing different types of AP and none of the studies giving demographic specifics of the ID population, which makes it difficult to compare the different studies and draw specific conclusions. A second limitation is that most studies were from the USA. Thus, there was a limited understanding of different countries or settings, especially of low and middle income countries. Third, where studies mention barriers, there are not always facilitators described to overcome these barriers. There is a need to develop facilitators influencing access to AP to be able to draw firm conclusions for proposed actions that can be taken to resolve the barriers.

The need for research in the field of ID and access to AP is increasing. There are two trends that underline this need for research. First, in most high income countries, the current trend for living situations for people with ID is moving towards greater social inclusion and community living. The use of mainstream services is promoted within this perspective. One must take into consideration both how this will influence access to AP for people with ID, and also the continuous use of AP. After AP is obtained by people with ID, there is a high rate of non-use or product abandonment (Carey *et al.* 2005). To prevent AP abandonment, there is a need for maintenance, correct support and making AP available in every place of a person's life (home, work, day care, school, etc.). This has to be integrated in this community-based perspective. Second, the life expectancy of people with ID is increasing in line with the general population trends. The interaction of lifelong impairments related to ID including the effects of long-term medication use, and normative aging processes will all increase the need for AP in order for individuals with ID to maintain independence within society for as long as possible.

Future research includes investigating cost-effectiveness of AP for people with ID; implementation of national policy programmes around AP acquisition, adoption and use; understanding the convergence between the health services and consumer markets as once high-tech products become more affordable for individuals at home; market analysis of the use of AP in low and middle income countries; and understanding differences between urban and rural areas and the allocation of resources including financial and

training to support AP adoption, sustainability and scalability for persons with ID. Research should also focus on best practices for the implementation of AP within the care plans of people with ID and as part of the daily routines. Another important aspect within future research activities is the inclusion of people with ID themselves as experience experts. It is important that individuals with ID are actively involved in the co-design and development of AP and related services to support their needs. Such programmes should also be localised to ensure cultural and region specificity. Outcomes from these recommended research programmes will be critical to accurately inform the future direction of government, service and technology developers to the design, use and adoption of new and existing AP, especially those outlined in the WHO GATE top 50 APL.

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Conflict of Interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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Supporting Information

Additional Supporting Information may be found online in the supporting information tab for this article.

Data S1 The WHO priority Assistive Product List (APL).

Data S2 Search strategies of all electronic literature databases; PubMed, Embase, ASSIA, Web of Science, Medline, CINAHL complete, PsycInfo, Scopus and ERIC.