



# BMJ Open Assistive technology, information asymmetry and the role of brokerage services: a scoping review

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## ABSTRACT

**Objectives** Access to assistive technologies (ATs) is a human right for people with disabilities, but there are a range of barriers, including lack of adequate information. This review aimed to explore the implications of information asymmetry on the delivery of AT and to investigate if there are effective and equitable ways of providing AT brokerage services to people needing AT.

**Design** Scoping review.

**Data sources** EBSCO Medline, EBSCO Cinahl, Academic Search Ultimate, Business Source Ultimate, Proquest Central, Scopus, Web of Science, PsychINFO, EconLit and JSTOR were searched through 18 July 2021.

**Eligibility criteria** Intervention and observational studies and articles directly related to information asymmetry and brokerage in the context of AT were included. In addition, a scan of web-based resources and services was undertaken.

**Data extraction and synthesis** Four authors independently screened the articles for inclusion and performed a narrative synthesis.

**Results** Thirty-three articles were identified. The narrative synthesis showed that: (1) AT users want access to impartial information sources; (2) users want to be involved in AT selection; (3) users benefit from access to demonstration sites; (4) users want access to training and ongoing support in their use of AT; and (5) users want access to information on new and emerging technologies. Access to information and user engagement, we produced better outcomes and satisfaction. Web-based repositories are valuable for user research and peer feedback, while demonstration sites address the need for expert advice, trial use of equipment, training and support in equipment use and maintenance.

**Conclusions** Access to impartial information brokerage is critical to optimise AT selection. The implications of information asymmetry include lower user satisfaction, equipment underutilisation or abandonment. Aspects such as access to demonstration sites and web-based resources were also important.

## BACKGROUND

According to the WHO, assistive technologies (ATs) can provide opportunity for people with disabilities of all ages to do things they may otherwise be unable to do, maintain their independence and promote well-being.

## STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ The scoping review was designed to incorporate a wide range of methodologies and summarised in a narrative synthesis, with 10 databases searched from inception to 18 July 2021, following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews checklist.
- ⇒ The paper incorporates the results of supplementary searches to identify additional web-based platforms not found in the academic literature, as web-based platforms emerged as a significant feature.
- ⇒ The scope of the included studies, while a major strength of the project, also introduced a limitation as the broad range of study designs, types of interventions and assistive technology (AT) programmes, limited the generalisability of our results.
- ⇒ As all of the identified studies (except one) reported AT use in developed countries, it was not possible to report on the relevance to AT selection, use and funding in developing nations.
- ⇒ To our knowledge, this is the first review addressing information asymmetry and the use of brokerage services in the context of AT, and as such, it was not possible to compare to the similar literature.

AT is an umbrella term describing the systems, equipment or devices used by people to increase functional capacity in tasks that would otherwise be more difficult or impossible. Most commonly, this includes mobility aids such as wheelchairs or walking frames and communication aids such as hearing aids or spectacles. Worldwide, AT is used by more than 1 billion people, although variability in the definition of what constitutes AT may limit the ability to accurately identify the number of users.<sup>1</sup> In the contemporary world, digital devices are a rapidly growing AT sector. Often, a combination of devices and technologies are used to meet an individual's needs. A range of available AT can contribute to functional ability and independence, such as aiding with mobility, tasks of daily living, communication and recreation.



Access to AT has been identified as a human right in the United Nations Convention on the Rights of Persons with Disabilities<sup>2</sup> and is recognised as an essential resource to support independent living for persons of all ages.<sup>3,4</sup> There is a range of barriers that may be faced by people who access these technologies, including those that are financial, geographic and those that are information based.<sup>5,6</sup> The focus of this study is on information-based barriers.

In accessing AT, consumers are often at a disadvantage as they do not have the experience or knowledge to make the most informed choice about the most appropriate AT to meet their needs. Consumers have several ways of gaining information about AT. They can go directly to suppliers of AT to purchase equipment or consult with expert clinicians in AT or with other users of AT. They can also browse websites, some with formal recognition from national or international bodies and some without. They can access AT devices under government-funded schemes, typically under the direction of experts or healthcare professionals, to identify a suitable product(s) from a regulated list of products or product specifications, which may, depending on the country, have established prices or reimbursement thresholds. When a consumer obtains information on AT in any of these ways, it can be argued that in the broadest sense, they are accessing information brokers. The term brokerage service is typically used for a subset of this group to refer to an impartial or independent source of advice, in some way discrete from an AT supplier.

The concept of information asymmetry was first used by Akerlof<sup>7</sup> to describe a condition where one party in a relationship has more or better information than another. The concept has been used in various disciplines, including management, business and organisation psychology,<sup>8</sup> but is less well described in the provision of health or social services. The assessment and selection of AT are often conducted by a health professional or technology provider with a person with a disability. In many cases, the health professional or provider has more knowledge and information about the AT products and the assessment process. This is information asymmetry.

The existence of information asymmetry can provide a 'moral hazard'<sup>9</sup> if the interests of the agent (a health professional or equipment provider) do not align with the client. A concrete example is if a provider sells only one type of powered wheelchair. It is not in the supplier's interest to suggest a brand of powered wheelchairs that they do not supply, even if it may be more appropriate for the client. One party's access to more relevant and up-to-date information can result in the inappropriate selection of AT, which can adversely affect the quality of life of the person with a disability.

Brokerage services may assist in overcoming information asymmetry. Typically, they are independent parties who provide information and advice in acquiring AT. In a brokerage model, the 'moral hazard' is mitigated as the broker has no incentive to bias the information given to

the client. In this way, brokerage services have the potential to improve consumer outcomes, especially for vulnerable people and people living with disabilities who may require support when making decisions about what AT to purchase. However, the role that brokerage can play in potentially improving outcomes in the selection of AT is not well understood.

This scoping review aimed to address two poorly understood aspects of access to AT and can be encapsulated in two research questions. First, what are the most effective, efficient and equitable ways of providing information brokerage services to people needing AT? Second, what are the implications of information asymmetry for the delivery of AT?

## Materials and methods

To examine the existing methods of provision of AT and evidence of information asymmetry in the literature, a scoping review was undertaken according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews.<sup>10</sup> Due to the broad scope of AT and the diverse nature of its provision, a scoping review was deemed suitable to explore the current evidence base.

## Search strategy

The search strategy was developed in consultation with a librarian. The search strategy was: ('assistive technolog\*' OR 'health consumer\*') AND ('disseminat\*' OR 'broker\*') AND 'information'. The search strategy was intentionally broad and used consistently across databases. The searches were performed in ten electronic databases (EBSCO Medline, EBSCO Cinahl, Academic Search Ultimate, Business Source Ultimate, Proquest Central, Scopus, Web of Science, PsychINFO, EconLit and JSTOR) by four researchers (NMD, SI, NN and DG). A qualified librarian selected the electronic databases intending to capture journal articles, book chapters, theses and other scholarly articles. All databases were searched from inception to 18 July 2021. The reference lists of relevant reviews and articles selected for full-text screening were also used to identify pertinent articles that might have been missed during the initial search strategy.

## Eligibility criteria

The included articles needed to address AT access under the broad scope of information asymmetry or brokerage, and all study designs were eligible for inclusion. In particular, we aimed to identify studies with human participants (intervention, observational, survey, qualitative, mixed methods, case studies and case series studies); studies that related to AT access provided through a brokerage service; and opinion articles, editorials or policy documents that specifically discussed information asymmetry or brokerage. Articles were excluded if they were reviews, protocols, methodological or validation articles or published in a language other than English. As this was a scoping review aimed at identifying the nature and

extent of the current literature, the validity and power of the included studies were not considered as part of the eligibility criteria.

### Selection of sources of evidence

Articles identified during the database searches were imported into EndNote (Clarivate Analytics, Philadelphia, Pennsylvania, USA) and duplicates were removed. All records were uploaded to Covidence systematic review software (Veritas Health Innovation, Melbourne, Australia). Four authors (NMD, SI, NN and DG) screened articles for inclusion based on titles and abstracts according to the eligibility criteria. For any articles where meeting the eligibility criteria was unclear, the article was carried forward into the full-text review. When articles could not be sourced from the databases, a document delivery request was made with the university library. Four authors (NMD, SI, NN and DG) independently reviewed the full text of the remaining articles based on the eligibility criteria. Any disagreements were resolved by discussion to reach consensus, where needed.

### Data extraction

To address the research questions of this scoping review, all articles were summarised by their (1) study aim, (2) methods, (3) results and (4) relevance to information asymmetry or brokerage in relation to AT use. Table 1 presents a summary of this material. Table 2 presents the results of supplementary material derived from an environmental scan of web-based resources.

### Patient and public involvement

No patients and/or the public were involved in this research.

## RESULTS

### Search results

In total, 537 articles were sourced across all 10 databases. After the removal of duplicates, 407 articles remained. Eighty-five articles met the criteria for full-text screening. Articles were excluded because they were not related to brokerage of AT (n=33), related to brokerage but not AT (n=6), full-text not available (n=5), methodological article (n=3), conference abstract (n=2), not published in English (n=1), popular media/magazine article (n=1) and a book chapter summarising articles already included (n=1). In total, 33 articles met the final inclusion criteria. The flow chart of the search procedure is presented in figure 1. In relation to the first research question on effective, efficient and equitable ways of providing information brokerage services to people needing AT, 22 out of 33 papers addressed this issue. In relation to the second research question on the implications of information asymmetry for the delivery of AT, 15 out of 33 papers addressed this issue.

### Narrative synthesis

#### The role of the national or regional systems

Several articles explored the influence of national or regional policy and practice settings in delivering AT,

and their potential for enhancing user knowledge and choice.<sup>11–14</sup> These articles highlighted the importance of models of service provision and the way in which they incorporated information brokerage, in shifting choice in favour of AT users who are provided with a range of suitable options by practitioners. Several examples of AT brokerage models in a range of countries were identified.

In Sweden, each county has an 'Assistive Technology Centre' that acts as a support and brokerage service for professionals selecting AT for their clients. Dahlberg *et al*<sup>14</sup> examined implementation of a voucher system in several Swedish counties and municipalities whereby following assessment, consumers were issued a voucher for a specified amount to enable individual purchase of their preferred device, which was found to improve user participation, confidence and satisfaction with AT.<sup>14</sup> In central Norway, Pedersen *et al* evaluated a 'user involvement' model<sup>15</sup> recommended by the European Assistive Technology Information Network (EASTIN),<sup>16</sup> finding that consumers responded positively to the opportunity for enhanced participation, for engagement with a health professional who acted as a broker and emphasised the importance of information dissemination and practical testing. Maximo and Clift's<sup>12</sup> study of the service delivery system in Brazil highlighted the negative consequences of the absence of many of these features, whereby a 'medical model' of prescription of AT by health professionals without user involvement, access to information or access to training, not only increased information asymmetry, but was suggested to lead to inappropriate equipment selection, abandonment of devices and waste of resources.<sup>12</sup>

Ripat and Booth<sup>13</sup> described the preferred AT service delivery system from the perspectives of providers, funders and users in Canada. The value of testing centres was evident in the Norwegian and Swedish studies described above. However, the Canadian study took this further by highlighting the importance of consumers testing the AT in their own environment prior to purchase and by introducing an important argument concerning change over time. Their participants argued that service delivery models need to account for changes in AT preferences and the technology itself over time through training and follow-up appointments.<sup>13</sup> An Italian network of AT centres aimed to enhance access to information by employing a range of mediums, including online, paper-based, telephone and face-to-face meetings, as well as guided visits to the AT centres where each centre had the flexibility to offer individual on-site assessments.<sup>17</sup> The emphasis on the benefits for centres to provide an opportunity to test AT and also be able to receive training was also highlighted by Utley<sup>18</sup> in the USA.<sup>18</sup>

Key findings from these national or regional level studies were that better outcomes for consumers were achieved where models of service delivery emphasised providing consumers with information, supported consumer participation in the choice of equipment and



**Table 1** Summary of included articles

Author	Year	Country	Key focus	Key findings
Andrich <sup>17</sup>	2007	Italy	AT service delivery description	To reduce information asymmetry, four strategies were used: (1) disseminating information through databases, websites and publications; (2) telephone helplines with experts; (3) guidance via phone calls and face-to-face meetings; and (4) guided visits to the AT centres where each centre has an exhibit of the available AT.
Borg and Östergren <sup>34</sup>	2012 and 2015	Bangladesh	AT provision in a resource-limited environment	Traditional advisors were an important source of knowledge for hearing aid and wheelchair selection. User involvement in training and maintenance of AT was important. NGO and government involvement was necessary for the subsidisation or purchase of AT.
Cowan and Turner-Smith <sup>37</sup>	1999	UK	Experiences of AT users	Common problems with accessing AT were: (1) funding issues and funding sources; (2) lack of information on the devices available (where to access the device and receive a demonstration); (3) delays in provision; and (4) support on maintenance and training.
Craddock and McCormack <sup>29</sup>	2002	Ireland	AT assessment outreach service	Case studies highlighted the lack of information participants had prior to the service. Assessment, information and impartial advice provided were appreciated by participants.
Dahlberg <i>et al</i> <sup>14</sup>	2014	Sweden	Description and critique of a voucher-based AT service delivery system	The voucher system increased user participation, confidence in using AT and satisfaction and provided access to a broader variety of AT. Where local health authorities retain ownership of AT, there is opportunity for reconditioning and reusing items no longer suited to the original recipient, reducing costs and waste.
Ehrlich <i>et al</i> <sup>19</sup>	2003	USA	Description of AT services used	Of 1400 participants with disabilities, 64% were daily AT users. Sources of provision were general practitioners/healthcare professionals (53%), family members (15%) and rehabilitation counsellors (13%).
Freiesleben <i>et al</i> <sup>23</sup>	2012	Germany	Identifying barriers to adopting technologies in dementia	The theme of 'awareness limitation' is an important element of information asymmetry, where experts' have knowledge about what they believe is a useful product, but the end user has minimal knowledge of its potential benefits. Professional stakeholders want the information they hold to be readily available and accessible so that potential AT users are empowered to make more informed choices.
Gramstad <i>et al</i> <sup>25 26</sup>	2013 and 2014	Norway	Influences of unmet AT needs	Unmet AT needs are influenced by an individual's knowledge of AT, sociocultural factors and their experience of a disability. Participants delegated decision-making to others, most commonly family. When the person holding the information about the technology is not selling the product, bias can be partially offset when things go wrong by their lack of connection to the purchase process.
Johnston <i>et al</i> <sup>30</sup>	2014	Canada	Evaluation of consumer led AT programme	Survey results supported the participation model and a high value on an impartial 'Navigator' role in the selection process, leading to higher use of the selected AT.
Lane and Stone <sup>33</sup>	2015	USA	Evaluation of AT information dissemination	Dissemination of information targeted to specific stakeholders effectively improves knowledge levels compared with a general or passive form of dissemination.
Martin <i>et al</i> <sup>20</sup>	2011	USA	Consumer involvement in AT decision-making	The 145 survey respondents were most likely to obtain information from suppliers, the internet and healthcare professionals. Knowing about the available options improved consumer confidence, and being influenced by the funding source decreased consumer confidence.
Maximo and Clift <sup>12</sup>	2015	Brazil	Identifying the characteristics of user-centred AT service provision	AT provision conformed to a 'medical model' of service delivery, in which only qualified professionals prescribe AT, and public provision involved individual referrals to centres that primarily worked from prespecified equipment lists. Therefore, failure to achieve user involvement in AT selection may lead to inappropriate equipment selection, abandonment of devices and waste of resources.
Mirza and Hammel <sup>32</sup>	2009	USA	AT intervention with adults with intellectual disabilities	The group that received the consumer-directed intervention improved in self-reported satisfaction and performance with the AT.
Newton <sup>27</sup>	2002	USA	Barriers to implementing AT in schools	A specialised AT team successfully acted as brokers to teachers and students. The AT team addressed information asymmetry in this study when purchasing AT for students.
Pederson <i>et al</i> <sup>15</sup>	2020	Norway	Evaluation of a 'user involvement' model of AT delivery	Service providers should initiate information dissemination relevant to consumers and facilitate practical testing. Users were critical of some aspects of the service but were generally supportive of a model that allowed them to participate in the AT selection process with a 'broker' who was a health professional.
Quinby <i>et al</i> <sup>22</sup>	2021	USA	Identifying gaps in AT information sources	The largest knowledge gaps occurred in awareness of new technologies, AT assessment tools and clinical practice guidelines. The most important sources of AT information included word-of-mouth (48%), clinicians (17%), the internet (16%), conferences and events (7%), social media (5%) and magazines (5%).
Racz and Field <sup>21</sup>	2011	USA	Preferred method of receiving AT information	Members surveyed preferred printed newsletters (71%) and printed publications (67%) to other formats. Staff preferred to access AT information via the internet (61%), email (60%) and printed publications (58%).
Ripat and Booth <sup>13</sup>	2005	Canada	AT service delivery system evaluation	Users need to be able to try the technology in their own environment prior to purchase. Both AT user needs and the AT itself will change over time, and service delivery models need to consider this.
Scherer <i>et al</i> <sup>38</sup>	2005	USA	Validation of an AT prediction tool	The Assistive Technology Device Predisposition Assessment measure is intended to identify key personal and psychosocial characteristics and quality of life and predicts an individual's predisposition to use a particular form of AT.

Continued

**Table 1** Continued

Author	Year	Country	Key focus	Key findings
Sprigle <i>et al</i> <sup>26</sup>	2012	USA	Supplier involvement in wheelchair selection	Supplier training of AT devices can be relatively short (around 15 min) but dependent on device complexity.
Steel and Layton <sup>6</sup>	2016	Australia	Review of traditional biomedical approaches to a user-centred approach	The literature on choice surrounding the provision of AT is focused on the decision-making of practitioners who provide the AT and the range of devices available. Recommendations are made for research to better understand choice in AT provision regarding the interactions between AT provider and the consumer experience.
Sund <i>et al</i> <sup>28</sup>	2013	Denmark and Norway	User satisfaction with AT delivery service	Advice and information from health professionals regarding powered scooter selection led to 50% of surveyed respondents being 'very satisfied' and less than 6% were 'dissatisfied'.
Tsertsidis <sup>24</sup>	2021	Sweden	Barriers to AT delivery to people with dementia	Therapist knowledge and confidence in selection AT was a main barrier to people with dementia and their families receiving appropriate advice on digital AT.
Utley <sup>18</sup>	2006	USA	Description of a low-cost AT service	The AT service described was established at a low cost and, over time developed into a demonstration centre and a training centre, both of which were important and valued.
Ward <i>et al</i> <sup>31</sup>	2007	UK	Description of an AT brokerage service	A lack of available information for 50–70-year-old AT users was a key barrier to purchasing AT. More accessible, high-quality information was desired to increase purchase confidence.

AT, assistive technology.

provided access to testing centres, resulted in better outcomes for consumers.

### Sources of information

Several articles highlighted the importance of receiving information on AT from various sources, and there was an indication that this had evolved over time toward increasing the use of web-based resources. In the USA in 2003, AT users reportedly received most of their information from general practitioners/healthcare professionals (53%), followed by family members (15%) and rehabilitation counsellors (13%).<sup>19</sup> A more recent study by Martin and *et al* in 2011 found that participants were most likely to obtain their information from suppliers, the internet and healthcare professionals. In most cases, the information-gathering activities undertaken prior to purchasing the AT included participants who tested the device themselves, talked with other consumers (mostly via electronic means) and studied a range of available options to improve their confidence in making the correct purchase.<sup>20</sup> However, the diversity of patterns of use was demonstrated by another study in the USA in 2011 that found that a sample of farmers preferred printed newsletters (71%) and printed publications (67%) to other formats.<sup>21</sup> United States Veterans who used their mobility devices for more than 6 years found the most important source of AT information to come from peers, family and word-of-mouth, over clinicians and the internet.<sup>22</sup>

The information asymmetry between AT users and individual clinicians is a potential barrier to gaining sufficient information. This was, a key theme identified by Freisleben *et al*<sup>23</sup> in Germany as 'awareness limitation' where experts' have knowledge about what they believe is a useful product, but the end user has minimal knowledge of its potential benefits. In this case, the stakeholders

wanted the information they hold to be readily available and accessible to be empowered to make more informed choices.<sup>23</sup> In a qualitative study by Tsertsidis about accessing information and support for AT for families of people with dementia, respondents indicated that some occupational therapists were 'scared' of technology with the inference that they did not give the most appropriate information to consumers.<sup>24</sup>

Another example of the constraints that emerge when the consumer is reliant on an individual clinician was reported by Gramstadt *et al*, who studied AT use before delivery, after delivery and at least 2 months later.<sup>25 26</sup> A key finding related to circumstances where the AT did not work or was not fit for purpose, and advice to fix the issues from the occupational therapist who recommended the AT did not fix the situation. This article highlighted that where the person holding the information about the technology is not selling the product, the benefit of reduced bias can be partially offset when things go wrong by their lack of connection to the purchase process. A similar finding was reported by Newton<sup>27</sup> who examined barriers to implementing AT in schools and the benefits of a team of AT advisors in overcoming those barriers.<sup>27</sup> The authors identified a barrier to AT use as 'information dissemination', noting that end users 'often have difficulty keeping abreast of developments in the AT field'. However, a study of people from Denmark and Norway found approximately 50% of informants were 'very satisfied', and less than 6% were 'dissatisfied', respectively, with consulting a health professional to receive adequate information.<sup>28</sup>

Several studies described models of information brokerage services specifically targeting enhanced knowledge for consumers. Craddock and McCormack<sup>29</sup>

**Table 2** Examples of assistive technology services and resources

Service	Country/ continent	Practice characteristics	Website
Southern Africa Assistive Technology Database	Africa	A database funded by Google Impact Challenge that uses field officers (called 'admins') to collect data about AT and make it available to be viewed on a mobile app or computer for free. The site also lists suppliers of equipment and service providers.	<a href="https://assistivetechmap.org/">https://assistivetechmap.org/</a>
National Equipment Database ATA Australia	Australia	There are two national AT databases providing independent advice. They are owned and managed by Indigo Solutions Australasia and Assistive Technology Australia. Both organisations have AT showrooms (in Perth and Sydney, respectively). Health professionals provide assessment and advice on AT products but do not sell products.	<a href="https://ilcaustralia.org.au/search_category_paths">https://ilcaustralia.org.au/search_category_paths</a> <a href="https://at-aust.org/">https://at-aust.org/</a>
China Disabled Person's Federation	China	The website does not work, but from secondary sources, the CDPF: 'The three basic functions of the CDPF are to represent the interests of people with disabilities in China and help protect their legitimate rights, to provide them with comprehensive and effective services and to supervise affairs relating to people with disabilities'.	<a href="http://www.cdpg.org.cn/">http://www.cdpg.org.cn/</a>
Global Assistive Technology Information Network (EASTIN)	Europe/Australia	EASTIN is a global technology information network with full partners being Italy, the UK, Germany, Denmark, France, Australia and Belgium. The organisations in partner countries supply their databases to the EASTIN portal for consumers to search. Consumers can access the EASTIN database to obtain information about AT. There is an inquiry function where a member of EASTIN will answer consumers' specific questions about AT. The individual partner organisations (and affiliate members) have locally based services. Some of these services (such as ATA in Australia) employ health professionals to advise consumers in addition to the database searching functions.	<a href="http://www.eastin.eu/en-gb/searches/Products/Index">http://www.eastin.eu/en-gb/searches/Products/Index</a> Partners: UK: <a href="https://www.dlf.org.uk/">https://www.dlf.org.uk/</a> Italy: <a href="http://www.dongnocchi.it/">http://www.dongnocchi.it/</a> Germany: <a href="https://www.iwkoeln.de/">https://www.iwkoeln.de/</a> Denmark: <a href="http://www.socialstyrelsen.dk/">http://www.socialstyrelsen.dk/</a> Australia: <a href="http://www.at-aust.org/">http://www.at-aust.org/</a> Belgium: <a href="http://www.vaph.be/">http://www.vaph.be/</a> France: <a href="http://www.hacavie.com/">http://www.hacavie.com/</a>
EASTIN affiliate organisations	EASTIN affiliates	As above.	Israel: <a href="https://azarim.org.il/">https://azarim.org.il/</a> Lithuania: <a href="http://www.tpnc.lt/">http://www.tpnc.lt/</a> Cyprus: <a href="http://www.euc.ac.cy/">http://www.euc.ac.cy/</a> Thailand: <a href="http://www.nstda.or.th/">http://www.nstda.or.th/</a> Latvia: <a href="http://www.vtpc.lv/">www.vtpc.lv/</a> Taiwan: <a href="http://www.treats.org.tw/">http://www.treats.org.tw/</a> Slovakia: <a href="http://accesscentre.tuke.sk/">http://accesscentre.tuke.sk/</a> The Netherlands: <a href="http://www.innovatiesindezorg.eu/">www.innovatiesindezorg.eu/</a>
Enable Ireland	Ireland	Brokerage service to children and adults with disabilities based on the Social Model of Disability.	<a href="https://www.enableireland.ie/">https://www.enableireland.ie/</a>
Fondazione Don Carlo Gnocchi	Italy	'The Italian Web Portal providing information and guidance on assistive technologies for independence, quality of life and participation of persons with disabilities. A systematic and up-to-date review of assistive technology products available in Italy and in Europe'.	<a href="http://portale.siva.it/en-GB/home/default">http://portale.siva.it/en-GB/home/default</a>
Display centre, information service and Hyogo Assistech	Japan	'The Association promotes research and development on welfare equipment, collects and provides information on welfare equipment, clinically evaluates welfare equipment, trains welfare equipment-related technicians, and conducts examination work related to artificial limb equipment. The purpose is to promote the safe and effective use of assistive devices and contribute to the promotion of the welfare of the elderly and the disabled'. Hyogo Assistivetechnology is a network of organisations offering information about AT.	<a href="http://www.techno-aids.or.jp/">http://www.techno-aids.or.jp/</a> and <a href="https://www-hyogo-an-com.translate.google.com/index.html?x_tr_sl=ja&amp;x_tr_tl=en&amp;x_tr_hl=en-GB&amp;x_tr_pto=nui,op,sc">https://www-hyogo-an-com.translate.google.com/index.html?x_tr_sl=ja&amp;x_tr_tl=en&amp;x_tr_hl=en-GB&amp;x_tr_pto=nui,op,sc</a>
Enable New Zealand	New Zealand	'Enable New Zealand provides disability services in New Zealand. We are a division of MidCentral District Health Board. The Ministry of Health and ACC contract us to provide disability information services, disability equipment, and housing modification and vehicle modification services'.	<a href="https://www.enable.co.nz/">https://www.enable.co.nz/</a>
Tech Able	Singapore	'Tech Able is a joint initiative between SG Enable and SPD. Comprising an assessment centre, an assistive device library, a smart home/office technology showcase and an event space, Tech Able aims to provide information and resources on assistive and infocomm technologies (AT/ICT); Promote the adoption of AT/ICT among persons with disabilities and employers; and Leverage technology for more training and employment opportunities for persons with disabilities'.	<a href="https://techable.enablingvillage.sg/aboutus">https://techable.enablingvillage.sg/aboutus</a>
TREATS	Taiwan	'Taiwan Rehabilitation Engineering and Assistive Technology Society, TREATS, was established in 2011. Our members include experts and scholars from various fields such as medical physician, rehabilitation engineering, physiotherapist, occupational therapist, special education, social workers and etc. Our missions are mainly (1) to assist the government to develop AT policies, (2) to participate in international affairs and related activities and (3) to host relevant conferences or activities to promote AT affairs'.	<a href="http://treats.org.tw/Contactus.php?Lang=2">http://treats.org.tw/Contactus.php?Lang=2</a>

Continued

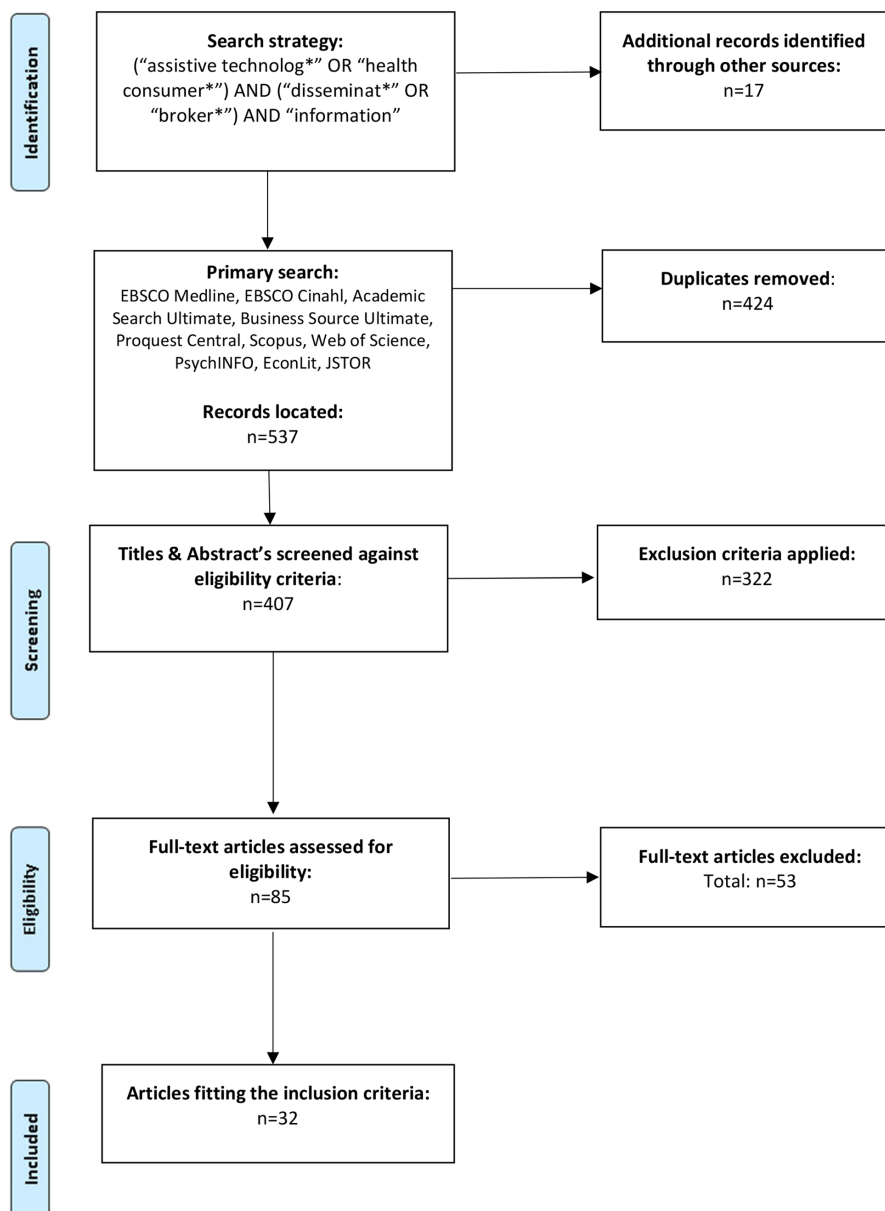
**Table 2** Continued

Service	Country/continent	Practice characteristics	Website
Centre for Assistive Technology Act Data Assistance—AT demonstration centres	USA	'State and Territory Assistive Technology Programmes focus on improving the provision of AT through comprehensive, statewide programmes that are consumer responsive. The goal of these programmes is to increase access to and acquisition of AT. Programmes serve people with all types of disabilities, of all ages, in all environments'.	<a href="https://catada.info/">https://catada.info/</a>

AT, assistive technology; ATA, Assistive Technology Australia; EASTIN, European Assistive Technology Information Network; TREATS, Taiwan Rehabilitation Engineering and AT Society.

described the development of an outreach model of AT assessment and advice in Ireland for people with disabilities provided by multiple 'Technical Liaison Officers' whom all had a disability themselves. The findings

highlight the lack of information the participants had prior to the appointment, and the value attached to the service because the advice was impartial, as the officers were not selling the products.<sup>29</sup> In Canada, a consumer-led



**Figure 1** Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow chart summary of scoping review search process.<sup>10</sup>



programme employed ‘Navigators’, to work directly with potential users as a form of impartial brokerage. The role of the ‘Navigator’ was to give consumers as much information as possible about a range of relevant products, which was found to lead to higher use of the selected AT.<sup>30</sup>

A complex mixed methods study undertaken by Ward *et al* in the UK identified a lack of available information for 50–70-year-old AT users as a key barrier to purchasing electronic assisted living technologies and set out to explore potential business solutions. They concluded that a brokerage model was determined to be the most appropriate solution by the survey respondents, focus groups and business experts to achieve more accessible, high-quality information and reduce the uncertainty associated with perceived wide differences in the prices of AT.<sup>31</sup>

Two intervention studies were identified that attempted to reduce information asymmetry. In a randomised controlled trial, Mirza and Hammel<sup>32</sup> examined the effects of the ATLAS programme on people with intellectual disabilities. The ATLAS intervention programme is a five-session, 3-month, consumer-directed, collaborative problem-solving approach with an occupational therapist which focused on the participants’ community-based goals and strategies to meet them, including AT. The group that received the consumer-directed intervention had an improvement in self-reported satisfaction and performance with the AT.<sup>32</sup> Lane and Stone<sup>33</sup> examined the dissemination process of AT through three randomised controlled case studies.<sup>33</sup> Each trial included researchers, clinicians, manufacturers, consumers and brokers to evaluate whether passive diffusion, targeted dissemination or tailored translation were best in communicating research findings on AT. The findings highlighted that dissemination targeted to specific stakeholders, regardless of whether the content of the information is specifically tailored to the recipient, effectively improves knowledge levels in contrast to passive diffusion.

#### Other barriers

Other barriers to accessing appropriate AT have been identified. In Norway, Gramstad *et al* found that unmet needs of people who do not already have AT are influenced by an individual’s knowledge of AT, sociocultural factors and their experience of a disability.<sup>26</sup> In this study, participants often delegated decision-making to others, most commonly family. Awareness of AT was also described as a barrier to equitable provision of AT in two studies of hearing aid and wheelchair users in Bangladesh by Borg *et al* in 2012 and 2015.<sup>34 35</sup> The findings indicated that user involvement in the service delivery process, included asking about their preferences and providing training on the use and maintenance, increased the likelihood of reporting better outcomes with the AT. In another study of wheelchair providers, Sprigle *et al*<sup>36</sup> found training to be an important factor in AT use, with more complex wheeled mobility and seating equipment requiring more time, on average, than providing standard wheeled mobility and seating equipment.<sup>36</sup> In a study by

Cowan and Turner-Smith<sup>37</sup>, heavy users of AT identified their common barriers to accessing AT as cost, lack of information on the devices available (where to access the device and receive a demonstration) and long delays (often years) in provision, and support on maintenance and training on the use of the device.<sup>37</sup>

Finally, Scherer *et al*<sup>38</sup> identified the importance of matching users to AT based on their psychosocial attributes and motivation.<sup>38</sup> By using The Assistive Technology Device Predisposition Assessment model, the authors found that identifying key personal and psychosocial characteristics and quality of life, has the potential to predict an individual’s predisposition to use a particular form of AT, which could also help in reducing issues related to information asymmetry.

#### AT services and web-based services

There is a growing role for place and web-based databases to disseminate information about AT as identified in our searches, although supplementary searches found additional web-based platforms, which are also discussed below. Wouters<sup>39</sup> described the development of EASTIN, the European Union national search portal about AT (providing access to information on almost 70 000 products, addresses of manufacturers and distributors, fact sheets, selection procedures) comprising founding partners (UK, Italy, Germany and Denmark), full partners (Australia, Belgium and France) and multiple affiliates across the world.<sup>39</sup> The portal provides access to consumers as well as professionals, reducing information asymmetry. AbleData served a similar function in the USA providing information on AT and rehabilitation equipment available from American and international sources, targeting a range of stakeholders, including people with disabilities, their families, disability organisations and health professionals. Lowe<sup>40</sup> documented a formative evaluation of AbleData assessing various system improvements, including enhanced capacity relating to consumer product reviews.<sup>40</sup> However, a search for AbleData suggests the website was shut down in 2020 due to a realignment of funding resources (<https://www.mobility-withlove.com/what-happened-to-abledata/>).

Assistive Technology Australia (ATA) and Independent Living Centres Australia serve a similar function in Australia. The ATA website (<https://at-aust.org/>) provides advice and information for consumers as well as training for AT users and health professionals. ATA employ health professionals and consumers to advise consumers and are not affiliated with AT suppliers. Independent Living Centres Australia host the National Equipment Database (NED) (<https://www.askned.com.au/>). The website is a source of information dissemination and brokerage, providing advice, therapy services, training and events for AT users and health professionals. NED also functions as a dropshipping service for suppliers where AT users can order directly from suppliers through the database. In the UK, the Disabled Living Foundation has combined its AT database with a self-assessment tool (AskSARA)



(<https://asksara.livingmadeeasy.org.uk/selector>) that generates an individualised report that provides information on relevant AT devices, demonstration centres and suppliers.<sup>5</sup> AskSARA provides an opportunity for consumers to start with a need or desired outcome for those not aware of the kind of AT they are searching for, as well as subsequent information on product options.

Web-based information dissemination systems (see [table 2](#) for other examples) address information asymmetry by enabling free access to enable consumers to increase their knowledge of available AT. Web-based systems open up opportunities for consumers to access international markets in purchasing AT devices, introducing elements of both opportunity and risk. The common features of these services are that they claim to provide independent advice for people when selecting AT. Some provide information through databases only, while others provide independent AT experts to help clients navigate the AT selection process.

In addition to web-based information, two further types of information dissemination were identified. One study explored the potential of an existing children's television programme called 'Readabilities' to disseminate information about AT and the kinds of help they can provide to children in several broad disability groups.<sup>41</sup> The programme aimed to improve community knowledge about AT for children with disabilities that could contribute to quality of life through the medium of a children's television show. The other non-web-based study examined the use of voice messaging technology to make essential AT information and procedures available for people with a disability.<sup>42</sup> However, voicemail messaging was relatively new technology at that time, and access to data on aids, devices and independent living procedures were limited.

## DISCUSSION

The current evidence on optimising access to appropriate AT emphasises the key role of appropriate access to information. The findings highlighted that greater access to AT information from trusted, impartial sources, including health professionals, peers with AT use experience and brokerage services, are desired by AT users. Independent parties acting as information brokers by providing information and advice, and assisting in the acquisition of information or services, have the potential to bridge the gap between the service provider or seller and the consumer. Information brokerage services may improve consumer outcomes, especially for vulnerable people and people living with disabilities.<sup>27</sup> However, the role that brokerage can play in addressing information asymmetry and potentially improving outcomes in the selection of AT is not well understood.

The implications of information asymmetry include reduced likelihood that end users will receive technology that meets their needs, resulting in poorer outcomes in terms of satisfaction, function or participation. In turn,

this can lead to equipment being under-used or discarded. Information asymmetry can be addressed by ensuring the independence and impartiality of the advice given, allowing greater access to consumers regarding information about AT and having systems and processes in place, enabling the end user to have flexibility and autonomy over decisions made in relation to their AT.

AT brokerage services play a valuable role in ensuring AT users have the required information to participate in the selection process and the opportunity for practical testing.<sup>15 17 18</sup> Ongoing access to new and emerging AT as it becomes available and as user needs change was seen as important by users.<sup>13</sup> In addition to having an opportunity to test the AT, users also want to be trained in how to use it after the purchase is made and advice on maintenance.<sup>13 37</sup> Training in the use of AT was associated with greater benefits.<sup>35</sup> This is supported by evidence that AT users have better outcomes when they are involved and engaged throughout the entire service delivery process.<sup>5 20 35</sup> Concomitantly, the failure to deliver on these elements was associated with poorer outcomes.<sup>12 30</sup>

Independent parties or entities (professionals, peers, reviews or large websites) can also act as brokers by providing advice and assistance in bridging the gap between the consumer and the service provider or seller. Overall, the included literature showed that skilled brokerage without vested interest improves consumer outcomes through any, or a combination, of these channels. AT brokerage services that involved an impartial advisor were more effective at identifying appropriate AT for the user and ensuring the consumer has as much information as possible, and this was associated with more sustained use of AT.<sup>29</sup> This included the use of trial centres and voucher schemes which both enable consumers to take an active role in the decision-making process and purchasing of AT.<sup>5 6</sup> The Nordic countries appear to have trialled voucher systems more intensively than other countries.<sup>14 15</sup> The advantages of vouchers or allowances are that they may enable great flexibility in selecting the most appropriate and tailored AT, with consumer self-determination, professional advice and peer input. However, without these enabling factors, information asymmetry remains, allowance/voucher limits or thin markets may preclude socioeconomically disadvantaged groups from the most appropriate AT option. The Norwegian model also suggested that collaborative inputs to voucher usage and quantum, involving consumers, professionals, peers and funders, is ideal.

In relation to the second research question concerning the implications of information asymmetry for the delivery of AT, this review highlighted (1) where information asymmetry contributed to poorer outcomes and (2) how addressing information asymmetry resulted in better outcomes for AT users. In selecting AT, consumers are often at a disadvantage as they do not have the experience or knowledge to make the most of AT services to meet their needs. While professionals can act on behalf of consumers, the literature suggests that



consumer involvement is critical in achieving optimal outcomes.<sup>12 15 20 30</sup> Similarly, while peers and other consumers may provide views or reviews of different AT items, these views may be conflicting and not always skilled or tailored to another individual. Suppliers may have a vested interest in advising consumers to purchase what they sell rather than the most appropriate item. Consumers use multiple sources of information, with internet-based resources more commonly mentioned in more recent studies.<sup>19 20 22</sup>

An absence of comprehensive information was identified as a barrier to appropriate and efficient access and use of AT.<sup>22</sup> A key finding was that information asymmetry contributed to awareness limitations whereby the end user has minimal knowledge of the potential benefits of a product or even the existence of a potentially helpful product. In a rapidly developing field such as AT, limited awareness of potential options can be an issue for both consumers and professionals.<sup>6 22 23</sup> All stakeholders want the information they hold to be readily available and accessible so end users can decide what could benefit them. The implications arising from information asymmetry in AT provision means that the end users have AT that does not meet their needs. If AT aims to improve people's quality of life of people, then the end result of information asymmetry is to prevent this from occurring.

The findings of this scoping review demonstrated that engaging AT users in information access, the opportunity to test and be trained in AT use, professional and peer support and providing ongoing knowledge about maintenance and emerging new AT were essential elements for appropriate and efficient AT access.<sup>5 20</sup> In all aspects of the consumer journey, empathy is a key element of care, incorporating attentiveness, responsibility, competence and responsiveness.<sup>43</sup> Empathy is typically, but not always, provided best through peer support processes, reviews, empathic professional and brokering experiences, and supportive families and carers.

In the literature, articles described services provided by countries and municipalities and smaller, more focused services. The current trend for larger services appears to incorporate a collaborative, complementary approach whereby web-based information is available to potential AT users, and smaller local centres enable people to test the AT and ask specific questions while they seek the AT most suitable for their condition. Approaches that enabled potential Steel and Layton article AT users to access information on AT, the opportunity to trial the AT and support in using the AT were successful and supported by participant feedback.<sup>6</sup> In the AskSARA model, which the UK Disabled Living Foundation developed, the self-assessment tool that accompanies the database enables consumers to start with a 'need' for those not aware of the kind of AT they are searching for, which ultimately generates information on product options, as well as local showrooms in particular regions that users can visit to trial AT items.<sup>5 6</sup>

The advantages of web-based repositories are that they can assist AT users in undertaking background research, and they may facilitate communication with other AT users through reviews or chat functions.<sup>5 40</sup> The main Australian-based internet repositories are those of (1) the ATA and (2) Indigo through NED, noting that both organisations offer services much broader than just their data repositories. However, databases alone are not sufficient to provide for all the needs identified in this section that would optimise effectiveness, efficiency and equity of AT information and access. Disadvantages include that, if they are not impartial or sell products, they may be biased in their information provision. They do not alone currently allow the opportunity for trialling, training, maintenance support or loans/hires. They also do not alone provide tailored support and contain tens of thousands of options for AT items, which may be overwhelming or confusing for consumers without professional or tailored support in decision-making.

There is a risk of impartial databases being summarily defunded (as with AbleData in the USA) and few options for their viability beyond selling services (such as online products or training) that may induce perceived or actual non-impartiality. Sustainability is a key issue for consideration in database models. There is also the potential for algorithms or artificial intelligence introduced into AT databases or supplementary information provision to be inappropriate and unempathic. Unless they are of very high quality, chatbot add-ons or 'find out what you need' surveys can add to frustration and misinformation in AT decision-making. People with disability may be suspicious of any system which takes away their choice and control—whether it be an IT algorithm or experts who purport to know what the person with disability needs. Any proposed algorithm needs to be evaluated by users to ensure choice and control are enhanced by the system.

Web-based repositories play a crucial role in enabling AT users to complete background research and facilitating communication with other AT users. Several internet repositories and databases were identified, which provide information about currently available AT, and some of these included reviews from prior or existing users. The experience of peer users was also valued by AT users. While web-based resources and information from peers and other AT users are valuable resources, the role of independent expert advice remains an important component, as does the opportunity for testing the equipment and receiving training on it. Access to web-based information is an essential complementary resource in ensuring the most suitable AT is sourced successfully and sustainably.

## LIMITATIONS

The present scoping review is limited by the diversity of studies included, limiting the generalisability of the overall results. There is a paucity of controlled trials comparing strategies and brokerage services to overcome

information asymmetry with typical service models. Moreover, the included studies reported on data collected from a wide range of populations, age groups and people in different roles, further limiting extrapolations that can be made from the results. To our knowledge, there are no comparable reviews addressing information asymmetry and the use of brokerage services in the context of AT, and as such, it was not possible to make comparisons to the similar literature. Despite these limitations, the review highlights important considerations for existing and future AT services, which may also inform future research.

## CONCLUSION

In conclusion, we found that the literature supported the use of impartial and independent advice in the selection of AT, with a view that the end user of the AT should be at the centre of the selection process. If the end users are involved in the AT selection process, particularly in relation to choice and engagement, it leads to better outcomes in terms of satisfaction and intended use. The literature also highlighted the importance of training users to use the AT in its intended way and the importance of follow-up to ensure the technology not only works immediately, but into the future. In addition, the AT selection process literature highlighted the importance of easy access to information in empowering end users to gather information themselves (and with clinicians) regarding the technology they wanted to use.

Accessing information from the internet is increasingly important to inform AT selection, as are personalised, web-based services focussing on AT. Web-based repositories enable efficiency to be achieved because of economies of scale, and if designed well and funded appropriately, can also address equity. The ability to access, trial and evaluate technology is also important, as is a physical venue to see and trial AT, with impartial and independent advice provided was an important point highlighted in the literature. Testing, training, maintenance and follow-up advice (including being aware of new AT) were all associated with better outcomes. A combination of different types of services are needed to meet the particular needs of a diverse population of users.

The way AT services are provided is an important factor in outcomes for AT users. Services which aim to maximise profit may have different outcomes for AT users compared with services providing impartial advice from clinicians, peers or formal independent information brokerage services. The range of AT available is also an important factor, but in some circumstances, a limited range may be preferable if the AT user receives training, maintenance, and has the option of replacing or upgrading the AT at an appropriate time. However, further research is required to understand these relationships to optimise AT selection and whether such models result in better outcomes for AT users.

While the scope of the literature review was varied, the reoccurring message was that selecting AT can be challenging for end users due to the amount of information available. These challenges can be mitigated by providing AT users with impartial advice and/or empowering them to access the information they need to inform their decisions. All of this is best supported by a process that puts the end user at the centre of the AT selection process.

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