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The experiences and perceptions of health-care professionals regarding assistive technology training: a systematic review

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ABSTRACT

Worldwide, there is an increasing demand for assistive technologies (ATs) that can support people to live independently for longer. Health-care professionals (HCPs) often recommend AT devices, however there exists a lack of availability of devices and appropriate training in the field. This systematic review aimed to synthesize the available evidence into the experiences and training needs of HCPs in relation to AT. Six electronic databases were searched without date restrictions: MEDLINE, PsycINFO, SPP, SSCI, CINAHL, and ASSIA. Journal handsearching, searching reference lists of included studies and relevant reviews, and contacting experts in the field of AT were also conducted. Findings were analyzed using narrative synthesis. Data from 7846 participants from 62 studies were synthesized, eliciting perceived challenges in access to and provision of training, resulting in knowledge gaps across disciplines and geographic locations. Mechanisms to mitigate these issues included ongoing support following training and tailoring education to meet individual needs since comprehensive training is essential to maintain and improve competence, knowledge, and confidence. Further research is required to explore the impact and effectiveness of AT training for HCPs to ensure that users of devices are supported to live independent and healthy lives.

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KEYWORDS
assistive devices; assistive technology; education; health-care professionals; training; training needs

Introduction

Disabilities often result in a loss of autonomy and a breakdown of social interaction (Tough et al., 2017), and thus there is a demand for assistive technology (AT) solutions that ensure people feel enabled to live independently for as long as possible. AT is an increasingly important aspect of many fields of health and care practice, and consequently the issue of transdisciplinary terminology and the potential for misunderstanding is an ongoing challenge (Elsaesser et al., 2022). The definition of AT used for this systematic review was reported by the World Health Organization (WHO) as: "An umbrella term covering the systems and services related to the delivery of assistive products and services. Assistive products maintain or improve an individual's functioning and independence, thereby promoting their wellbeing" (WHO, 2018).

It is predicted that demand for AT devices will increase significantly and become more widespread in the coming years, with more than 2 billion people needing at least one assistive product by 2030 and many older people needing two or more (WHO, 2018). This is partly due to a rise in non-communicable diseases and people worldwide living longer, with one in six people expected to be aged 60 years or older by 2030 (WHO, 2022a). The MHRA (2021) suggests that there will be an increasing need for AT devices that compensate for or alleviate injury, disability, or illness or replace physical function including, for example, mobility aids, wheelchairs, walking aids, artificial limbs, communication, and hearing aids. It is vital to ensure that people with disabilities, the older population, and those affected by chronic diseases are included in society and enable to live healthy and dignified lives (WHO, 2018), and predicted increased demand will require a related increased in trained AT providers.

Evidence has highlighted the key role innovative AT devices have in enhancing mobility and social inclusion (WHO, 2018). However, factors such as environmental obstacles (both within and outside of the homes of users), lower rates of prescription, challenges in accessing AT equipment, rapid advances in new technologies, the perceived stigma of AT, and low uptake of users can contribute to lower levels of AT usage (Bright et al., 2018; Kamal et al., 2020; Vignier et al., 2008). Consequently, there is an increasing need for clinicians and rehabilitation professionals to be aware of relevant, current, and novel technology and how it may be utilized in their work to fully support service users (Brose et al., 2010).

Comprehensive needs assessment for AT devices is important to ensure they are appropriately matched to the individual user's needs, lifestyle, motivation, attitude to risk, and home environment (Andrich et al., 2015; Gibson et al., 2019). Appropriate prescription of devices is vital to ensure their uptake and sustained use, and therefore comprehensive needs assessment and customized, systematic instruction to optimize the long-term benefits for users are vital (Lannin et al., 2014; Powell et al., 2015; Scherer & Craddock, 2002). Without adequately trained AT providers, assistive products are often of no benefit to users, may be abandoned and may even cause physical harm (WHO, 2018).

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Given these factors, knowledge about AT devices, the optimal match between devices and individual needs, and their appropriate and efficient use is essential for professionals in health care, rehabilitation, education, and social work to be able to provide quality advice and treatment (WHO, 2018). In order to promote continued use of AT devices, structured and systematic evaluation is vital to take into account user needs and preferences (Arthanat et al., 2007; Tao et al., 2020), along with support, training, and education of users and professionals (Widehammar et al., 2019). Adequately trained professionals are essential for effective assessment, recommendation, user training, and follow-up for continued use of assistive devices (WHO, 2018). Historically, there existed a lack of availability of appropriate education for HCPs and students in the field of AT (Copley & Ziviani, 2006), and whilst efforts have been made to enhance provision, gaps still exist in the capacity of the AT workforce (WHO, 2022b).

Objectives

Given the various types of AT and differing uptake of AT by HCPs, this review aimed to synthesize what is known about the training experiences, needs, and the perceived facilitators to training uptake in HCPs in relation to AT. The review aims were:

(1) To explore the experiences and perceptions of health-care professionals who have accessed and undertaken AT training.
(2) To identify the perceived facilitating factors for health-care professionals in accessing training in AT.
(3) To identify training needs of health-care professionals who are using AT.

Methods

This review followed the Centre for Reviews and Dissemination (CRD) guidelines (Centre for Reviews and Dissemination [CRD], 2008) and was reported using the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines (Page et al., 2021).

Inclusion criteria

(1) Health-care professionals' experiences of AT training
(2) All study method types were eligible for inclusion
(3) Primary research published in peer reviewed journals
(4) English language articles

Exclusion criteria

(1) Studies that do not focus on health-care professional experiences, challenges, or needs in relation to AT training
(2) Gray literature
(3) Conference papers/abstracts/commentary or discussion articles
(4) Other secondary research, e.g., literature reviews

Electronic search strategy

Six electronic databases were searched from first records to June 2022: MEDLINE (1946 to June 2022), PsycINFO (1967 to June 2022), Social Policy and Practice (SPP; 1981 to June 2022), Social sciences citation index (SSCI; 1900 to June 2022), Cumulative Index to Nursing and Allied Health Literature (CINAHL; 1937 to June 2022), and Applied Social Sciences Index and Abstracts (ASSIA; 1987 to June 2022). Search strategies were developed according to the requirements of each database and consisted of Medical Subject Heading (MeSH) terms and keywords. All keywords and combinations were the same throughout the database searching. An example search strategy used for MEDLINE is provided in Table 1. The further five electronic searches strategies can be requested by emailing the named corresponding author.

Other sources searched

Experts in the field of AT and training for HCPs were found during the electronic searches and contacted via e-mail in order to identify potentially relevant articles fitting the inclusion criteria. Three journals were hand searched (Assistive Technology; Disability and Rehabilitation: Assistive Technology; and

Table 1. Example search strategy conducted in MEDLINE.

Concept	Search terms	
Population	*Health Personnel; Health Occupations*; *Allied Health Personnel; Allied Health Occupations; Occupational Therapists; Physical Therapists; Nurses; social workers;* nurs$; healthcare professional$; health care professional$; health and social care professional$; healthcare practitioner$; health profession$; allied health profession$; allied healthcare profession$; AHP; health care provider$; occupational therapist$; physiotherapist$; speech and language therapist$; psychologist$; social worker$; physical therapist$	OR
	AND	
Assistive technologies	*Self-Help Devices; Robotics; Electronics; Equipment Design; Physical and Rehabilitation Medicine;* assistive tech$; assistive device$; assisted living; mobility aid$; motori?ed assist$; electronic$ assistive tech$; socially assistive robotic$; assistive robotic$; wheelchair$	OR
	AND	
Experiences	*Health Knowledge, Attitudes, Practice; Attitude of health personnel; knowledge*; staff attitude$; experience$; perception$; perspective$; challeng$; enable$; facilitat$; attitude$	OR
	AND	
Training	*Inservice Training; Simulation Training; Teaching*; teach$; train$; instruction$; instruct$; guid$; practic$; tuition; tutor$; learn$; interactive learning	OR

$ denotes truncation.
? denotes wildcard (e.g., motori?ed searches for motorised and motorized).
Italics denotes Medical Subject Heading (MeSH) term.

Technology and Disability), and other review reference lists reference lists of included studies were also searched in order to identify articles missed from the electronic searches.

Study screening and selection

Following duplicate removal, two review authors independently screened the titles and abstracts to identify studies potentially fitting the inclusion criteria. The authors then scrutinized full texts of the selected articles. Where there was uncertainty about inclusion, consensus was achieved by discussion or with the help of a third reviewer. A PRISMA flowchart was constructed to show the flow of articles through the process of identification through to inclusion or reasons for exclusion (Page et al., 2021).

Data extraction and management

Data were extracted using standardized data extraction forms and subsequently entered into an Excel file before being entered into standardized tables. An Excel database was used to remove duplicate articles and manage the titles and abstracts. Data extracted included details of database, country, study design, methods, participant characteristics, findings related to the research questions of this review, and study conclusions.

Quality appraisal

The quality of articles was appraised using the Mixed Methods Appraisal Tool (MMAT; Hong et al., 2018). The MMAT was chosen because it is a critical appraisal tool developed to assess the quality of the studies with multiple methodologies and designs, which were expected to be retrieved in this review. Data were entered into standardized tables, which included the main findings from each included study. Studies were not excluded based on quality score, rather they were used to interrogate the data and the robustness of the conclusions that could be drawn from the review synthesis. The MMAT has five questions for each type of study (which were assigned a score of 0 for "no", 1 for "can't tell", or 2 for "yes") and two screening questions that can be applied to all studies. However, if the answer to the screening questions was either "no" or "can't tell", the study would not be primary research. As primary research was an inclusion criterion for this systematic review, we felt it unnecessary to score the screening questions as they would already have been filtered out. Therefore, studies could score a minimum of zero and a maximum of 10.

Data synthesis

Narrative synthesis (Dixon-Woods et al., 2005) was undertaken due to the heterogeneous nature of the included articles. This method is inclusive, allows integration of qualitative and quantitative data from a wide variety of sources, and can be more descriptive and interpretive than other review types, for example, to explore relationships in the data and between groups of studies pertaining to research questions.

Results

Electronic searching of six databases was originally conducted in May 2021 and updated in June 2022. These searches resulted in 3667 results before duplicate removal: MEDLINE – 969; PsycINFO – 915; CINAHL – 151; ASSIA – 512; SPP – 122; and SSCI – 998. Following duplicate removal, 3170 titles and abstracts were screened by two members of the review team (SM and RS), leading to the retrieval of 161 full texts. Of these, 51 fitted the inclusion criteria and were included in the synthesis. From the electronic searches, four literature reviews relevant to the topic of AT and training needs (McSweeney & Gowran, 2019; Papadopoulos et al., 2018; Smith et al., 2018; Zanatta et al., 2022) were retrieved and their reference lists screened for studies possibly fitting the inclusion criteria. This revealed a further 10 potentially relevant articles. After screening titles and abstracts, two full-texts were retrieved and both were included in the synthesis (Aldersea et al., 1999; White et al., 2003).

Handsearching of three relevant peer-reviewed journals: Assistive Technology; Disability and Rehabilitation; Technology and Disability, resulted in 29 potentially relevant articles. After screening titles and abstracts, nine potentially relevant articles were sought for full-text retrieval. Of these, three fitted the inclusion criteria and were included in the synthesis (Bourassa et al., 2021; Rasouli et al., 2021; Worobey et al., 2020). Four experts in the area of AT identified during the electronic searches were contacted via e-mail to find relevant articles not revealed by the electronic searches. Three responded, suggesting five articles. However, two of these did not fit the inclusion criteria, and three were repeats of those found during the electronic searches.

Finally, reference list searching, of articles already included in the synthesis, led to the screening of further 38 titles and abstracts. Of these, 15 full-texts were retrieved, with six fitting the inclusion criteria and included in the synthesis. A total of 62 studies fitted the inclusion criteria and were included in the synthesis. Full details of the process of including and excluding articles, with reasons, are viewable in Figure 1.

Study details and methods

Study publication dates spanned more than three decades, with one published in 1987 (Glass & Hall, 1987) and the most recent ones published in 2022 (Graham et al., 2022; Papadopoulos et al., 2022; Rathiram et al., 2022; Worobey et al., 2022; Wright et al., 2022). Forty-one (66%) of the included studies were published since 2010, showing increasing recent research interest on the topic of AT. Most studies were conducted in Europe or North America (76%), with 26 conducted in Europe (the United Kingdom – 14; Norway – 5; Sweden – 2; The Netherlands – 2; Ireland – 1; and Cyprus – 1) and 21 in North America (the United States of America – 16 and Canada – 4). There were seven (11%) in Australasia (five in Australia and two in New Zealand); four in the Far East (one each in Pakistan, India, Taiwan, and the Philippines); two in Africa (one in Egypt and one in South Africa); and one each in South America (Brazil) and the Middle East (Israel).

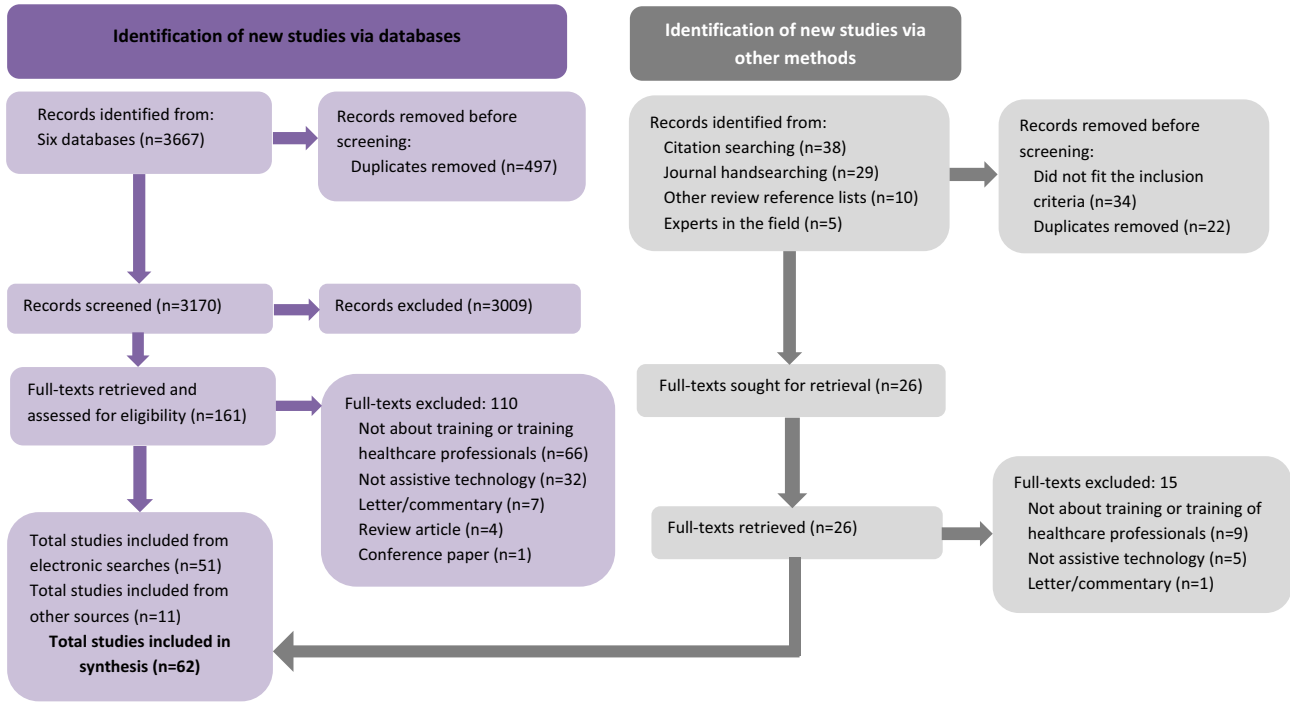

Figure 1. PRISMA 2020 flow diagram (Page et al., 2021) showing the process of article identification and selection.

Almost half of the included studies were quantitative (30), followed by qualitative (23), mixed methods (6), and multiple methods (3). Most studies (43) used convenience sampling to recruit participants, with a smaller number employing purposive sampling (10). Others used probability, random, snowball, criterion, or theoretical approaches. More than half of the studies (32) used surveys – online, paper, or a mixture of both – for data collection. Types of analysis varied by study methods, with qualitative studies using mainly thematical, framework, or content analysis and quantitative studies largely using descriptive statistics, frequencies, and percentages.

Included studies either investigated one or more assistive technologies or were generally looking at AT training needs. Specific types of AT investigated included, for example: wheelchairs, hearing aids, robotic technology, and health information and eHealth technologies. Full details of the types of AT investigated, where applicable, are viewable in Table 2. Full details of the included study methods are viewable in Table 3.

Participant characteristics

Data from a total of 7846 participants from the 62 studies were synthesized. Less than half of the studies (30) reported participant gender, with females (1499) far outweighing the number of males (388). Age was also sparsely and inconsistently reported, with 30 studies including data on this demographic, ranging from 16 to 77 years. Age was reported in various ways, for example, some reported participants' mean age and/or range, whereas others categorized ages by decade, e.g., 20–29 years.

Participant ethnicity was reported in seven studies (Compton et al., 2009; Graham et al., 2022; Long et al., 2007; Papadopoulos et al., 2022; Sax, 2002; Weakley et al., 2019; Worobey et al., 2022). Of these, participants were primarily White, except for in Papadopoulos et al. (2022) where White participants made up less than 40% of the total. Similar to participant ethnicity, whether the study was conducted in urban or rural locations was reported by just five studies (Compton et al., 2009; Gitlow & Sanford, 2003; Hall et al., 2017; Magnusson, 2019; Magnusson & Ramstrand, 2009). Three studies were conducted in a mixture of urban and rural locations, with another one each conducted in solely rural or urban settings.

There were a variety of health-care professional participants in the studies. However, some occupations were more prevalent than others. For example, occupational therapists/students = 2853; nurses/nursing students = 1645; speech and language therapists/pathologists = 911; and physiotherapists = 65. Taken together, these HCPs and students make up 70% of the total participant number. Full details of participant characteristics are available in Table 2.

Quality appraisal

All studies included in the synthesis were independently assessed by two members of the review team (SM, EH, JM, DT, and MS). Study quality scores ranged from 1 (10%) to 10 (100%) out of a maximum of 10 using the Mixed Methods Appraisal Tool (MMAT; Hong et al., 2018). Overall, the study quality was high, with 47 scoring 80% or above and 18 of these scoring the maximum 100%. However, the qualitative studies largely outperformed other studies that used quantitative or mixed methods. For example, of the 23 included qualitative studies, all score 80% or above, and 22 of the 31 quantitative studies score 80% or over. Further, of the eight mixed methods studies, just two scored 80% or above, with five scoring 50% or below. Mixed methods studies generally scored poorly to the question: "*Do the different components of the study adhere to the*

Table 2. Aims and participant demographic characteristics of the included studies.

Authors (Year published) [Country]	Aims	Participant numbers	Assistive technology type	Health profession	Age in years Mean (Range)	Ethnicity (%)	Gender (%)	Urban/rural
Aldersea et al. (1999) [The United Kingdom]	To identify where the training needs of therapists working in NHS wheelchair services existed and to gain information about the type of program required.	239 (270 total, of which 239 were health-care professionals)	Wheelchairs	OTs: 141; PTs: 39; Other therapists: 59	NR	NR	NR	NR
Andrusjak et al. (2021) [The United Kingdom]	To identify the gaps in staff knowledge regarding hearing and vision difficulties in older residents, and which practices known to improve ear and eye care in older care home residents are not commonly implemented in care homes in England.	280 (400 total, of which 280 were health-care professionals)	Hearing (e.g., hearing aids) and vision (e.g., environment adaptations)	Care home staff. Including: Health-care assistants: 210; Nurses: 56; Activity coordinators: 14	NR	NR	NR	NR
Batt-Rawden et al. (2017) [Norway]	To explore attitudes and beliefs among employees and patients at a nursing home and in home-based care services, throughout the introduction and adoption of a new digital alarm system.	14 (26 total, of which 14 were health-care professionals)	Digital alarm system	Described as nursing home employees: 14	NR	NR	NR	NR
Bergem (2020) [Norway]	To explore how important groups of actors working with young people with disabilities perceive their level of knowledge concerning adaptive equipment.	317 (522 total, of which 317 were health-care professionals)	Adaptive equipment for young people with disabilities	OTs: 317	NR	NR	NR	NR
Boger et al. (2014) [Canada]	To capture what assistive technologies are in use, factors that affect use and gaps in support from multiple stakeholders to support people living with dementia.	10 (13 total, of which 10 were health-care professionals)	To investigate type of AT in use	OTs: 10	NR	NR	All female	NR
Boman and Bartfai (2015) [Sweden]	To examine the expectations of nurses and assistant nurses when using the present mobile telepresence robotic systems. Another aim was to examine patients' and occupational therapists' experiences of using the MTR in their work in the hospital training apartments.	31	Mobile telepresence robot	Nurses: 23; Assistant night nurses: 5; OTs: 3	40.8 (27–66)	NR	Females: 26 (93%) Males: 2 (7%)	NR
Bourassa et al. (2021) [Canada]	To investigate and compare the current practices and perspectives of OTs who had and had not recommended a wheelchair-mounted robotic arm.	93	Wheelchair-mounted robotic arms (WMRA)	All OTs	40.7 (NR)	NR	Female: 79 (85%) Male: 13 (14%) Unknown: 1 (1%)	NR
Brady et al. (2007) [The United States of America]	To determine the extent to which assistive technology/assistive technology services were included in the curriculum for occupational therapy, physical therapy, special education, and speech language pathology programs in the United States.	153	To investigate how much AT training is included in course content	All program directors of: occupational therapy; physical therapy; special education; speech and language pathology programs.	NR	NR	NR	NR
Brophy-Arnott et al. (1992) [The United Kingdom]	To identify detailed information about clients who may benefit from using a communication aid, and it also highlighted some provision and research issues.	90 (95 total, of which 90 were health-care professionals)	To investigate type of AT in use	Nursing staff: 53; Speech and language therapists: 28; OTs: 5; GPs: 4	NR	NR	NR	NR

(*Continued*)

Table 2. (Continued).

Authors (Year published) [Country]	Aims	Participant numbers	Assistive technology type	Health profession	Age in years Mean (Range)	Ethnicity (%)	Gender (%)	Urban/rural
Burrola-Mendez et al. (2019) [India and Mexico]	To compare the effectiveness of hybrid and in-person learning methodologies based on knowledge and satisfaction among wheelchair service providers in India and Mexico.	81	Wheelchairs	Wheelchair service providers	India In-person: 36 Hybrid: 30;Mexico In-person: 35.8; Hybrid: 23.5	NR	Female: 51 (63%) Male: 30 (37%)	NR
Chmiliar (2007) [Canada]	To gather information in the following areas: (1) the current levels of and satisfaction with training in assistive technology; (2) current funders of assistive technology; (3) barriers associated with assistive technology use; and (4) the importance and availability of support strategies.	119 (248 total, of which 119 were health-care professionals)	To investigate assistive technology practices and needs	Health professional: 87; Speech and language pathologists: 32	NR	NR	NR	NR
Chua and Gorgon (2019) [Philippines]	To describe the perceived competence, pre- and post-professional training, and practice of Filipino speech-language pathologists in augmentative and alternative communication (AAC).	152	To investigate AAC use	All speech and language pathologists	27 (20–47)	NR	Female: 129 (85%) Male: 23 (15%)	NR
Clark et al. (2009) [The United Kingdom]	To develop a consensus on how best to incorporate eHealth issues into basic nursing education.	1120	eHealth	All nursing students	NR	NR	NR	NR
Compton et al. (2009) [The United States of America]	To examine the level of preparedness of North Carolina speech-language pathologists who serve school-aged children with cochlear implants.	190	Cochlear implants	All speech-language pathologists	Categorized from 22–61+ years. A majority were aged 22–35 years (83)	Caucasian: 177 (93%) African American: 7 (4%) Other: 3 (1.5%) Hispanic: 2 (1%) Unknown: 1 (0.5%)	Female: 182 (96%) Male: 5 (3%) Unknown: 3 (1%)	Most participants were from an urban area (146–77%)
Danial-Saad et al. (2015) [Israel]	To evaluate the ability of a novel clinical decision support system (CDSS) to help novice clinicians learn about and attain a more effective, expert-driven, decision-making process for selecting physically controllable pointing devices by means of the prescription methodology.	55	Ontology-Supported Computerize Assistive Technology Recommender (OSCAR)	All OTs	NR (26–66)	NR	All female	NR
De Leeuw et al. (2020) [The Netherlands]	To identify factors that influence the adoption of health information technology in a sample of nurses who describe themselves as digitally lagging behind the majority of their colleagues.	10	Health information technology	All nurses	56 (52–63)	NR	Female: 7 (70%) Male: 3 (30%)	NR
Demain et al. (2013) [The United Kingdom]	To investigate patients', family caregivers and health professionals' experiences and perceptions of stroke upper-limb rehabilitation and assistive technology use.	6 (21 total, of which six were health-care professionals)	Various	PTs: 3; OTs: 2; Doctor: 1	NR	NR	Female: 5 (83%) Male: 1 (17%)	NR
Dishman et al. (2021) [The United States of America]	To examine occupational therapists' perceptions of the AT education received in occupational therapy entry-level programs.	148	AT training in general	All OTs	NR	NR	NR	NR

(*Continued*)

Table 2. (Continued).

Authors (Year published) [Country]	Aims	Participant numbers	Assistive technology type	Health profession	Age in years Mean (Range)	Ethnicity (%)	Gender (%)	Urban/rural
Estes and Ishee (2007) [The United States of America]	To identify the effect of a PowerPoint presentation to introduce an emerging high technology device.	57	Assistive Dining Device	OTs: 30; OT students: 27	Categorized from 18 to 54+ years. A majority aged between 18–35 years (41).	NR	Female: 53 (93%) Male: 4 (7%)	NR
Farsjø et al. (2019) [Norway]	To explore the experiences and perspectives of health-care professionals who used our nutrition app for home-care services.	24	Appetitus app (advises on weight gain and maintenance)	Nurses: 11; Supervisor: 5; Home help aide: 4; Nursing students: 2; Social worker: 1; Others: 1	43 (23–65)	NR	Female: 23 (96%) Male: 1 (4%)	NR
Feijt et al. (2018) [The Netherlands]	To gain an in-depth and comprehensive understanding of the drivers and barriers for psychologists in adopting eMental health tools.	12	Electronic/online mental health tools	All clinical psychologists	Categorized from 20 to 60+ years. Most aged between 30 and 59 years (9)	NR	Female: 8 (67%) Male: 4 (33%)	NR
Flynn et al. (2019) [Australia]	To explore occupational therapists' and physiotherapists' perceptions of RT-UL and the perceived barriers and enablers influencing implementation.	12	Robot-assisted therapy for the upper limb (RT-UL)	OTs: 6; PTs: 6	NR (23–51)	NR	Female: 9 (75%) Male: 3 (25%)	NR
Giesbrecht (2021) [Canada]	Retrospective review of a large dataset of student cohorts from a single site and delineate bootcamp effects on Wheelchair Skills Test-Questionnaire scores.	307	Wheelchairs	All OT students	NR	NR	NR	NR
Gitlow and Sanford (2003) [The United States of America]	To explore the AT education needs of allied health professionals in a rural state.	62	General AT devices	OTs: 21; physical therapists: 21; speech and language pathologists: 20	NR	NR	Female: 50 (81%) Male: 9 (15%)	Rural
Glass and Hall (1987) [The United States of America]	To explore occupational therapists' views about the use of robotic aids for people with disabilities.	51	Robotic aids	All OTs	31.5 (NR)	NR	NR	NR
Graham et al. (2022) [New Zealand]	To examine the design requirements of a telehealth wheelchair assessment service from the perspectives of key stakeholders.	23 (42 total, of which 23 were health-care professionals)	Telehealth for wheelchair assessment	OTs: 19; PTs: 4	26–35: 2 (10.5%) 36–45: 7 (36.8%) 46–55: 7 (36.8%) 56–65: 3 (15.8%)	NZ European: 19 (83%) European: 2 (7%) Maori: 1 (4%) Asian: 1 (4%)	All female	NR
Guay et al. (2013) [Canada]	To explore the support home health aides want to help them choose bathroom equipment for community-dwelling clients with bathing difficulties.	3	Bathing equipment	Home health aides	NR (52–58)	NR	Female: 1 (33%) Male: 2 (67%)	NR
Hall et al. (2017) [The United Kingdom]	To explore the facilitators and barriers to the implementation of monitoring technologies in care homes.	24 (42 total, of which 24 were health-care professionals)	Monitoring technologies (e.g., wearable location-tracking devices)	Care workers: 12; Nurses: 7; Managers: 5	39.75 (21–64)	NR	Reported as: "vast majority were females"	Urban

(*Continued*)

Table 2. (Continued).

Authors (Year published) [Country]	Aims	Participant numbers	Assistive technology type	Health profession	Age in years Mean (Range)	Ethnicity (%)	Gender (%)	Urban/rural
Hemsley et al. (2014) [Australia]	To investigate the views of allied health and nursing staff on supporting the communication of children with cerebral palsy and complex communication needs in hospital.	49	Various: aimed at supporting communication children with cerebral palsy	Described as community and hospital-based allied health professionals and nurses	NR	NR	NR	NR
Holthe et al. (2020) [Norway]	To explore how community health-care workers enacted current policy on technology with home-dwelling citizens with mild cognitive impairment and dementia.	24	Various	Nurses: 11; care workers: 7; PTs: 4; OTs: 2	NR	NR	NR	NR
Hughes et al. (2014) [The United Kingdom]	To understand patients', carers' and health-care professionals' experience and views of upper limb rehabilitation and ATs, to identify barriers and opportunities critical to the effective translation of ATs into clinical practice.	292 (419 total, of which 292 were health-care professionals)	Various use in stroke rehabilitation	Percentages instead of numbers given: PTs: (51%); OTs: (43%); Nurses: (5%); Doctors: (1%)	NR	NR	NR	NR
Huisman and Kort (2019) [The United Kingdom]	To which extent professionals and clients engage with the Zora robot and/or accept the robot.	62	Robot aimed at improving social and physical activities for older people living in care homes	Numbers not provided, but included: Activity counselors; Nurses; PTs	NR (16–62)	NR	NR	NR
Jans and Scherer (2006) [The United States of America]	To describe the diverse audiences being trained, and the content and methods of training in US assistive technology training programs.	55	Assistive technology training for students	NR	NA	NA	NA	NA
Jarvis et al. (2017) [Australia]	To describe the attitudes and practices of occupational therapists in recommending and using assistive technology for persons with dementia who have difficulties with way finding in the community.	85	Assistive devices for people living with dementia	All OTs	NR	NR	Females: 78 (92%) Males: 7 (8%)	NR
Karlsson et al. (2018) [Australia]	To explore how classroom teachers, allied health professionals, students with cerebral palsy, and their parents view high-tech assistive technology service delivery in the classroom.	16 (28 total, of which 16 were health-care professionals)	Various assistive technology devices used at school	OTs: 10; Speech and language pathologists: 6	NR	NR	Females: 15 (94%) Males: 1 (6%)	NR
Leite et al. (2018) [Brazil]	To identify the knowledge of professionals about assistive technology and its importance in the life of the elderly.	27 (45 total, of which 27 were health-care professionals)	Various assistive technology devices used with older people	Nurses: 11; Dentists: 5 PTs: 4; Nursing staff: 4; Medical doctors: 3	NR	NR	NR	NR
Liang et al. (2019) [Taiwan]	To explore nurses' views on the potential use of robotics in the pediatric unit.	23	Robotics	All nurses	30.8 (25.4–45.1)	NR	All female	NR
Long and Perry (2008)) [The United States of America]	To determine the perceived adequacy of previous training in AT, specific training needs, preferred methods of training, and the confidence level of pediatric physical therapists in providing AT.	380	Assistive technology training	All pediatric physical therapists	NR	NR	NR	NR

(*Continued*)

Table 2. (Continued).

Authors (Year published) [Country]	Aims	Participant numbers	Assistive technology type	Health profession	Age in years Mean (Range)	Ethnicity (%)	Gender (%)	Urban/rural
Long et al. (2007) [The United States of America]	To determine the specific assistive technology training needs of pediatric occupational therapists.	272	Assistive technology training	All OTs	NR	White: 245 (90%) – others not recorded	Female: 261 (96%) Male: 11 (4%)	NR
Magnusson (2019) [Sweden]	To compare and synthesize findings related to experiences of prosthetic and orthotic service delivery in Tanzania, Malawi, Sierra Leone and Pakistan from the perspective of local professionals.	49	Prosthetic and orthotic services	All prosthetist/orthotist technicians	NR (23–57)	NR	Female: 9 (18%) Male: 40 (82%)	Urban and rural
Magnusson and Ramstrand (2009) [Pakistan]	To explore areas in which education at the Pakistan Institute of Prosthetic & Orthotic Science (PIPOS) could be improved or supplemented to facilitate clinical practice of graduates.	15	Prosthetic and orthotic devices	All graduates working as prosthetists/ orthotists	25.9 (23–30)	NR	Female: 5 (33%) Male: 10 (67%)	Urban and rural
Martinez et al. (2020) [The United States of America]	To identify multilevel factors that influenced the implementation of environmental control units in Veterans Health Administration Spinal Cord Injury/ Disorders Centers.	153 (not all respondents provided all demographics)	Environmental control units	Nurses: 72; Therapists: 15; Health-care assistants: 13; Other: 13; Doctor: 8; Biomedical engineer: 4; Psychologist or social worker: 3	Categorized: majority aged between 36 and 65 years (79).	NR	Female: 42 (30%) Male: 100 (70%)	NR
Marvin et al. (2003) [The United States of America]	To explore issues relating to speech and language pathologists experience with and education in the use of alternative and augmentative communication.	71	Alternative and augmentative communication (AAC)	All speech and language pathologist	NR	NR	NR	NR
Matthews (2001) [The United Kingdom]	To replicate survey carried out by Balandin and Iacono (1998) which identified lack of training in high tech or electronic AAC equipment for SLTs, with a view to identifying if there was a similar picture in the UK to position within the SLT profession in Australia.	320	Augmentative and alternative communication	All speech and language therapists	NR	NR	NR	NR
McGrath et al. (2017) [The United Kingdom]	(1) to identify what OTs perceive as the enabling factors that need to be in place to support their ability and comfort in prescribing Assisted Living Technology (ALT) to their older adult clients; (2) to understand how OTs overcome obstacles to the use of ALT for their clients; (3) to recommend solutions.	20	Assisted living technology	All OTs	NR	NR	NR	NR
Newton et al. (2016) [The United Kingdom]	To explore views and experiences of people with dementia, their family carers and general practitioners (GPs) on their knowledge and experience of accessing information about, and use of, AT in dementia care.	17 (56 total, of which 17 were health-care professionals)	Assistive technology in dementia care	All GPs or GP trainees	GPs: 42 (34–58); GP trainees: 30 (27–34)	NR	NR	NR

(*Continued*)

Table 2. (Continued).

Authors (Year published) [Country]	Aims	Participant numbers	Assistive technology type	Health profession	Age in years Mean (Range)	Ethnicity (%)	Gender (%)	Urban/rural
Norwood-Chapman and Burchfield (2000) [The United States of America]	Investigated the knowledge of, and attitudes about, hearing impairment and the basic skills regarding hearing aids in a sample of nursing home nurses and nursing assistants.	260	Hearing aids	Nursing assistants: 153; Nurses: 84; Unknown: 23	40.25 (18–76)	NR	NR	NR
Orton (2008) [The United Kingdom]	To identify the importance OTs attach to various factors associated with AT provision, and their practice on assessment and prescription.	36	General AT devices	All OTs	NR	NR	NR	NR
Pampoulou et al. (2018) [Cyprus]	To collect descriptive information regarding the current AAC practices by SLTs working in Cyprus.	59	Augmentative and Alternative Communication (AAC)	All speech and language therapists	NR	NR	NR	NR
Papadopoulos et al. (2022) [The United Kingdom]	To explore the views and attitudes of care home workers about the socially assistive robot (SAR) that was trialed in their workplace, in order to identify training needs in relation to the hypothetical future use of these robots in their workplace.	23	Socially assistive robot (SAR)	All care home workers	40–50: 26.1% Over 50: 43.5%	Asian/Asian British: 39.1%; White: 39.1%; Black African/Black Caribbean: 21.7%	NR	NR
Rasouli et al. (2021) [Norway]	To explore health-care staff's perspectives and insights regarding AT in daily support and welfare services for people with intellectual disabilities, and to explore the associations between the use of AT and workplace-related factors and background characteristics.	187	AT for people with intellectual disabilities	Health-care staff: 176; Home-based or day service workers: 11	35.9 (19–64)	NR	Female: 133 (76%) Male: 43 (24%)	NR
Rathiram et al. (2022) [South Africa]	To describe the communication challenges and strategies of health-care students whilst managing adults with communication disorders.	23	AT for communication	All students (medical, nursing, physiotherapy, OT and dietetics and human nutrition)	NR	NR	NR	NR
Sax (2002) [The United States of America]	Describing an online model for delivering AT education to rehabilitation professionals and their responses.	120	General AT devices	All students (rehabilitation professionals)	45	White: 49%; Other ethnic background: 22%; Unknown: 29%	NR	NR
Somerville et al. (1990) [The United States of America]	Identifying the technology training needs of OTs.	1038	General AT devices	All OTs	NR	NR	NR	NR
Taherian and Davies (2018) [New Zealand]	To gain an understanding of the experiences and perspectives of AT from different stakeholders in technology adoption, in the New Zealand context.	5 (13 total, of which five were health-care professionals)	General AT devices	Speech and language therapists: 3; OTs: 1; Biomechanical engineer: 1	Categorized: Most (4) aged between 20 and 39, one over 50	NR	Female: 3 (60%) Male: 2 (40%)	NR
Toro-Hernández et al. (2020) [Colombia]	To assess the current wheelchair provision knowledge of final year OT students in Colombia.	83	Wheelchairs	All OT students	NR	NR	NR	NR

(*Continued*)

Table 2. (Continued).

Authors (Year published) [Country]	Aims	Participant numbers	Assistive technology type	Health profession	Age in years Mean (Range)	Ethnicity (%)	Gender (%)	Urban/rural
Verdonck et al. (2011) [Ireland]	To explore: Irish OTs' views on the benefits of electronic assistive technology (EAT); their perceived competence in this area; identify their understanding of whose role it is to assess for and prescribe EAT.	56	Electronic AT	All OTs	NR	NR	NR	NR
Weakley et al. (2019) [The United States of America]	Evaluation of a video-based educational program aimed at improving HCP awareness of Aging services technologies (ASTs).	65	Aging services technologies (ASTs)	Health-care professionals and hospital volunteers	47.5 (22–77)	White: 89.1%; African American: 1.6%; Asian American: 4.6%; American Indian: 1.5%; Other: 3.1%	Female: 52 (80%) Male: 13 (20%)	NR
White (2003) [The United Kingdom]	To assess the effect that course attendance had made to both personal and service developments by surveying 30 HCPs who had attended a university validated level 3 training course on wheelchair prescription and provision for professional practice.	24	Wheelchairs	OTs: 15; PTs: 5; Rehabilitation or biomedical engineers: 4	NR	NR	NR	NR
Wormnæs and Malek (2004) [Egypt]	To explore speech therapists' knowledge about and experiences with AAC and identify training needs.	30	Augmentative and Alternative Communication (AAC)	All speech and language therapists	Reported as: 80% were 30 or older	NR	Female: 22 (73%) Male: 8 (27%)	NR
Worobey et al. (2022) [The United States of America]	To test the hypothesis that remote learning to teach clinicians manual wheelchair skills is efficacious.	41	Remote learning, wheelchairs	All therapists (physical and occupational)	32.2 (NR)	Caucasian: 32 (78%)	Female: 37 (90%) Male: 4 (10%)	NR
Wright et al. (2022) [Australia]	To understand the patterns of use of sensory approaches and what demographic and clinical factors influence their use, across one health region in Queensland, Australia.	183	Sensory technology	All health-care professionals and peer support workers	39.0 (21–67)	NR	Female: 124 (67.8%) Male: 49 (26.8%) Other: 1 (0.5%) Missing: 9 (4.9%)	NR

NR = not reported (where possible, study authors were contacted to retrieve missing data); NA = not applicable; AT = assistive technology; OT = occupational therapist; PT = physiotherapist; GP = general practitioner; CDSS = clinical decision support system.

Table 3. Methods of included studies.

Authors (Year published) [Country]	Study type and design	Sampling	Data collection	Data analysis
Aldersea et al. (1999) [The United Kingdom]	Quantitative cross-sectional study	Convenience	Paper survey	Descriptive statistics, frequencies and percentages
Andrusjak et al. (2021) [The United Kingdom]	Quantitative cross-sectional survey	Convenience	Online and paper survey	Descriptive statistics, chi-square analyses, Bonferroni adjustment
Batt-Rawden et al. (2017) [Norway]	Qualitative longitudinal case study	Convenience	One-to-one interviews, focus groups, observation	Thematic analysis, grounded theory
Bergem (2020) [Norway]	Quantitative cross-sectional survey	Convenience	Online survey	Descriptive statistics, chi-square tests
Boger et al. (2014) [Canada]	Mixed methods cross-sectional	Convenience	One-on-one, semi-structured interviews	Quantitative data: frequency counts and descriptive statistics. Qualitative data: described as "visually analyzed to identify themes"
Boman and Bartfai (2015) [Sweden]	Mixed methods	Convenience	Questionnaires and one-on-one, semi-structured interviews	Quantitative data: descriptive statistics. Qualitative: dontent analysis
Bourassa et al. (2021) [Canada]	Quantitative cross-sectional study	Convenience	Online survey	Descriptive statistics, frequencies and percentages, means and standard deviation, two-sample test (adjusted for multiple comparisons using Benjamini-Yekutieli procedure)
Brady et al. (2007) [The United States of America]	Quantitative cross-sectional survey	Convenience	Online survey	Descriptive statistics, frequencies and percentages
Brophy-Arnott et al. (1992) [The United Kingdom]	Quantitative cross-sectional survey	Convenience	Paper survey	Descriptive statistics, frequencies and percentages
Burrola-Mendez et al. (2019) [India and Mexico]	Quantitative quasi-experimental study	Convenience	Online survey	Descriptive statistics, percentages and frequencies, means and standard deviation, chi-square test or Fisher's exact test for categorical variables; t-student or Wilcoxon test for continuous variables
Chmiliar (2007) [Canada]	Quantitative cross-sectional survey	Convenience	Paper survey	Percentages
Chua and Gorgon (2019) [The Philippines]	Quantitative cross-sectional survey	Convenience	Online and paper survey	Descriptive statistics, means and standard deviations
Clark et al. (2009) [The United Kingdom]	Mixed methods	Convenience	Online survey and a workshop	NR
Compton et al. (2009) [The United States of America]	Quantitative cross-sectional survey	Convenience	Paper survey	Descriptive statistics, frequencies and means
Danial-Saad et al. (2015) [Israel]	Quantitative prospective cohort study	NR	Questionnaires	Descriptive statistics, Mann–Whitney U test
De Leeuw et al. (2020) [The Netherlands]	Qualitative cross-sectional	Purposive	Semi-structured, face-to-face interviews	Thematic analysis
Demain et al. (2013) [The United Kingdom]	Qualitative cross-sectional	Purposive	An interactive exhibition and four focus groups	Thematic analysis
Dishman et al. (2021) [The United States of America]	Quantitative cross-sectional survey	Convenience	Online survey	Descriptive statistics, including frequencies, means, and standard deviations. Chi-square analyses.
Estes and Ishee (2007) [The United States of America]	Quantitative cross-sectional	Convenience	Questionnaires	Descriptive statistics, independent sample t-test, MANOVA
Farsjø et al. (2019) [Norway]	Qualitative cross-sectional	Convenience	One-on-one, semi-structured interviews and focus groups	Content analysis

(*Continued*)

Table 3. (Continued).

Authors (Year published) [Country]	Study type and design	Sampling	Data collection	Data analysis
Feijt et al. (2018) [The Netherlands]	Qualitative descriptive approach	Theoretical	In-depth semi-structured interviews	Thematic analysis
Flynn et al. (2019) [Australia]	Qualitative cross-sectional	Convenience	Focus groups	Theoretical domain framework
Giesbrecht (2021) [Canada]	Quantitative evaluation	Convenience	Survey	Descriptive statistics, means and confidence intervals, ANOVA, Gabriel post-hoc analyses, Welch test, Games – Howell post-hoc analysis, Pearson correlation
Gitlow and Sanford (2003) [The United States of America]	Quantitative cross-sectional study	Probability	Paper survey	Descriptive statistics, frequencies, Chi-square tests
Glass and Hall (1987) [the United States of America]	Quantitative cross-sectional survey	Convenience	Paper survey	Descriptive statistics, means and percentages
Graham et al. (2022) [New Zealand]	Qualitative	Convenience	Focus groups; interviews	Inductive thematic analysis
Guay et al. (2013) [Canada]	Qualitative cross-sectional	Purposive	One-on-one, semi-structured interviews	Content analysis
Hall et al. (2017) [The United Kingdom]	Qualitative, embedded multiple-case study	Purposive	One-on-one, semi-structured interviews	Framework analysis
Hemsley et al. (2014) [Australia]	Qualitative cross-sectional	Purposive	Focus groups	Thematic analysis
Holthe et al. (2020) [Norway]	Qualitative cross-sectional	Purposive	Focus groups	Thematic analysis
Hughes et al. (2014) [The United Kingdom]	Quantitative cross-sectional survey	Convenience	Online and paper survey	Descriptive statistics, including frequencies, means, and percentages.
Huisman and Kort (2019) [The United Kingdom]	Mixed methods	NR	Observations, questionnaires, semi-structured interviews, open interviews	Coding of qualitative data, descriptive statistics, frequencies, means, and standard deviations.
Jans and Scherer (2006) [The United States of America]	Multiple methods, longitudinal	Snowball	E-mail surveys, telephone inquiries	Descriptive statistics, including frequencies and percentages.
Jarvis et al. (2017) [Australia]	Quantitative cross-sectional survey	Convenience	Online and paper survey	Descriptive statistics, including frequencies and percentages.
Karlsson et al. (2018) [Australia]	Qualitative multiple case study	Purposive; snowball	Focus groups	Linked coding
Leite et al. (2018) [Brazil]	Qualitative, descriptive, cross-sectional	Convenience	Semi-structured interviews	Content analysis
Liang et al. (2019) [Taiwan]	Qualitative, descriptive, cross-sectional	Purposive	One-on-one, semi-structured interviews	Content analysis
Long and Perry (2008) [The United States of America]	Multiple methods cross-sectional survey	Random	Paper survey – with both closed and open-ended questions	Descriptive statistics, including frequencies and percentages, Kruskal-Wallis tests, ANOVA. Qualitative data analyzed through coding.
Long et al. (2007) [The United States of America]	Multiple methods cross-sectional survey	Random	Paper survey – with both closed and open-ended questions	Descriptive statistics, including frequencies and percentages. Qualitative data analyzed through coding.
Magnusson (2019) [Sweden]	Qualitative cross-sectional	Purposive	One-on-one interviews	Phenomenographic and content analysis
Magnusson and Ramstrand (2009) [Pakistan]	Qualitative cross-sectional study	Criterion	One-to-one semi-structured interviews	Content and thematic analysis

(*Continued*)

Table 3. (Continued).

Authors (Year published) [Country]	Study type and design	Sampling	Data collection	Data analysis
Martinez et al. (2020) [The United States of America]	Mixed methods	Convenience; snowball	Survey and telephone interviews	Descriptive statistics, content analysis
Marvin et al. (2003) [The United States of America]	Quantitative cross-sectional survey	Convenience	Paper survey	Descriptive statistics, frequencies and percentages
Matthews (2001) [The United Kingdom]	Quantitative cross-sectional survey	Probability	Paper survey	Percentages
McGrath et al. (2017) [The United Kingdom]	Qualitative	Convenience	One-to-one, semi-structured interviews; focus groups	Thematic analysis
Newton et al. (2016) [The United Kingdom]	Qualitative	Convenience	Semi-structured interviews	Thematic analysis
Norwood-Chapman and Burchfield (2000) [The United States of America]	Quantitative cross-sectional survey	Convenience	Paper survey	Descriptive statistics, frequencies and percentages, means and standard deviations, ANOVA, Pearson correlation coefficient
Orton (2008) [The United Kingdom]	Quantitative cross-sectional survey	Convenience	Paper survey	Descriptive statistics, percentages, means and standard deviation, Mann-Whitney U test
Pampoulou et al. (2018) [Cyprus]	Quantitative cross-sectional survey	Convenience	Online survey	Descriptive statistics, frequencies and percentages
Papadopoulos et al. (2022) [The United Kingdom]	Qualitative	Convenience	One-to-one semi-structured interviews	Inductive thematic analysis
Rasouli et al. (2021) [Norway]	Mixed methods	Convenience	Paper survey; focus groups	Quantitative data: descriptive statistics, means and standard deviation, Cronbach's alpha, Spearman's correlation Qualitative data: constant comparative thematic analysis
Rathiram et al. (2022) [South Africa]	Qualitative	Convenience	Online survey	Inductive thematic analysis
Sax (2002) [the United States of America]	Qualitative	Convenience	Written data from completed assessments	Thematic analysis
Somerville et al. (1990) [the United States of America]	Quantitative cross-sectional survey	Probability	Paper survey	Descriptive statistics, frequencies and percentages, means and standard deviation, chi-square tests
Taherian and Davies (2018) [New Zealand]	Qualitative	Convenience	Focus group	Thematic analysis
Toro-Hernández et al. (2020) [Colombia]	Quantitative	Convenience	Online post-training assessment	Descriptive statistics, mean and standard deviation, parametric one-sample t test
Verdonck et al. (2011) [Ireland]	Quantitative cross-sectional study	Convenience	Paper survey	Descriptive statistics, percentages
Weakley et al. (2019) [The United States of America]	Quantitative evaluation	Convenience	Survey	Descriptive statistics, independent and paired-sample t tests, regression analyses
White (2003) [The United Kingdom]	Quantitative cross-sectional survey	Convenience	Paper survey	Percentages
Wormnæs and Malek (2004) [Egypt]	Quantitative cross-sectional survey	Convenience	Paper survey	Descriptive statistics, frequencies and percentages, Spearman's correlation, Mann-Whitney U test
Worobey et al. (2022) [The United States of America]	Quantitative cohort study with pre- post-training comparisons	Convenience	Online training assessments	Descriptive statistics, frequencies and percentages, means and standard deviation, paired t-tests, Wilcoxon Sign Rank test, stepwise linear regression, chi-square tests, Mann–Whitney U test, observation
Wright et al. (2022) [Australia]	Quantitative cross-sectional survey	Convenience	Online and paper survey	Descriptive statistics, frequencies and percentages, means and standard deviation, Cronbach's alpha, ANOVA, summative content analysis

quality criteria of each tradition of the methods involved?," with half scoring zero. Quantitative descriptive studies more often scored poorly to the question: "*Is the risk of nonresponse bias low*?," with seven studies not scoring any points here. Full details of the quality scores, including how each study was scored against each of the MMAT questions, are viewable in Table 4.

Synthesis of included studies

Synthesis of the included 62 studies led to the development of three main themes which link to the review's research questions: (1) gaps in assistive technology training knowledge of HCPs and students; (2) perceived facilitators and barriers to assistive technology training; (3) mechanisms to support effective assistive technology training. These themes are reported in detail along with their subthemes.

Gaps in assistive technology training knowledge of health-care professionals and students

Knowledge-related issues

A lack of knowledge regarding AT was reported in over half (32) of the studies, eleven of which involved specialist HCPs who commonly work with AT (e.g., occupational therapists; speech and language therapists; and physiotherapists). Gaps in AT knowledge were mainly related to a lack of familiarity and experience of using devices. These knowledge gaps caused some HCPs to report a lack of competence and confidence, as well as uncertainty regarding the needs and requirements or AT users. For example, it was found that 79% of speech-language pathologists had little confidence in managing cochlear implant technology due to a lack of adequate training (Compton et al., 2009).

For HCPs and students who had received some form of AT training, interventions were mostly effective in increasing basic to intermediate knowledge and competency (Giesbrecht, 2021). Participants felt prepared to apply learning to practice as a result of their increased skills and expertise. However, more detailed and comprehensive knowledge was required, for example, training should incorporate practical experience with specific devices, rather than generic AT information (Brophy-Arnott et al., 1992; Long & Perry, 2008). This will better prepare HCPs with the clinical skills needed for AT technologies used in their specialty.

Training needs

Various training needs were reported in almost half of the included studies. Knowledge of AT assessment, for example, obtaining the best fit and use of devices by patients and clients, were the most commonly identified training needs (Flynn et al., 2019; Graham et al., 2022). There was also an awareness that the evidence-based benefits of AT on users were important for training to cover (Bourassa et al., 2021; Hughes et al., 2014). Participants reported needing further information regarding regulation and legislation surrounding AT and AT services, to fully understand when and where to use it and for whom it was designed for use with (Bergem, 2020; Long & Perry, 2008). Further, there is a need for greater awareness of cultural issues and influences in relation to AT, as training programs contained limited information on the cultural influences which impact AT use (Brady et al., 2007). Also, AT training needs to be adjusted to various countries' regulations to effectively deliver person-centered rehabilitation (Magnusson, 2019). However, with a reported lack of funding for AT training and education, it is currently unclear how these needs and knowledge gaps can be improved. Studies from which the data were synthesized are viewable in Table 5.

Perceived facilitators and barriers to assistive technology training

Accessing AT training

Poor availability of AT training was reported across a range of health-care professions and student groups (Magnusson & Ramstrand, 2009; Rathiram et al., 2022). Further, there was variable provision of training in the AT field across professions and geographical locations, particularly in terms of structure, inadequate content, and insufficient time allocated to the subject (Brady et al., 2007; Long et al., 2007; Matthews, 2001).

Improving provision of AT training

A third of the included studies recommended that dedicated time for ongoing in-service training for professionals was important to ensure targeted education and increased awareness of the latest AT devices (Holthe et al., 2020; Leite et al., 2018). Also reported was a need for enhanced instruction and curricula for health-care education specifically related to AT (Giesbrecht, 2021; Somerville et al., 1990). Curriculum content should be sufficiently in-depth and embedded for those who will be entering health-care professions, as well as made an integral part of basic health-care education (Pampoulou et al., 2018). Furthermore, the importance of providing opportunities for regular updated training and continuing professional development (CPD), was necessary to ensure up-to-date AT knowledge, enhanced clinical practice, and improved AT user satisfaction (Gitlow & Sanford, 2003; Long et al., 2007).

Importance of multidisciplinary approach

There were reported benefits of applying a multidisciplinary approach to AT training, including the strength of a whole systems approach (Demain et al., 2013), enhanced collaboration and communication, shared responsibility, and provision of the best solutions for AT users (Magnusson & Ramstrand, 2009). Other benefits included opportunities for networking and collaboration between HCPs from different academic and professional backgrounds (Gitlow & Sanford, 2003). Furthermore, it was suggested that AT education and training should include those using AT devices and their informal carers, as shared experience and collaboration on multiple levels is a key facilitator in preventing abandonment of devices by service users (Demain et al., 2013). As there are variations in AT knowledge between disciplines (Bergem, 2020), applying

Table 4. Quality scores of included studies.

Authors (Year published) [Country]	Methods						Quality score points out of 10 (%)
	Qualitative	Is the qualitative approach appropriate to answer the research question?	Are the qualitative data collection methods adequate to address the research question?	Are the findings adequately derived from the data?	Is the interpretation of results sufficiently substantiated by data?	Is there coherence between qualitative data sources, collection, analysis, and interpretation?	
Batt-Rawden et al. (2017) [Norway]		2	2	2	2	2	10 (100)
Boger et al. (2014) [Canada]		2	2	1	2	2	9 (90)
De Leeuw et al. (2020) [The Netherlands]		2	2	2	2	2	10 (100)
Demain et al. (2013) [The United Kingdom]		2	2	2	2	2	10 (100)
Farsjø et al. (2019) [Norway]		2	2	2	2	2	10 (100)
Feijt et al. (2018) [The Netherlands]		2	2	2	2	2	10 (100)
Flynn et al. (2019) [Australia]		2	2	2	2	2	10 (100)
Graham et al. (2022) [New Zealand]		2	2	2	2	2	10 (100)
Guay et al. (2013) [Canada]		2	2	2	2	2	10 (100)
Hall et al. (2017) [The United Kingdom]		2	2	2	2	2	10 (100)
Hemsley et al. (2014) [Australia]		2	2	2	2	2	10 (100)
Holthe et al. (2020) [Norway]		2	2	2	1	1	8 (80)
Karlsson et al. (2018) [Australia]		2	2	2	2	2	10 (100)
Leite et al. (2018) [Brazil]		2	1	1	2	2	8 (80)
Liang et al. (2019) [Taiwan]		1	2	2	2	2	9 (90)
Magnusson (2019)[Sweden]		2	2	1	2	2	9 (90)
Magnusson and Ramstrand (2009) [Pakistan]		2	2	2	2	2	10 (100)
McGrath et al. (2017) [The United Kingdom]		2	2	2	2	2	10 (100)
Newton et al. (2016) [The United Kingdom]		2	2	2	2	2	10 (100)
Papadopoulos et al. (2022) [The United Kingdom]		2	1	2	1	2	8 (80)

(*Continued*)

Table 4. (Continued).

Authors (Year published) [Country]	Methods						Quality score points out of 10 (%)
Rathiram et al. (2022) [South Africa]		2	1	1	2	2	8 (80)
Sax (2002) [The United States of America]		1	1	2	2	2	8 (80)
Taherian and Davies (2018) [New Zealand]		2	2	2	1	2	9 (90)
	Quantitative non-Randomized	Is randomization appropriately performed?	Are the groups comparable at baseline?	Are there complete outcome data?	Are outcome assessors blinded to the intervention provided?	Did the participants adhere to the assigned intervention?	Quality score points out of 10 (%)
Burrola-Mendez et al. (2019) [India and Mexico]		1	2	1	2	1	7 (70)
Danial-Saad et al. (2015) [Israel]		1	1	2	0	2	6 (60)
Estes and Ishee (2007) [The United States of America]		2	2	2	0	2	8 (80)
Giesbrecht (2021) [Canada]		1	2	2	1	2	8 (80)
Weakley et al. (2019) [The United States of America]		2	2	2	2	2	10 (100)
Worobey et al. (2022) [The United States of America]		2	2	2	0	2	8 (80)
	Quantitative Descriptive	Is the sampling strategy relevant to address the research question?	Is the sample representative of the target population?	Are the measurements appropriate?	Is the risk of nonresponse bias low?	Is the statistical analysis appropriate to answer the research question?	Quality score points out of 10 (%)
Aldersea et al. (1999) [The United Kingdom]		2	1	2	1	2	8 (80)
Andrusjak et al. (2021) [The United Kingdom]		2	2	1	0	2	7 (70)
Bergem (2020) [Norway]		2	1	2	2	2	9 (90)
Bourassa et al. (2021) [Canada]		2	1	2	1	2	8 (80)
Brady et al. (2007) [The United States of America]		2	2	2	2	2	10 (100)
Chmiliar (2007) [Canada]		2	1	2	1	2	8 (80)
Chua and Gorgon (2019) [The Philippines]		2	2	2	0	2	8 (80)
Compton et al. (2009) [The United States of America]		2	2	2	1	2	9 (90)
Dishman et al. (2021) [The United States of America]		2	2	1	2	1	8 (80)
Gitlow and Sanford (2003) [The United States of The America]		2	0	2	0	2	6 (60)
Glass and Hall (1987) [The United States of America]		1	1	1	1	1	5 (50)

(*Continued*)

Table 4. (Continued).

Authors (Year published) [Country]	Methods						Quality score points out of 10 (%)
Hughes et al. (2014) [The United Kingdom]		2	1	2	0	2	7 (70)
Jarvis et al. (2017) [Australia]		1	2	2	0	0	7 (70)
Long et al. (2007) [The United States of America]		2	0	2	1	2	7 (70)
Marvin et al. (2003) [The United States of America]		2	1	1	2	2	8 (80)
Matthews (2001) [The United Kingdom]		2	2	1	1	2	8 (80)
Norwood-Chapman and Burchfield (2000) [The United States of America]		2	1	2	1	2	8 (80)
Orton (2008) [The United Kingdom]		2	2	1	1	2	8 (80)
Pampoulou et al. (2018) [Cyprus]		2	1	2	2	2	9 (90)
Somerville et al. (1990) [The United States of America]		2	2	2	2	2	10 (100)
Toro-Hernández et al. (2020) [Colombia]		2	1	2	1	2	8 (80)
Verdonck et al. (2011) [Ireland]		2	1	1	2	2	8 (80)
White (2003) [The United Kingdom]		1	2	1	2	2	8 (80)
Wormnæs and Malek (2004) [Egypt]		2	2	2	0	2	8 (80)
Wright et al. (2022) [Australia]		2	1	2	0	2	7 (70)
	Mixed Methods	Is there an adequate rationale for using a mixed methods design to address the research question?	Are the different components of the study effectively integrated to answer the research question?	Are the outputs of the integration of qualitative and quantitative components adequately interpreted?	Are divergences and inconsistencies between quantitative and qualitative results adequately addressed?	Do the different components of the study adhere to the quality criteria of each tradition of the methods involved?	Quality score points out of 10 (%)
Boman and Bartfai (2015) [Sweden]		0	0	0	1	0	1 (10)
Brophy-Arnott et al. (1992) [The United Kingdom]		2	1	1	1	0	5 (50)
Clark et al. (2009) [The United Kingdom]		2	1	1	1	0	5 (50)
Huisman and Kort (2019) [The United Kingdom]		0	2	0	0	0	2 (20)
Jans and Scherer (2006) [The United States of America]		2	2	2	2	2	10 (100)
Long and Perry (2008) [The United States of America]		0	2	1	1	1	5 (50)
Martinez et al. (2020) [The United States of America]		2	2	2	1	2	9 (90)
Rasouli et al. (2021) [Norway]		2	1	1	1	1	6 (60)

Table 5. Gaps in at knowledge of health-care and social care professionals and students.

1.Gaps in AT knowledge	Articles in which gaps is knowledge topics were reported
1.1 Knowledge-related issues	
Lack of AT knowledge	Andrusjak et al. (2021), Batt-Rawden et al. (2017), Bergem (2020), Boger et al. (2014), Bourassa et al. (2021), Brady et al. (2007), Brophy-Arnott et al. (1992), Chmiliar (2007), Chua and Gorgon (2019), Clark et al. (2009), Compton et al. (2009), De Leeuw et al. (2020), Demain et al. (2013), Feijt et al. (2018), Flynn et al. (2019), Gitlow and Sanford (2003), Glass and Hall (1987), Guay et al. (2013), Hemsley et al. (2014), Holthe et al. (2020), Karlsson et al. (2018), Leite et al. (2018), McGrath et al. (2017), Newton et al. (2016), Norwood-Chapman and Burchfield (2000), Orton (2008), Papadopoulos et al. (2022), Rathiram et al. (2022), Taherian and Davies (2018), Verdonck et al. (2011), Wormnæs and Malek (2004), Worobey et al. (2022)
Training resulted in increased knowledge and competency	Burrola-Mendez et al. (2019), Danial-Saad et al. (2015), Giesbrecht (2021), Pampoulou et al. (2018), Sax (2002), Weakley et al. (2019), White (2003)
More comprehensiveknowledge required	Brophy-Arnott et al. (1992), Chua and Gorgon (2019), Compton et al. (2009), Dishman et al. (2021), White (2003)
1.2 Training needs	
Assessment for AT	Bergem (2020), Bourassa et al. (2021), Brophy-Arnott et al. (1992), Flynn et al. (2019), Gitlow and Sanford (2003), Graham et al. (2022), Guay et al. (2013), Holthe et al. (2020), Long and Perry (2008), Martinez et al. (2020), Pampoulou et al. (2018), Papadopoulos et al. (2022), Rathiram et al. (2022), Somerville et al. (1990), Verdonck et al. (2011),
AT devices	Bergem (2020), Brophy-Arnott et al. (1992), Demain et al. (2013), Dishman et al. (2021), Feijt et al. (2018), Gitlow and Sanford (2003), Guay et al. (2013), Jarvis et al. (2017), Long et al. (2007), Long and Perry (2008), McGrath et al. (2017), Orton (2008), Somerville et al. (1990)
Evidence-based benefits of AT	Bourassa et al. (2021), Compton et al. (2009), Feijt et al. (2018), Flynn et al. (2019), Glass and Hall (1987), Hall et al. (2017), Hughes et al. (2014)
AT regulation and legislation	Bergem (2020), Graham et al. (2022), Long et al. (2007), Long and Perry (2008)
Funding for AT	Gitlow and Sanford (2003), Long et al. (2007), Long and Perry (2008)
Cultural issues and influences	Brady et al. (2007), Magnusson (2019)

the above approaches to education may enhance knowledge about AT across health-care sectors.

Different means of education

Providing various modes of training as opposed to solely lecture-based approaches to learning was reportedly important for successfully engaging learners in course content (Chua & Gorgon, 2019; Leite et al., 2018). Learners valued and preferred hands-on experiential learning from other HCPs. Suggestions for other means of education included blended and distance learning approaches and providing learning opportunities via attendance at symposia and conferences. Valuable sources of information to enhance learning included journal articles, textbooks, telephone information services with AT specialists and newsletters (Chmiliar, 2007). Studies from which data were synthesized are viewable in Table 6.

Mechanisms to support effective assistive technology training

Ongoing support following training

In order for professionals to practice and maintain optimal operational skills, there was a need for ongoing support following AT training. Employing organizations and educational institutions were suggested as potentially effective options by providing educational updates and acting as conduits for information sharing (Liang et al., 2019; McGrath et al., 2017). Internal organizational support mechanisms could include facilitating peer support between colleagues, implementing mentoring programs, and recruiting internal experts or "AT champions" (De Leeuw et al., 2020; Wright et al., 2022). Furthermore, within organizations and institutions, the support of managers who recognize challenges faced by HCPs and facilitate training opportunities is vital for maintaining clinicians' AT knowledge (Aldersea et al., 1999; Rasouli et al., 2021). External support from AT specialists and device manufacturers was also reported as a possible way of providing ongoing technical support and guidance (Taherian & Davies, 2018).

Individual variables

HCPs reported challenges, including fear and lack of confidence, in using information technology needed in order to use AT effectively (Graham et al., 2022). Others reported time constraints as a barrier to undertaking AT training (Bergem, 2020), which is particularly important for some individuals who may need more time than others to learn how to use new and sometimes complex devices (Boman & Bartfai, 2015). Furthermore, HCPs reported limited time to undertake AT training, with higher priority tasks, such as providing care to patients and clients, taking precedence (Farsjø et al., 2019).

Generic "one-size-fits-all" strategies for AT training that do not cater for individual learning needs and styles were not well received by participants (De Leeuw et al., 2020), with interventions tailored to individual learning needs and goals being preferred were preferred (Gitlow & Sanford, 2003; Sax, 2002). Tailored training could include setting up programs that are available as a series, as well as stand-alone courses. Furthermore, the importance of enhancing accessibility, such as giving due consideration to the location of training, providing online/web-based courses, and developing captioned videotapes and alternate formats for all training materials were discussed. These findings suggest that tailoring education to meet individual needs, skills, and learning styles could be a valuable solution to support effective AT training. Studies from which data were synthesized are viewable in Table 7.

Discussion

This systematic review set out to explore the experiences of HCPs who had undertaken training in the area of AT and to

Table 6. Perceived facilitators and barriers to at training.

2. Access and provision of assistive technology training	Articles in which access and provision topics were reported
2.1 Accessing AT training	
Lack of availability of training	Boger et al. (2014), Brophy-Arnott et al. (1992), Chmiliar (2007), Magnusson and Ramstrand (2009), Marvin et al. (2003), Rasouli et al. (2021), Rathiram et al. (2022), Wright et al. (2022)
Variable provision of training	Brady et al. (2007), Long et al. (2007), Matthews (2001), Martinez et al. (2020), Taherian and Davies (2018), Verdonck et al. (2011)
2.2 Improving provision of AT training	
In-service training forprofessionals	Aldersea et al. (1999), Batt-Rawden et al. (2017), Brophy-Arnott et al. (1992), Chua and Gorgon (2019), Compton et al. (2009), De Leeuw et al. (2020), Hall et al. (2017), Holthe et al. (2020), Hughes et al. (2014), Jarvis et al. (2017), Leite et al. (2018), Liang et al. (2019), Long et al. (2007), Long and Perry (2008), Martinez et al. (2020), Marvin et al. (2003), McGrath et al. (2017), Norwood-Chapman and Burchfield (2000), Orton (2008), Wormnæs and Malek (2004), Wright et al. (2022)
Enhance instruction/curricula for students	Brady et al. (2007), Chua and Gorgon (2019), Clark et al. (2009), Dishman et al. (2021), Giesbrecht (2021), Jans and Scherer (2006), Long et al. (2007), Long and Perry (2008), Magnusson (2019), Magnusson and Ramstrand (2009), Marvin et al. (2003), Matthews (2001), Pampoulou et al. (2018), Rathiram et al. (2022), Somerville et al. (1990), Toro-Hernández et al. (2020), Wormnæs and Malek (2004), Worobey et al. (2022)
Opportunities for continuing professional development	Aldersea et al. (1999), Chmiliar (2007), Clark et al. (2009), Farsjø et al. (2019), Gitlow and Sanford (2003), Long et al. (2007), Magnusson (2019), Pampoulou et al. (2018), Somerville et al. (1990), Taherian and Davies (2018)
2.3 Importance of a multidisciplinary approach to training	
Variation of knowledge between disciplines	Bergem (2020)
Multidisciplinary training	Aldersea et al. (1999), Chua and Gorgon (2019), Clark et al. (2009), Demain et al. (2013), Jans and Scherer (2006), Long et al. (2007), Magnusson and Ramstrand (2009), Martinez et al. (2020)
Networking	Gitlow and Sanford (2003), Verdonck et al. (2011)
2.4 Different means of education	
Mode of training, e.g., blended/distance learning, symposia/ conferences, presentations, videos, and written resources	Aldersea et al. (1999), Burrola-Mendez et al. (2019), Chmiliar (2007), Chua and Gorgon (2019), Estes and Ishee (2007), Gitlow and Sanford (2003), Glass and Hall (1987), Leite et al. (2018), Norwood-Chapman and Burchfield (2000), Sax (2002), Weakley et al. (2019), Worobey et al. (2022)
Experiential learning	Aldersea et al. (1999), Jans and Scherer (2006), Long et al. (2007), Papadopoulos et al. (2022), White (2003)

Table 7. Mechanisms to support effective at training.

3. Mechanisms to support effective AT training	Articles in which mechanisms to support effective AT training were reported
3.1 Ongoing support following training	
Internal support, e.g. peersupport, mentors, superusers, managementsupport	Chmiliar (2007), Huisman and Kort (2019), Karlsson et al. (2018), Martinez et al. (2020) Aldersea et al. (1999), Andrusjak et al. (2021), Batt-Rawden et al. (2017), De Leeuw et al. (2020), Flynn et al. (2019), Graham et al. (2022), Guay et al. (2013), Holthe et al. (2020), Long et al. (2007), Magnusson (2019), McGrath et al. (2017), Newton et al. (2016), Rasouli et al. (2021), White (2003), Wright et al. (2022)
External support, e.g., technical expertise	Boman and Bartfai (2015), Chmiliar (2007), Karlsson et al. (2018), Taherian and Davies (2018)
3.2 Individual variables	
Varying IT skills of participants	Batt-Rawden et al. (2017), Boman and Bartfai (2015), Feijt et al. (2018), Graham et al. (2022)
Time constraints	Boman and Bartfai (2015), Chmiliar (2007), Farsjø et al. (2019), Karlsson et al. (2018)
Tailoring learning to individual needs	Aldersea et al. (1999), De Leeuw et al. (2020), Gitlow and Sanford (2003), Sax (2002)

identify factors in accessing such training as well as training needs. Synthesis of the included studies uncovered that for HCPs and students who had received some form of AT training, such training was effective in increasing basic to intermediate AT knowledge and competency. Despite the support and education of professionals working in the field being highlighted as vital to maintain the use of AT and increase user participation (Widehammar et al., 2019), the synthesis uncovered a lack of availability and varying provision of training across health disciplines and geographic locations. In fact, just one study reported on the variation of AT knowledge between disciplines (Bergem, 2020), suggesting further research needs conducting to explore this important issue.

The perceived challenges in accessing and the poor provision of AT training found here were largely responsible for numerous gaps in AT knowledge across disciplines and countries. Some reported a lack of knowledge about AT, in general, whereas others reported specific gaps, such as: assessment, availability of specific devices, evidence-based practice, regulation and legislation, funding, and the impact of cultural issues and influences. This was also found by Copley and Ziviani (2006), highlighting a worldwide problem with access to AT training.

Despite the importance of systematic evaluation of educational programs (Arthanat et al., 2007; Tao et al., 2020), only a small number of studies reported on evaluation of AT training here. This suggests that a more robust exploration is necessary to understand the impact and effectiveness of such interventions.

Findings from the synthesis suggested a number of perceived facilitating factors that enable HCPs to access AT training throughout their career. This is important given the rapid development of new technologies which require continuous lifelong learning (Liang et al., 2019). For example, the

provision of enhanced graduate training, in-service training, opportunities for ongoing support and continuing professional development. The importance of a multidisciplinary approach to AT training also emerged as a perceived facilitating factor, however only two studies mentioned the importance of opportunities for networking, suggesting that this is an area that could be further developed or researched.

The synthesis revealed that HCPs' individual abilities and circumstances, such as varying IT skills and knowledge, time constraints, and learning styles, are perceived as potential barriers to accessing AT training. Different means of education are therefore warranted to ensure training is tailored to meet individual needs and preferences. This could include different modes of learning, such as online or blended approaches, providing opportunities for experiential practice, developing training programs that can be undertaken either as a series or stand-alone units, and providing opportunities to attend symposia and conferences. Consideration needs giving to the location of training and provision of alternate formats for training materials, to make it as flexible and accessible as possible, and to the potential time and financial costs involved in tailoring training to individuals. This echoes earlier research which suggests customized, systematic instruction to optimize the long-term benefits for users is vital (Lannin et al., 2014; Powell et al., 2015; Scherer & Craddock, 2002). These findings echo the WHO recommendation to enlarge, diversify, and improve workforce capacity in relation to AT (WHO, 2022b).

Limitations

Given the various challenges that exist in defining what is meant by AT (Elsaesser et al., 2022), and the great lengths the review team went to in deciding on an overarching definition of AT, some studies about AT training may have been missed where the subject was not reported as being AT. However, the thorough search strategies developed and the extensive searching for peer reviewed articles will have mitigated the negative impact that selection bias may have had on the findings. Further, despite the comprehensive literature search, none of the included studies were randomized-controlled trials.

Since the objectives of this review did not include mapping what AT training did exist, nor whether any recommendations proposed in the vast amount of studies the searches elicited were taken up in practice, further research to investigate active programs and identify additional existing gaps in training the AT workforce would be of value. There was also a lack of participants from black and minority ethnic backgrounds, which limits how these findings may apply to HCPs from minority ethnic groups. It is therefore unclear if findings in relation to AT training needs will be applicable to HCPs from different cultures or communities.

As only studies published in English were included, the generalizability of the findings is limited to English speaking and Western countries.

Future directions

More studies in the field of AT training for HCPs are required. More high-quality, robust research would be valuable to provide statistical evidence regarding the efficacy and impact of AT training.

Since most studies were conducted in Europe or North America, future studies should explore whether there are any variations in the training needs of HCPs in the Global South compared to other geographic areas and cultures. Further, whether studies were conducted in urban or rural areas was an area largely unreported by those included in this review. Prior to the COVID−19 pandemic, access to training was often centralized in urban areas that may be difficult for those living in rural or remote areas to reach, especially individuals with physical or mental impairment (Chmiliar, 2007). Future research exploring or comparing the impact and effectiveness of innovative online health-care professional education is therefore warranted.

Conclusions

Comprehensive and ongoing training in the field of AT is essential in a world where new technologies are rapidly developing and established ATs are underused. Effective training improves skills, competence, and knowledge of HCPs. However, challenges in accessing and providing training have resulted in numerous knowledge gaps across disciplines and geographic locations. Further research is needed to explore the impact and effectiveness of AT training to ensure that HCPs are able to continue supporting patients and clients to live independent and healthy lives.

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