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The Experiences and Perceptions of Healthcare Professionals regarding Assistive Technology Training: A Systematic Review

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The Experiences and Perceptions of Healthcare Professionals regarding Assistive Technology Training: A Systematic Review

Worldwide there is an increasing demand for assistive technologies (ATs) that can support people to live independently for longer. Healthcare 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 synthesise 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 analysed using narrative synthesis. Data from 7846 participants from 62 studies were synthesised, 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 users of devices are supported to live independent and healthy lives.

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 noncommunicable 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) suggest that there will be an increasing need for AT devices that compensate for or alleviate injury, disability or illness, or replace physical function include, 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 (Kamal et al., 2020; Bright et al., 2018; 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 utilised 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 (Gibson et al., 2019; Andrich et al., 2015). Appropriate prescription of devices is vital to ensure their uptake and sustained use and therefore comprehensive needs assessment and customised, systematic instruction to optimise the long-term benefits for users is vital (Powell et al., 2015; Lannin et al., 2014; 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).

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 healthcare, 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 (Tao et al., 2020; Arthanat, 2007), 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 used 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 synthesise 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 healthcare professionals who have

accessed and undertaken AT training.

(2) To identify the perceived facilitating factors for healthcare professionals in

accessing training in AT.

(3) To identify training needs of healthcare professionals who are using AT.

Methods

This review followed the Centre of Reviews and Dissemination (CRD) guidelines

(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) Healthcare 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 healthcare professional experiences, challenges or needs in relation to AT training

(2) Grey 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), 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 key words. All key words 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 search strategies can be requested be emailing the named corresponding author.

[insert near here] Table 1. Example search strategy conducted in MEDLINE

Other sources searched

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

Disability), other review reference lists and 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 scrutinised 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 standardised data extraction forms and subsequently entered into an Excel file before being entered into standardised 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 standardised 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 '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 of 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 the research questions.

Results

Electronic searching of six databases were 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; 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; Papadopolous 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 & Rehabilitation; Technology & 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 email 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. Lastly, reference list searching, of articles already included in the synthesis, led to the screening of a 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, is 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; Papadopoulous 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 (United Kingdom - 14; Norway – 5; Sweden – 2; The Netherlands – 2; Ireland – 1; Cyprus – 1), and 21 in

North America (United States of America – 16; 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).

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, is viewable in Table 2. Full details of included study methods are viewable in Table 3.

Participant characteristics

Data from a total of 7846 participants from the 62 studies were synthesised. 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 categorised ages by decade, e.g., 20-29 years.

Participant ethnicity was reported by seven studies (Compton et al., 2009; Graham et al., 2022; Long et al., 2007; Papadopoulous et al., 2022; Sax, 2002; Weakley et al., 2019; Worobey et al., 2022). Of these, participants were primarily White, except for in Papadopoulous et al. (2022) where White participants made up less than 40% of the total. Similarly 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 was a variety of healthcare 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; 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.

[insert near here] Table 2. Aims and participant demographic characteristics of included studies; Table 3. Methods of included studies; Figure 1. PRISMA 2020 flow diagram (Page et al., 2021) showing the process of article identification and selection

Quality appraisal

All studies included in the synthesis were independently assessed by two members of the review team (SM, EH, JM, DT, 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, 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 which 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 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 quality scores, including how each study was scored against each of the MMAT questions, are viewable in Table 4.

[insert near here] Table 4. Quality scores of included studies

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 with their subthemes below.

1. Gaps in assistive technology training knowledge of healthcare professionals and students

1.1 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; 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 (Long & Perry, 2008; Brophy-Arnott et al., 1992). This will better prepare HCPs with the clinical skills needed for AT technologies used in their specialty.

1.2 Training needs

Various training needs were reported by almost half of the included studies. Knowledge of AT assessment, for example, obtaining best fit and use of devices by patients and clients, were the most commonly identified training needs (Graham et al., 2022; Flynn et al., 2019). There was also an awareness that the evidence-based benefits of AT on users was 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 programmes 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-centred 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 data were synthesised is viewable in Table 5.

[insert near here] Table 5. Gaps in AT knowledge of health and social care professionals and students

2. Perceived facilitators and barriers to assistive technology training

2.1 Accessing AT Training

Poor availability of AT training was reported across a range of healthcare professions and student groups (Rathiram et al., 2022; Magnusson & Ramstrand, 2009). 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).

2.2 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 healthcare education specifically relating to AT (Giesbrecht, 2021; Somerville et al., 1990). Curriculum content should be sufficiently in-depth and embedded for those who will be entering healthcare professions, as well as made an integral part of basic healthcare education

(Pampoulou et al., 2018). Further, 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 (Long et al., 2007; Gitlow & Sanford, 2003).

2.3 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). Further, 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, 2013). As there are variations in AT knowledge between disciplines (Bergem, 2020), applying the above approaches to education may enhance knowledge about AT across healthcare sectors.

2.4 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 synthesised is viewable in Table 6.

[insert near here] Table 6. Perceived facilitators and barriers to AT training

3. Mechanisms to support effective assistive technology training

3.1 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 organisations 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 organisational support mechanisms could include facilitating peer support between colleagues, implementing mentoring programmes and recruiting internal experts or 'AT champions' (Wright et al., 2022; De Leeuw et al., 2020). Further, within organisations and institutions, the support of managers who recognise challenges faced by HCPs and facilitate training opportunities is vital for maintaining clinicians' AT knowledge (Rasouli et al., 2021; Aldersea et al., 1999). 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).

3.2 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 & Bartafi, 2015). Further, HCPs reported limited time to undertake AT training, with higher priority tasks, such as providing care to patients and clients, taking precedence (Farsjo 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 were preferred (Gitlow & Sandford, 2003; Sax, 2002). Tailored training could include setting up programmes that are available as a series, as well as stand-alone courses. Further, 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 synthesised is viewable in Table 7.

[insert near here] Table 7. Mechanisms to support effective AT training

Discussion

This systematic review set out to explore the experiences of HCPs who had undertaken training in the area of AT, and to 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. However, despite the support and education of professionals working in the field being highlighted as vital to maintain 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 was 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 & Ziviani (2006), highlighting a worldwide problem with access to AT training.

Despite the importance of systematic evaluation of educational programmes (Tao et al., 2020; Arthanat, 2007), only a small number of studies reported on evaluation of AT training here. This suggests 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 which enable HCPs to access AT training throughout their career. This is important given the rapidly development of new technologies which requires 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 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 is 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 and providing opportunities for experiential practice, developing training programmes 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 customised, systematic instruction to optimise the long-term benefits for users is vital (Powell et al., 2015; Lannin et al., 2014; 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 randomised-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 programmes 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 generalisability of the findings are 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 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 centralised 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 healthcare 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.

Disclosure statement

The authors report there are no competing interests to declare.

References

Aldersea, P., Ham, R., & White, E. (1999). Wheelchair training needs for OTs and physiotherapists. British Journal of *Therapy and Rehabilitation, 6*(10), 510-515.

Andrich, R., Salatino, C., Converti, R. M., & Saruggia, M. (2015). Cost-effectiveness of powered wheelchairs: findings of a study. In C. Sik-Lányi, E. J. Hoogerwerf, K. Miesenberger (Eds), *Assistive Technology: Building Bridges*. IOS Press

Andrusjak, W., Barbosa, A., & Mountain, G. (2021). Hearing and vision care provided to older people residing in care homes: a cross-sectional survey of care home staff. *BMC Geriatrics, 21*(32).

Arthanat, S., Bauer, S. M., Lenker, J.A., Nochajski, S .M., & Wu, Y. W. B. (2007). Conceptualization and measurement of assistive technology usability. *Disability and Rehabilitation: Assistive Technology*, *2*(4), 235-248.

Batt-Rawden, K. B., Björk, E., & Waaler, D. (2017). Human factors in implementation and adoption of innovations in health care services: A longitudinal case study on the introduction of new technology. *The Innovation Journal: The Public Sector Innovation Journal, 22*(3).

Bergem, S. (2020). Knowledge among important actors in the field of adaptive equipment for young people with disabilities. *Disability and Rehabilitation: Assistive Technology, 15*(1), 109-118.

Boger, J., Quraishi, M., Turcotte, N., & Dunal, L. (2014). The identification of assistive technologies being used to support the daily occupations of community-dwelling older adults with dementia: a cross-sectional pilot study. *Disability and Rehabilitation: Assistive Technology, 9*(1), 17-30.

Boman, I. L. & Bartfai, A. (2015). The first step in using a robot in brain injury rehabilitation: patients' and health-care professionals' perspective. *Disability and Rehabilitation: Assistive Technology, 10*(5), 365-70

Bourassa, J., Faieta, J., Bouffard, J., & Routhier, F. (2021). Wheelchair-mounted robotic arms: a survey of occupational therapists' practices and perspectives. *Disability and Rehabilitation: Assistive Technology, 22*, 1-10.

Brady, R., Long, T. M., Richards, J., & Vallin, T. (2007). Assistive technology curriculum structure and content in professional preparation service provider training programs. *Journal of Allied Health, 36*(4), 183-192.

Bright, T., Wallace, S., & Kuper, H. (2018). A Systematic Review of Access to Rehabilitation for People with Disabilities in Low- and Middle-Income Countries. *International Journal of Environmental Research and Public Health, 15*(10), 2165.

Brophy-Arnott, M. B., Newell, A. F., Arnott, J. L., & Condie, D. (1992). A survey of the communication-impaired population of Tayside. *European Journal of Disorders of Communication, 27*(2), 159-73.

Brose, S. W., Weber, D. J., Salatin, B. A., Grindle, G. G., Wang, H., Vazquez, J. J., & Cooper, R. A. (2010). The role of assistive robotics in the lives of persons with disability. *American Journal of Physical Medical Rehabilitation*, *89*, 509–521.

Burrola-Mendez, Y., Bonilla-Escobar, F. J., Goldberg, M., & Pearlman, J. (2019). Comparing the effectiveness of a hybrid and in-person courses of wheelchair service provision knowledge: A controlled quasi-experimental study in India and Mexico. *PLoS One, 14*(5), e0217872.

Chmiliar, L. (2007). Perspectives on Assistive Technology: What Teachers, Health Professionals, and Speech and Language Pathologists Have to Say. *Developmental Disabilities Bulletin, 35*(1), 1-17.

Chua, E. C. K., & Gorgon, E. J. R. (2019). Augmentative and alternative communication in the Philippines: a survey of speech-language pathologist competence, training, and practice. *Augmentative and Alternative Communication, 35*(2), 156-166.

Clark, J., Baker, B., & Baker, D. (2009). Getting eHealth into basic nursing education: report of the RCN information in nursing project. *Studies in Health Technology and Informatics, 146*, 534-9.

Compton, M. V., Tucker, D. A., & Flynn, P. F. (2009). Preparation and Perceptions of Speech-Language Pathologists Working With Children With Cochlear Implants. *Communication Disorders Quarterly, 30*(3), 142–154.

Copley, J., & Ziviani, J. (2006). Barriers to the use of assistive technology for children with multiple disabilities. *Occupational Therapy International, 11*(4), 229-243.

Centre for Reviews and Dissemination (2008*). Systematic Reviews: CRD Guidance for Undertaking Reviews in Health Care*. CRD: University of York.

Danial-Saad, A., Kuflik, T., Weiss, P. L., & Schreuer, N. (2015). Effectiveness of a Clinical Decision Support System for Pointing Device Prescription. *American Journal of Occupational Therapy, 69*(2), 1-7.

De Leeuw, J. A., Woltjer, H., & Kool, R. B. (2020). Identification of Factors Influencing the Adoption of Health Information Technology by Nurses Who Are Digitally Lagging: In-Depth Interview Study. *Journal of Medical Internet Research, 22*(8), e15630.

Demain, S., Burridge, J., Ellis-Hill, C., Hughes, A. M., Yardley, L., Tedesco-Triccas, L., & Swain, I. (2013). Assistive technologies after stroke: self-management or fending for yourself? A focus group study. *BMC Health Services Research, 13*, 334.

Dishman, K. M., Duckart, J., & Hardman, L. J. (2021). Perceptions of assistive technology education from occupational therapists certified as assistive technology professionals. *American Journal of Occupational Therapy, 75*(2), 1-7.

Dixon-Woods, M., Agarwal, S., Jones, D., Young, B., & Sutton, A. (2005). Synthesising qualitative and quantitative evidence: a review of possible methods. *Journal of Health Services Research & Policy, 10*(1), 45–53b.

Elsaesser, L., Layton, N., Scherer, M., & Bauer, S. (2022). Standard terminology is critical to advancing rehabilitation and assistive technology: a call to action. *Disability and Rehabilitation: Assistive Technology, 17*(8), 986-988.

Estes, R. I., & Ishee, J. H. (2007). Introduction of an emerging technology device through Powerpoint training. *The Internet Journal of Allied Health Sciences and Practice, 5*(2), Article 8.

Farsjø, C., Kluge ,A., & Moen, A. (2019). Using a tablet application about nutrition in home care-Experiences and perspectives of healthcare professionals. *Health & Social Care in the Community, 27*(3), 683-692.

Feijt, M. A., de Kort, Y. A., Bongers, I. M., & IJsselsteijn, W. A. (2018). Perceived drivers and barriers to the adoption of eMental health by psychologists: The construction of the levels of adoption of eMental health model. *Journal of Medical Internet Research, 20*(4), e153.

Flynn, N., Kuys, S., Froude, E., & Cooke, D. (2109). Introducing robotic upper limb training into routine clinical practice for stroke survivors: Perceptions of occupational therapists and physiotherapists. *Australian Occupational Therapy Journal, 66*(4), 530-538.

Gibson, G., Dickinson, C., Brittain, K., & Robinson, L. (2019). Personalisation, customisation and bricolage: How people with dementia and their families make assistive technology work for them. *Ageing and Society, 39*(11), 2502-2519.

Giesbrecht, E. (2021). Wheelchair Skills Test Outcomes across Multiple Wheelchair Skills Training Bootcamp Cohorts. *International Journal of Environmental Research and Public Health, 19*(1), 21.

Gitlow, L., & Sanford, T. (2003). Assistive technology education needs of allied health professionals in a rural state. *Journal of Allied Health, 32*(1), 46-51.

Glass, K., & Hall, K. (1987). Occupational therapists' views about the use of robotic aids for people with disabilities. *American Journal of Occupational Therapy, 41*(11), 745-7.

Graham, F., Boland, P., Jones, B., Wallace, S., Taylor, W., Desha, L., Maggo, J., McKerchar, C., & Grainger, R. (2022). Stakeholder perspectives of the sociotechnical requirements of a telehealth wheelchair assessment service in Aotearoa/New Zealand: A qualitative analysis. *Australian Occupational Therapy Journal, 69*(3), 279-289.

Hall, A., Wilson, C. B., Stanmore, E., & Todd, C. (2017). Implementing monitoring technologies in care homes for people with dementia: A qualitative exploration using Normalization Process Theory. *International Journal of Nursing Studies, 72*, 60-70.

Hemsley, B., Lee, S., Munro, K., Seedat, N., Bastock, K., & Davidson, B. (2020). Supporting communication for children with cerebral palsy in hospital: views of community and hospital staff. *Developmental Neurorehabilitation, 17*(3), 156-66.

Holthe, T., Halvorsrud, L., Thorstensen, E., Karterud, D., Laliberte Rudman, D., & Lund, A. (2020). Community Health Care Workers' Experiences on Enacting Policy on Technology with Citizens with Mild Cognitive Impairment and Dementia. *Journal of Multidisciplinary Healthcare, 13*, 447-458.

Hong, Q. N., Pluye, P., Fàbregues, S., Bartlett, G., Boardman, F., Cargo, M., Dagenais, P., Gagnon, M., Griffiths, F., Nicolau, B., O'Cathain, A., Rousseau, M., & Vedel, I.

(2018). The Mixed Methods Appraisal Tool (MMAT) Version 2018 for Information Professionals and Researchers. *IOS Press, 34*(4), 285-291.

Hughes, A. M., Burridge, J. H., Demain, S. H., Ellis-Hill, C., Meagher, C., Tedesco-Triccas, L., Turk, R., & Swain, I. (2014). Translation of evidence-based Assistive Technologies into stroke rehabilitation: users' perceptions of the barriers and opportunities. *BMC Health Services Research, 14,* 124.

Huisman, C., & Kort, H. (2019). Two-Year Use of Care Robot Zora in Dutch Nursing Homes: An Evaluation Study. *Healthcare (Basel), 7*(1), 31.

Jans, L. H., & Scherer, M. J. (2006). Assistive technology training: diverse audiences and multidisciplinary content. *Disability and Rehabilitation: Assistive Technology, 1*(1-2), 69-77.

Jarvis, F., Clemson, L. M., & Mackenzie, L. (2017). Technology for dementia: attitudes and practices of occupational therapists in providing assistive technology for way finding. *Disability and Rehabilitation: Assistive Technology, 12*(4), 373-377.

Kamal, S. A., Shafiq, M., & Kakria, P. (2020). Investigating acceptance of telemedicine services through an extended technology acceptance model (TAM). *Technology in Society, 60*, 101212.

Karlsson, P., Johnston, C., & Barker, K. (2018). Influences on students' assistive technology use at school: the views of classroom teachers, allied health professionals, students with cerebral palsy and their parents. *Disability and Rehabilitation: Assistive Technology, 13*(8), 763-771.

Lannin, N., Carr, B., Allaous, J., Mackenzie, B., Falcon, A., & Tate, R. (2014). A randomized controlled trial of the effectiveness of handheld computers for improving everyday memory functioning in patients with memory impairments after acquired brain injury. *Clinical Rehabilitation*, *28*(5), 470-481.

Leite, E. S., Pimenta, C. J. L., Costa, M. S., Oliveira, F. B., Moreira, M. A. S. P., & Silva, A. O. (2018). Assistive technology and active aging according to professionals working in community groups. *Revista da Escola de Enfermagem da USP, 13*(52), e03355.

Liang, H. F., Wu, K. M., Weng, C. H., & Hsieh, H. W. (2019). Nurses' Views on the Potential Use of Robots in the Pediatric Unit. *Journal of Pediatric Nursing, 47*, e58-e64.

Long, T. M., & Perry, D. F. (2008). Pediatric physical therapists' perceptions of their training in assistive technology. *Physical Therapy, 88*(5), 629-39.

Long, T. M., Woolverton, M., Perry, D. F., & Thomas, M. J. (2007). Training needs of pediatric occupational therapists in assistive technology. *The American Journal of Occupational Therapy, 61*(3), 345-54.

Magnusson, L. (2019). Professionals' perspectives of prosthetic and orthotic services in Tanzania, Malawi, Sierra Leone and Pakistan. *Prosthetics and Orthotics International, 43*(5), 500-507.

Magnusson, L., & Ramstrand, N. (2009). Prosthetist/orthotist educational experience & professional development in Pakistan. *Disability and Rehabilitation: Assistive Technology, 4*(6), 385-92.

Martinez, R. N., Etingen, B., French, D. D., Vallette, M. A., Bidassie, B., Cozart, H. T., & Weaver, F. M. (2020). An ecological perspective on implementing environmental control units for veterans with spinal cord injuries and disorders. *Disability and Rehabilitation: Assistive Technology, 15*(1), 67-75.

Marvin, L. A., Montano, J. J., Fusco, L. M., & Gould, E. P. (2003). Speech-Language Pathologists' Perceptions of Their Training and Experience in Using Alternative and

Augmentative Communication. *Contemporary Issues in Communication Science and Disorders, 30*, 76-83.

Matthews, R. (2001). A survey to identify therapists' high-tech AAC knowledge, application and training. *International Journal of Language & Communication Disorders, 36(*Suppl), 64-9.

McGrath, C., Ellis, M., Harney-Levine, S., Wright, D., Williams, E. A., Hwang, F., & Astell, A. (2017). Investigating the enabling factors influencing occupational therapists' adoption of assisted living technology. *British Journal of Occupational Therapy, 80*(11), 668-675.

McSweeney, E., & Gowran, R. J. (2019). Wheelchair service provision education and training in low and lower middle income countries: a scoping review. *Disability and Rehabilitation: Assistive Technology, 14*(1), 33-45.

MHRA (2021). *Assistive technology: definition and safe use*. Medicines & Healthcare products Regulation Agency. https://www.gov.uk/government/publications/assistive-technology-definition-and-safe-use/assistive-technology-definition-and-safe-use.

Newton, L., Dickinson, C., Gibson, G., Brittain, K., & Robinson, L. (2016). Exploring the views of GPs, people with dementia and their carers on assistive technology: a qualitative study. *BMJ Open, 6*(5), e011132.

Norwood-Chapman, L., & Burchfield, S. B. (2000). Nursing Home Personnel Knowledge and Attitudes About Hearing Loss and Hearing Aids. *Gerontology & Geriatrics Education, 20*(2), 37-47.

Orton, M. (2008). Factors that may be considered by occupational therapists during the assessment of clients for assistive technology and whether it permeates through to the eventual prescription. *Journal of Assistive Technologies, 2*(1), 11-22.

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffman, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brenna, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., . . . Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ, 372*, n71.

Pampoulou, E., Theodorou, E., & Petinou, K. (2018). The use of augmentative and alternative communication in Cyprus: Findings from a preliminary survey. *Child Language Teaching and Therapy, 34*(1), 5–21.

Papadopoulos, I., Ali, S., Papadopoulos, C., Castro, N., Faulkes, N., & Koulouglioti, C. (2022). A qualitative exploration of care homes workers' views and training needs in relation to the use of socially assistive humanoid robots in their workplace. *International Journal of Older People Nursing, 17*(3), e12432.

Papadopoulos, I., Koulouglioti, C., & Ali, S. (2018). Views of nurses and other health and social care workers on the use of assistive humanoid and animal-like robots in health and social care: a scoping review. *Contemporary Nurse, 54*(4-5), 425-442.

Powell, L. E., Glang, A., Pinkelman, S., Albin, R., Harwick, R., Ettel, D. & Wild, M. R. (2015). Systematic instruction of assistive technology for cognition (ATC) in an employment setting following acquired brain injury: A single case, experimental study. *NeuroRehabilitation*, *37*, 437-447.

Rasouli, O., Kvam, L., Husby, V. S., Røstad, M., Witsø, A. E. (2021). Understanding the possibilities and limitations of assistive technology in health and welfare services for people with intellectual disabilities, staff perspectives. *Disability and Rehabilitation: Assistive Technology, 17*, 1-9.

Rathiram, V., Neilson, L. O., Syed Kassim, A., Mokone, W. T., & Green, C. C. (2022). Communication experiences of healthcare students whilst managing adults with

communication disorders. *South African Journal of Communication Disorders, 69*(1), e1-e9.

Sax, C. L. (2002). Assistive technology education: an online model for rehabilitation professionals. *Disability and Rehabilitation, 24*(1-3), 144-51.

Scherer, M. J. & Craddock, G. (2002). Matching Person and Technology (MPT) assessment process. Technology & Disability, Special Issue: *The Assessment of Assistive Technology Outcomes, Effects and Costs, 14*(3), 125-131.

Smith, E. M., Gowran, R. J., Mannan, H., Donnelly, B., Alvarez, L., Bell, D., Contepomi, S., Ennion, W. L., Hoogerwerf, E. J., Howe ,T., Jan, Y. K., Kagwiza, J., Layton, N., Ledgerd, R., MacLachlan, M., Oggero, G., Pettersson, C., Pousada, T., Scheffler, E., & Wu, S. (2018). Enabling appropriate personnel skill-mix for progressive realization of equitable access to assistive technology. *Disability and Rehabilitation: Assistive Technology, 13*(5), 445-453.

Somerville, N. J., Wilson, D. J., Shanfield, K. J., & Mack, W. (1990). A Survey of the Assistive Technology Training Needs of Occupational Therapists. *Assistive Technology, 2*(2), 41-49.

Taherian, S., & Davies, C. (2018). Multiple stakeholder perceptions of assistive technology for individuals with cerebral palsy in New Zealand. *Disability and Rehabilitation: Assistive Technology, 13*(7), 648-657.

Tao, G., Charm, G., Kabacińska, K., Miller, W. C., & Robillard, J. M. (2020). Evaluation Tools for Assistive Technologies: A Scoping Review. *Archives of Physical Medicine and Rehabilitation, 101*(6), 1025-1040.

Toro-Hernández, M. L., Alvarez, L., Vargas-Chaparro, M. C., & Goldberg, M. (2020). Final Year Students' Knowledge on Basic Manual Wheelchair Provision: The State of

Occupational Therapy Programs in Colombia. *Occupational Therapy International, 2020*.

Tough, H., Siegrist, J., & Fekete, C. (2017). Social relationships, mental health and wellbeing in physical disability: a systematic review. *BMC Public Health*, *17*(414).

Verdonck, M., McCormack, C., & Chard, G. (2011). Irish Occupational Therapists' Views of Electronic Assistive Technology. *British Journal of Occupational Therapy, 74*(4), 185-190

Vignier, N., Ravaud, J., Winance, M., Lepoutre, F. & Ville, I. (2008). Demographics of wheelchair users in France: results of national community-based handicaps-incapacités-dépendance surveys. *Journal of Rehabilitation Medicine*, *40*, 231-239.

Weakley, A., Tam, J. W., Van Son, C., & Schmitter-Edgecombe, M. (2019). Effectiveness of a video-based aging services technology education program for health care professionals. *Gerontology & Geriatrics Education, 40*(3), 339-356.

White, E. (2003). Impact of training for wheelchair service specialists. *British Journal of Therapy and Rehabilitation, 10*(2), 60-63.

WHO (2022a). *Ageing and health*. World Health Organization. https://www.who.int/news-room/fact-sheets/detail/ageing-and-health

WHO (2022b). *Global report on assistive technology (GReAT)*. World Health Organization.

WHO (2018). *Assistive Technology*. World Health Organization. https://www.who.int/news-room/fact-sheets/detail/assistive-technology

Widehammar, C., Lidström, H., & Hermansson, L. (2019). Environmental barriers to participation and facilitators for use of three types of assistive technology devices. *Assistive Technology, 31*(2):68-76.

Wormnæs. S., & Malek, Y. A. (2004). Egyptian Speech Therapists Want More Knowledge About Augmentative and Alternative Communication. *Augmentative and Alternative Communication, 20*(1), 30-41.

Worobey, L. A., Kirby, R. L., Cowan, R. E., Dyson-Hudson, T. A., Shea, M., Heinemann, A. W., Pedersen, J. P., Hibbs, R., & Boninger, M. L. (2022). Using remote learning to teach clinicians manual wheelchair skills: a cohort study with pre- vs post-training comparisons. *Disability and Rehabilitation: Assistive Technology, 17*(7), 752-759.

Wright, L., Meredith, P., & Bennett, S. (2022). Sensory approaches in psychiatric units: Patterns and influences of use in one Australian health region. *Australian Occupational Therapy Journal, 69*(5), 559-573.

Zanatta, F., Giardini, A., Pierobon, A., D'Addario, M., & Steca, P. (2022). A systematic review on the usability of robotic and virtual reality devices in neuromotor rehabilitation: patients' and healthcare professionals' perspective. *BMC Health Services Research, 22*, 523.