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a systematic review

Brandt, Åse; Hansen, Else Marie; Christensen, Jeanette Reffstrup

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The effects of assistive technology service delivery processes and factors associated with positive outcomes – a systematic review

Åse Brandt[ab*], Else Marie Hansen[a], Jeanette Reffstrup Christensen[b]

[a]*Centre for Disability and Mental Vulnerability, The National Board of Social Services, Odense, Denmark*

[b]*The Research Initiative for Activity Studies and Occupational Therapy, Research Unit of General Practice, Department of Public Health, University of Southern Denmark, Odense, Denmark*

Corresponding author:

Åse Brandt

aabrandt@health.sdu.dk.

ORCiD: 0000-0002-1743-8426

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Abstract

Purpose: The objective of this systematic review was to investigate effects of different assistive technology service delivery processes (AT-SDPs) for people with functional limitations, including investigation of factors associated with positive outcomes.

Materials and methods: The study was registered in PROSPERO, registration number CRD42018097030. Included were quantitative studies published in peer reviewed journals: randomised controlled trials, cohort, case-control and analytical cross-sectional studies investigating effects of different AT-SDPs or factors associated with the AT-SDP and with n≥10 participants. A systematic literature search was carried out in the databases PsycINFO, CINAHL, SSCI and Medline from 1 January 2008 to 25 July 2018. Besides, four journals were hand searched. The Joanna Briggs Institute MAStARI Critical Appraisal Tools were utilised to assess the risk of bias.

Results: The search resulted in a total of 2,947 references of which 12 articles representing 10 studies were included. Five studies were experimental, two were cohort, and five were cross-sectional studies.

Conclusions: This systematic review confirms previous findings that assistive technology users should be involved in the AT-SDP in order to achieve positive outcomes. The level of evidence is, however, low, and it is not clear which of the applied methods are most effective. The review also gives some indication that new technologies could be used to improve the AT-SDP and reduce costs and that training in using the assistive devices seems to be useful. Even though some evidence of effective AT-SDP methods has been identified, more research is still needed to give valid recommendations to AT-SDP practice.

Introduction

Assistive technology is an important means for people with disability to carry out everyday-, leisure-, and work activities, and sometimes even to sleep, and to participate in societal life. The World Health Organization (WHO) has initiated the Global Cooperation on Assistive Technology (GATE), which aims to improve the access to assistive technology worldwide (1) so that "everyone in need has access to high-quality, affordable assistive products to lead a healthy, productive and dignified life" (2). Assistive technology encompasses two elements: the assistive device and related services (3); the latter often called the assistive technology service delivery process (AT-SDP). The GATE statement only mentions the assistive devices, called products, but GATE also focuses on the service element, which is considered to be an important part of the assistive technology provision (4).

The AT-SDP can be defined in several ways. A well-known North American model described by Cook & Polgar defines the AT-SDP as "any service that directly assists an individual with disability in the selection, acquisition, or use of an assistive technology device" (5). The contents of the AT-SDP have been described by different models including similar steps of the process, mostly differing regarding the degree of detail (5-7). In Europe a model developed about 25 years ago encompassing generic steps of the AT-SDP is often used, and lately the steps of the model have been included in a GATE position paper (4). The steps in the model are: 1) initiative – first contact; 2) assessment – evaluation of needs; 3) typology of the assistive technology solution – choosing the appropriate type of assistive technology; 4) selection – selecting the specific device; 5) authorisation for financing – obtaining funding; 6) delivery – getting the device to the user; 7) management and follow up – continued support. It is known that the steps of the model are applied to various extents (8), but to our knowledge so far only two reviews have investigated outcomes of the entire AT-SDP, and a meta-analysis has studied the effectiveness of a specific method for training wheelchair skills, i.e. as described in step 6, the delivery (9-11).

In 2015 Brandt et al conducted a literature review of 20 quantitative studies on methods of the AT-SDP regarding positive outcomes in terms of effectiveness, social significance, and subjective wellbeing (10) as described by Jutai et al (12). The authors found studies concerning all steps in the AT-SDP and all three types of outcomes, but the evidence was weak. The main tendencies were that user involvement in the AT-SDP, training in using the device, and the professionals' competences seemed to result in positive outcomes concerning assistive device use and user satisfaction with the device, while outcomes regarding activity and participation were less studied (10). Ranada and Lidström performed a systematic review of qualitative and quantitative

studies in 2017 focusing on user satisfaction and several other outcomes (9). They included 53 studies, found results concerning all steps of the AT-SDP and concluded that all steps seem to be important and that a client-centered approach to the AT-SDP was an important factor for user satisfaction and an effective AT-SDP. The evidence of the findings was assessed as moderate (9). In 2018 Keeler et al carried out a meta-analysis of the effectiveness of the Wheelchair Skills Training Program (WSTP) aiming at improving wheelchair users' wheelchair skills. Based on 13 articles including 581 participants the review concluded that the WSTP had a clinically meaningful effect, and that new wheelchair users profited the most. The evidence was moderate (11).

The two reviews about the entire AT-SDP found studies focusing on outcomes concerning use/non-use of and user satisfaction with the assistive devices (9, 10), and Ranada & Lidström found that everyday activity outcomes seemed to be associated with the AT-SDP (9). Use/non-use is an important outcome, since non-use means that the activity and participation problems of the person in question have not been solved, and besides, assistive devices that are not used constitute a societal waste of resources. The magnitude of non-use of assistive devices varies from 1-80% (13). User satisfaction with the device and the AT-SDP is also important, since user satisfaction is a dimension of personal well-being and has also been shown to be related to the extent of assistive device use (13). Performance of everyday activities is pivotal, since the basic aim of assistive devices is to assist people with disability in accomplishment of activities and participation in society (5) (page 2-4).

The extent and quality of research has steadily been growing, and it can be expected that more research about the AT-SDP will be available now some years after the previous reviews. Especially new effect studies can help establish a basis for recommendations on how to perform the AT-SDP in the best possible way. Hence, the objective of this systematic review was to investigate effects of different AT-SDPs for people with physical or mental functional limitations, including investigation of factors associated with positive outcomes.

Materials and methods

This systematic review was reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guideline (14) and registered in the international prospective register of systematic reviews, PROSPERO, registration number CRD42018097030.

Eligibility criteria

Types of studies:

Included studies were quantitative studies published in peer reviewed journals: randomised controlled trials (RCTs), cohort and case-control studies and analytical cross-sectional studies investigating factors associated with the AT-SDP. Excluded were qualitative studies, case studies, studies with n<10 participants, and studies that reported product development or development and description of methods and models without investigating outcomes.

Types of participants:

Community living people with physical or mental functional limitations in all ages. Excluded were school-, hospital-, institutional-, or work place settings.

Types of interventions:

Any intervention contained in the European AT-SDP model. When the intervention was assistive devices only and the outcome originated from this or when the AT-SDP was mixed with assistive device interventions, so that it could not be determined whether the outcome originated from this or the AT-SDP, the study was excluded. Also, studies where the AT-SDP mostly concerned assistive devices for measuring, supporting, training or replacing body functions (ISO-9999 group 04) were excluded.

Types of comparators:

Any type of comparator, e.g. no intervention or a different intervention.

Types of outcomes:

Activity and participation including skills, autonomy and independence, assistive device use/non-use, quality of life, satisfaction with the assistive device or the AT-SDP, comfort, safety, and goal attainment.

Information sources

A systematic literature search was carried out by a librarian in the databases PsycINFO, CINAHL, Social Sciences Citation Index (SSCI) and Medline from 1 January 2008 to 4 June 2017 and supplemented with a search until 25 July 2018, as earlier studies were expected to have been reported in the previous reviews. Besides, the three journals Assistive Technology; Disability and Rehabilitation: Assistive Technology; and Technology and Disability were hand searched for the same period, and selected reference lists including reference lists from the identified systematic

reviews were reviewed. Only articles published after year 2007 were included. No restriction concerning language was applied.

Search

The search was organised in four themes/building blocks combined with the Boolean operator AND: Person, AT-SDP, assistive technology, and outcomes with different search terms within each theme combined with OR. The search terms were adapted to each database, and an example of search terms used in Medline is displayed in the appendix.

Study selection

The identified documents were first screened on basis of title and abstract by two authors (ÅB, EMH) who divided the findings between them. In case of uncertainty the article was either included or discussed with the last author. The potentially relevant articles were then retrieved and read in full text and examined for eligibility by all authors on basis of the defined inclusion and exclusion criteria.

Data items and data collection process

Data from the included studies were extracted by ÅB and EMH in a standardised form containing information about 1) the reference, 2) population, 3) type of assistive device, 4) intervention/control or factors analysed, 5) outcome measures, and 6) effects or factors associated with effects. In case of disagreement inclusion/exclusion of the study was discussed until agreement was reached. Finally, the contents of the table were checked by JRC.

Risk of bias in individual studies

The Joanna Briggs Institute Meta-Analysis of Statistics Assessment and Review Instrument (MAStARI) Critical Appraisal Tools were utilised to assess the risk of bias and the three following checklists were used: checklists for critical assessment “of experimental studies”, “of observational cohort studies”, and “of descriptive analytical cross-sectional studies” (15, 16). The quality of the articles was regarded as good when at least 75% of the criteria were met, when 50%-74% were met it was acceptable, and when less were met the quality was regarded as low. The assessment was carried out by ÅB and JRC independently, and any disagreement was resolved by discussion

between the two authors. ÅB and JRC assessed the level of evidence by means of The Joanna Briggs Institute New JBI Levels of Evidence (17).

Synthesis of results

A narrative data synthesis was conducted as a meta-analysis was not considered relevant due to the variety of study designs and outcome measures. The synthesised results were presented according to the European AT-SDP generic model except from the step concerning authorisation, which cannot be research-based.

Results

Study selection

The search resulted in 2,947 references: PsycINFO n=745; CINAHL n=1,340; SSCI n=464; Medline n=398. After removal of duplicates, 1,978 references were left. Four articles were identified from other sources. 61 articles were read in full text after which 12 articles remained. Reasons for exclusion differed, but main reasons were that the studies did not carry out analytical analyses or that they were not about the AT-SDP. In seven articles it was not possible to determine whether the outcomes derived from the assistive devices or from the AT-SDP. See figure 1.

[Insert figure 1 about here]

Study characteristics

Study characteristics can be seen in table 1 and are described below.

[Insert table 1 about here]

Study design and level of evidence

All in all, 12 articles were included of which four, (18, 19) and (20, 21), stemmed from two studies. Five studies were experimental (18, 20, 22-24). Two of these were basic RCTs that both collected data immediately at the end of the AT-SDP. One of the studies also collected data at three months' follow-up (18) and the other after six, 22 and 58 weeks (24). The remainder three experimental studies collected data when the AT-SDP had ended. One of these was a quasi-experimental study

(20), one was a pilot RCT (22), and the last was described as a pre-post controlled study (23), but had a RCT design with random assignment to intervention or control. All five experimental studies were assessed as RCT studies. Two studies were cohort studies (19, 25), and five were cross-sectional studies (21, 26-29). Accordingly, the level of evidence (17) for four of the 12 studies was 1c (18, 22-24), for one study 1d (20), for two studies 3e (19, 25), and for the last five studies 4b (21, 26-29).

Participants

In total 1,310 persons participated in the 12 included studies. 389 participated in the five RCTs, resulting in a mean participation of 88.8 and a range of 10-116 participants. In two of the five studies diagnoses were given as stroke patients learning to use powered scooters (22) and persons with intellectual disabilities using different kind of devices such as rollators, talking books, and computer games (23). The last three studies didn't report the participants' diagnoses but provided the participants with different kinds of wheelchairs and scooters (18, 20) and devices for mobility and daily activities (24).

The two cohort studies encompassed 153 participants with a mean number of 76.5 participants in each of the two studies. The first study had only 17 participants with a mean age of 54.1. The participants suffered from different kinds of diseases such as spinal cord injury, multiple sclerosis, stroke, Parkinson's and arthritis (19). The second study had 136 participants with a mean age of 73.8, but with no specific description of the participants' diseases (25).

The five cross sectional studies included in total 768 participants resulting in a mean participation of 153.6 and a range of 48-225 participants. All the five studies either didn't report the diagnosis of the included participants or only wrote "various diagnosis". Three of the studies, on the other hand, reported on the devices that the participants needed, giving some indication of the participants' conditions. These were hearing aids and manual wheelchairs (26), hearing and mobility devices (27) and manual and powered wheelchairs (21). The last two studies just reported 'most types of devices' (28, 29).

Interventions and comparisons

Three of the five experimental studies examined the AT-SDP of different mobility devices. One of the studies tested the use of virtual reality training, as the intervention group half of the training time didn´t train the scooter driving skills by driving the scooter but by using a virtual reality device. The control group received usual training in driving the scooter (22). In the study of Schein

et al the intervention group was delivered wheeled mobility training by an occupational therapists or a physiotherapist who received guidance from an expert via a videoconferencing system, whereas the control group was delivered the training by the expert in person (20). In the last of the RCT mobility training studies, Kirby et al tested an individual wheelchair skills training program in the intervention group, where the control group received usual care, which could be no training (18). In one of the two studies that didn´t deliver mobility training, Mortenson et al compared the differences in use of daily activity devices when the caregiver in the intervention group was systematically involved in the AT-SDP, while they were not systematically involved in the control group (24). Finally, Mirza et al tested a collaborative problem-solving AT-SDP approach that included five sessions for participants with intellectual disability and their social supports against standard AT-SDP consisting of assessment of mobility, communication, and basic functional needs followed by delivery of devices (23).

The five cross-sectional studies analysed whether different types of AT-SDP interventions had a significantly higher association with selected outcomes than no AT-SDP intervention or a specific comparison. Federici et al compared assistive technology centres that had different management strategies: effectiveness focusing on problem-solving including a person-centredness approach compared to efficiency focusing on using as few resources as possible (27). Johnston et al compared AT-SDPs carried out by the user (self-assessment), by an assistive technology professional and by a collaboration between the user and the assistive technology professional (28). Martin et al investigated the user's reported levels of being informed during the AT-DSP (29), while Schein et al compared a telerehabilitation AT-SDP with a convention AT-SDP (21). Lastly, Borg et al studied several different AT-SDP factors, e.g. user preference, measurement, and having received training compared to no AT-SDP (26).

Outcomes

The outcomes were measured by different instruments measuring various dimensions of performance, activity, participation, and satisfaction.

The five experimental studies were besides one study all measuring different outcomes related to mobility devices, thus focus was on outcomes such as driving ability, wheelchair skills capacity, and wheelchair skills performance (18, 20, 22), comfort with the mobility device (22), safety issues and injuries when using the mobility device (18, 22), confidence in use (18), satisfaction with performance (18, 23), mobility related participation (18, 20, 24),

activity performance (20, 23, 24), and goal attainment (18, 23). Some of these outcomes were also used in the study by Mortenson et al but the researchers in this study also used outcomes related to caregiver assistance such as independence, reintegration to normal living and burden of the caregivers (24).

The two cohort studies were both looking into the entire AT-SDP. The study by MacGillivra et al measured outcomes of the AT-SDP as satisfaction with goal attainment (19), and the study by Sund et al measured outcomes of the AT-SDP as satisfaction with the service delivery system and time used for the entire AT-SDP (25).

The five cross-sectional studies were focusing on a few different outcomes, but all included an aspect of user satisfaction: indication of "whether the assistive technology is worth the trouble" (26), user satisfaction with assistive technology as measured by the Quebec User Evaluation of Satisfaction with Assistive Technology (QUEST 2.0) (27), satisfaction with the device (29) and satisfaction with "your evaluation and prescription process for your current wheelchair/scooter" (21). Additional outcomes were device usefulness (28), device abandonment (27), and Borg et al also included daily device use, improved activity, residual activity restrictions, residual participation restrictions, impact on others, and quality of life (26).

Risk of bias within studies

The quality of the five experimental studies differed as one was good (18), two were acceptable (23, 24) and the last two were of low quality (20, 22). The intervention allocator was only blinded in the study by Kirby et al (18) and in two of the studies the assessors were blinded (18, 24), see table 2.

The quality of one of the two cohort studies was good (25) and the other one was acceptable (19). In both studies the outcomes had been measured in a reliable and valid way, but only in the study by Sund et al we were able to identify factors and strategies that dealt with potential confounders, see table 3.

All five cross-sectional studies were of acceptable quality, and all defined clearly the inclusion criteria's, but here the similarities ended. Only with regard to two of the five studies we were able to detect that the outcomes had been measured in a reliable and valid way (20, 27), in only two studies confounding criteria were identified (26, 29) and in three studies strategies to deal with confounding was stated (26, 27, 29), see table 4.

[insert about here tables 2-4]

Synthesis of results

The results are presented in two groups according to the objectives of this systematic review.

Effects of different assistive technology service delivery processes

Five experimental studies with control groups investigated the effects of application of an AT-SDP. Three studies (18, 20, 22) concerned mobility devices, of which two investigated the effect of training powered wheelchair users and powered scooter users in driving their mobility device. Kirby et al carried out a high quality RCT where they applied a well-described training program, the Wheelchair Skills Training Program 4.1, while the control group did not get any training in driving a powered wheelchair (18). At the end of the training period, no change in wheelchair skills capacity ("can do") for either group was found, while the wheelchair skills performance ("does do") of the intervention group improved with 10.8%, but not in the control group. At three months' follow-up, however, the gain in the intervention group was not retained. In a pilot RCT Jannink et al compared powered scooter training where the control group got usual driving ability training and the intervention group had half of the training replaced with virtual reality training (22). Both groups' driving abilities increased with no difference between the two groups indicating that some of the training in driving ability maybe can be replaced by virtual reality training (22). The third study on mobility devices was a controlled study of low quality that also applied the use of newer technologies in the AT-SDP (20). The researchers compared an in-person expert-based AT-SDP with an AT-SDP where either an occupational therapist or a physiotherapist, who were not specialised in wheeled mobility and seating, carried out the process with consultancy from a wheeled mobility and seating expert via a videoconferencing system. Both the intervention group and the control group increased their functioning with a wheelchair at a clinically relevant level. The telerehabilitation AT-SDP was thus equally effective as the usual standard AT-SDP (20).

Two studies that were of acceptable quality investigated methods encompassing the entire AT-SDP concerning a mixture of devices (23, 24). Mirza et al applied a comprehensive collaborative problem-solving approach that involved participants with mild to severe intellectual disability and their social supports (23). The applied method was theoretically based upon the Competence-Environmental Press Framework (30). In addition to assistive devices, other strategies such as physical modifications, social environment changes, information access, and systems advocacy were also utilised. The AT-SDP for the control group consisted of usual assessment of mobility, communication and basic functional needs followed by delivery of device. At the end of

the process a small increase in the intervention group's activity performance of and satisfaction with their activity performance was found with no change in the control group (23). Mortenson et al applied an AT-SDP where caregivers were systematically involved in the AT-SDP in the intervention group and a usual AT-SDP was applied in the control group (24). It turned out that the caregivers were frequently involved in the usual AT-SDP as well, and there was no difference in the outcomes between the two groups at the end of the AT-SDP or at the follow-up three years later (24).

Assistive technology service delivery process factors associated with positive outcomes

Two cohort studies and five analytical cross-sectional studies investigated associations between parts of or the entire AT-SDP and positive outcomes. One of the cohort studies (19), which was a sub study of the RCT by Kirby et al (18), found an association between having received training in powered wheelchair skills in accordance with the individual Wheelchair Skills Training Program 4.1 and an increase in satisfaction with goal attainment (19). The other cohort study did not find any association between time spent on the steps in the AT-SDP of powered scooters and user satisfaction with the AT-SDP (25).

As to the cross-sectional studies Federici et al. compared two assistive technology centres management strategies and found that abandonment of hearing aids and mobility devices was lower when effectiveness strategies were applied compared to efficiency strategies (27). They also found that device users considered the quality of the AT-SDP of the effectiveness-oriented centres to be better, and furthermore, that there was an association between low satisfaction with the service delivery and with the follow-up and device abandonment (27). In another study, Johnston et al compared the AT-SDPs accomplished by the device user, an assistive technology professional or a collaboration between the device user and the professional. The result was that the device users rated their assistive device as most useful when the collaborative approach was applied (28). Martin et al found that feeling informed during the AT-SDP and user satisfaction were associated (29). The RCT by Schein et al on telerehabilitation AT-SDP (20) was supplemented with cross-sectional data on user satisfaction, showing that user satisfaction with the telerehabilitation AT-SDP of mobility devices was higher than conventional AT-SDP (21). Finally, Borg et al analysed several associations between steps in the AT-SDP of manual wheelchairs and various outcomes (26). The authors showed that there were associations between taking users' preferences into account and reduction of activity limitations and satisfaction with the wheelchair, respectively. That if the wheelchair user got training in using the wheelchair it was associated with reduction of activity

limitations and participation restrictions and an increased satisfaction with the wheelchair and quality of life. Finally, that having been measured during the AT-SDP was associated with higher satisfaction with the wheelchair in general (26).

Discussion

This article has systematically reviewed studies on effects of different AT-SDPs and AT-SDP factors associated with outcomes of AT-SDPs published in years 2008-2018. In all 12 articles representing 10 studies were identified. Eight studies concerned aspects of the entire AT-SDP (20, 21, 24-29), one of which also dealt with specific steps of the AT-SDP (26), and the remainder two studies investigated effects of training the user in using their device (18, 19, 22). Seven studies have been included in previous reviews. Three of the studies (26, 27, 29) were also included in the review by Brandt et al (10) and the systematic review by Ranada & Lidström (9), one (23) in Brandt et al (10), one (25) in Ranada & Lidström (9) and two (18, 19) in the meta-analysis by Keeler et al. (11). Thus, contrary to expectations, only five new articles (20-22, 24, 28) representing three studies were identified.

Comparison with previous systematic reviews

Textbooks and other literature about the AT-SDP has for many years emphasised the importance of user involvement in the process, with Scherer and colleagues' continuous development of the AT-SDP as a main driver (31-33), but also other approaches have been developed, for instance based on occupational therapy theory (5, 34, 35). The previous literature reviews has found empirical support for the necessity of user involvement in the AT-SDP in order to achieve positive outcomes (9, 10). This was also confirmed by five studies in the present systematic review (23, 26-29), but only one of the studies in the present review was not included in the previous reviews (28). The level of evidence was found to be low in the previous systematic review, which was also the case for the present systematic review.

The outcomes differed among the identified studies: increase of activity performance and satisfaction with their activity performance (23), that the users found that their device was useful (28), more improved activity (26), decrease of activity limitation (26), lower device abandonment, higher user satisfaction with the device (26, 27, 29) and higher user satisfaction with the AT-SDP (27). The operationalisation and degree of user involvement in the AT-SDP also varied: Mirza et al applied a comprehensive theory-driven and user-directed collaboration problem-

solving AT-SDP approach involving users with intellectual disability and their social network in the entire AT-SDP (23). Federici et al operationalised user involvement as a part of an effectiveness-oriented assistive technology centre management strategy described as having a clear and user centred approach and a well-defined follow-up strategy based on an ideal user-driven model for the assistive technology delivery process (27), and Johnston et al evaluated a specific user-driven program where users could self-assess and select assistive devices (28). Martin et al understood user participation in the AT-SDP as the users' feeling of being informed during the AT-SDP (29), and Borg operationalised user involvement as user preference of type of device, measurement of the users, and training of the users in using their device (26). As methods of user involvement and outcomes thus differed among the studies, and it is not clear in which way the users should be involved; is it for instance enough just to ask the user about preferences or will the results be improved by a user-driven AT-SDP? Given that only one study about user involvement was experimental and four studies were cross-sectional, the level of evidence is low, and experimental studies and cost-effectiveness studies are still needed. Yet, the different approaches all rendered positive outcomes supporting the theoretical literature and qualitative studies about user involvement being basic in the AT-SDP (9, 33). In addition, collaboration between patients – in the present study assistive device users – and professionals is recommended in the literature about evidence-based interventions rendering further theoretical support to user involvement (36).

Training in assistive device use was found to render positive outcomes in the three previous reviews, where Brandt et al (10) and Ranada & Lidström (9) found that the body of evidence was weak, while Keeler et al (11) found moderate evidence for application of the Wheelchair Skills Training Program, especially for new users. The present review identified four articles representing three studies investigating outcomes of training in wheeled mobility device use (18, 19, 22, 26). One of these articles (26) was included in the previous reviews by Brandt et al (10) and Ranada & Lidström (9) and two articles, representing one study (18, 19), in the metanalysis by Keeler et al (11). All four articles showed positive outcomes in some respects at the end of training: increased driving ability in the real world and virtual reality world (22), increased wheelchair skills performance, high goal attainment, high satisfaction with training (18), increased satisfaction with goal attainment (19). Borg et al. also found that having received training was associated with less activity limitations, less participation restrictions, more satisfaction with the device, and more improved quality of life (26). Kirby et al. found, however, that the increased wheelchair skills performance was not retained at three months' follow-up (18), while MacGillivray found that the

satisfaction with goal attainment was (19). The training methods varied from a highly structured and validated training method (18, 19) in an artificial surrounding to training methods in real world and virtual reality surroundings without further specification of the training methods (22) to just "having received training" without any specification (26). Due to the various methods applied, the varying outcomes, and that the quality of only one study was good, there is only a weak indication in the present systematic review that training in wheeled mobility device use should be carried out. Consequently, there is still need for more research on effective training methods and the extent and dose of training for which user groups. Until more knowledge is available, assistive technology professionals need to use their clinical experience and reasoning to assess each user's need for training in device use. In addition, there is a need to investigate cost-effectiveness of different kinds of training.

Three articles representing two studies that utilised new technologies in the AT-SDP have not been included in the previous reviews (20-22). Jannink et al replaced parts of conventional real-world training in scooter use with virtual reality training (22), and Schein used videoconference expert support in the wheeling and seating AT-SDP (20, 21). Both studies found that the use of the new technologies was as effective as conventional methods. The virtual reality training saved time for the assistive technology professional (22), and the videoconferencing system meant that travelling time could be reduced, and that more device users could receive relevant expertise in the AT-SDP (20). Even though the studies did not perform an economic analysis and they were of low quality, the interventions were probably cost-effective. The use of new technologies in the AT-SDP appears to be promising as it has been in other areas of health care, for instance, artificial intelligence used in diagnostics and robots for operations. New developments are especially needed in the light of the world-wide increase in the number of older people with functional limitations (37) who will need assistive technology, why more studies on the use of new technologies in the AT-SDP should be carried out in order to save resources and assist more device users while the quality of the AT-SDP is still maintained.

Limitations

Even though a comprehensive search was carried out, which resulted in many articles, we cannot be certain to have identified all relevant articles. Especially, articles about associations between AT-SDP factors and outcomes may be difficult to locate as these associations are often not evident in titles and sometimes not even in the abstract.

The field of assistive technology is broad encompassing many different types of devices, and the users have many different functional limitations resulting in the need for a great variety in the contents of the AT-SDP, mainly when it comes to the specific steps of the AT-SDP. This requires detailed search terms for each step and for each type of assistive device, which is not possible to include in one systematic review. For instance, we did not identify all the articles in the meta-analysis of one specific training method by Keeler et al (11). Yet, we believe that most central search terms for the overall AT-SDP were included, and consequently the overall AT-SDP can be regarded as the focus of the present systematic review.

Only few of the studies had a high level of evidence combined with a good quality of the studies indicating that the results of the present systematic review are only indicative.

Application and relevance of findings to stakeholders

User involvement operationalised as collaboration between the device users and the assistive technology professionals is important in order to achieve positive outcomes and should be implemented at an organisational level (27), even though this systematic review cannot identify whether any method of user involvement is superior to other methods. Training of the users in using their devices is probably useful, but since no specific methods nor extent or dose can be recommended, the assistive technology professionals need to use their clinical experience and reasoning to assess each user's needs.

Since the evidence level of the identified studies, that do not cover all steps of the AT-SDP, is low and only few newer studies have been performed, there is still a need for researchers to investigate the effectiveness and cost-effectiveness of different AT-SDP approaches and methods to be used in the specific steps of the AT-SDP for different types of assistive devices and device user groups. A specific focus could be on effectiveness of using new technologies in the AT-SDP from an organisational as well as from a device user perspective.

Generalisation

Most studies originated from North America, fewer from Europe, and one from Bangladesh. Assistive technology provision and therefore also the AT-SDP differs between countries why the studied methods and outcomes could be expected to differ between countries. The study by Borg et al carried out in Bangladesh could particularly be expected to differ from the remainder studies, since Bangladesh is a developing country with government provision of about 1% of the assistive

devices (38), while for instance in the Nordic welfare countries getting an assistive device is a human right and is included in the national legislation (39). Still, the outcomes of the study in Bangladesh (26) tend to follow the same lines as the other studies despite different organisation of the assistive technology provision and the conclusions seem to be generalisable across countries. Due to the limited number of studies this conclusion is, however, only tentative.

Even though most studies concerned the AT-SDP for wheeled mobility devices, the results of the studies on the overall AT-SDP can probably be generalised to other types of devices, while the results of studies on training in the use of specific devices (18, 19, 22, 26) may not be generalisable as shown by Borg et al who found different outcomes of training in the use of hearing aids and wheelchairs, even though positive outcomes of training were found for both groups (26).

No studies on the AT-SDP for children were identified with the youngest participant being 15 years of age. The findings thus do not apply to the AT-SDP for children.

Conclusion

This systematic review identified 12 articles, representing 10 studies published within the last 11 years. Only three of the studies have not been included in previous reviews. In line with textbooks, qualitative research, and literature on evidence-based medicine the review has found that assistive technology users should be involved in the AT-SDP in order to achieve positive outcomes. Based on the different methods applied and different outcomes, it is, however, not clear in which way the users should be involved. Furthermore, as the level of evidence is low, experimental studies comparing different methods of user involvement are needed. Likewise, there is low level of evidence that assistive technology users should receive training in using their device, and methods, dose and extent for different types of devices and user groups are still unknown.This requires more research and that the assistive technology professionals use their clinical experience and reasoning to determine need and methods for training. There is some indication that new technologies could be used to improve the AT-SDP and reduce costs, and more research in this is warranted. In fact, the present review has shown a surprising and alarming scarcity of AT-SDP effectiveness studies, both at an overall and at specific levels. Such studies supplemented with cost-effectiveness studies are required in addition to theoretical literature and qualitative research in order to give valid recommendations to the assistive technology practice.

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Disclosure of interest

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Appendix: The 2008 – 2017 MEDLINE search

#5: All blocks combined with AND	**398**	#4 AND #3 AND #2 AND #1 *Indexes=MEDLINE Timespan=2008-2017*
# 4: Outcomes	**4,161,442**	**TOPIC:** ((("activity") OR "activities") OR "non-use") OR "non-users") OR "non-uses") OR "non use") OR "non users") OR "non uses") OR "nonuse") OR "nonusers") OR "nonuses") OR "participation") OR "occupation") OR "occupations") OR "mobility") OR "self-care") OR "selfcare") OR "user satisfaction") OR "user satisfactions") OR "satisfaction") OR "satisfactions") OR "independence") OR "autonomy") OR "abandonment" OG "consumer satisfaction") OR "consumer satisfactions") OR "effect") OR "effects") OR "patient reported outcome measures") OR "outcome") OR "outcomes") OR "resource saving") OR "resource savings") OR "cost-effective") OR "cost effective") OR "costeffective") OR "cost-effectiveness") OR "cost effectiveness") OR "costeffectiveness") OR "cost utility") OR "cost utilities") OR "cost-benefit") OR "cost benefit") OR "costbenefit") OR "cost-benefits") OR "cost benefits") OR "costbenefits") OR "ADL") OR "activities of daily living") *OR* ((((((((((**TOPIC:** ("occupations" OR "self care") *OR* (**TOPIC:** ("personal satisfaction") *OR* **MeSH HEADING:** (Personal Satisfaction))) *OR* (**TOPIC:** ("patient satisfaction") *OR* **MeSH HEADING:** (Patient Satisfaction))) *OR* (**TOPIC:** ("consumer behavior") *OR* **MeSH HEADING:** (Consumer Behavior))) *OR* (**TOPIC:** ("quality of life") *OR* **MeSH HEADING:** (Personal Satisfaction) *OR* **MeSH HEADING:** (Quality of Life))) *OR* (**TOPIC:** ("personal autonomy") *OR* **MeSH HEADING:** (Personal Autonomy))) *OR* (**TOPIC:** ("treatment outcome") *OR* **MeSH HEADING:** (Treatment Outcome))) *OR* (**TOPIC:** ("outcome and process assessment") *OR* **MeSH HEADING:** ((Outcome and Process Assessment (Health

		Care))))) *OR* (**TOPIC:** ("economics") *OR* **MeSH HEADING:** (Economics))) *OR* (**TOPIC:** ("cost savings") *OR* **MeSH HEADING:** (Cost Savings))) *OR* (**TOPIC:** ("cost-benefit analysis") *OR* **MeSH HEADING:** (Cost-Benefit Analysis))) *Indexes=MEDLINE Timespan=2008-2017*
# 3: Technology	**3,170**	**TOPIC:** ((((((((((((((((((((((("assistive technology") OR "assistive technologies") OR "assistive device") OR "assistive devices") OR "assistive product") OR "assistive products") OR "assistive technology device") OR "assistive technology devices") OR "assistive technological device") OR "assistive technological devices") OR "self-help device") OR "self-help devices") OR "self help device") OR "self help devices") OR "selfhelp device") OR "selfhelp devices") OR "assistive technology product") OR "assistive technology products") OR "assistive technological product") OR "assistive technological products") OR "technical aid") OR "technical aids") OR "adaptive equipment") OR "adaptive equipments") OR "assistive equipment") OR "assistive equipments") *OR* (**TOPIC:** ("self-help devices") *OR* **MeSH HEADING:** (Self-Help Devices)) *Indexes=MEDLINE Timespan=2008-2017*
# 2: Service delivery	**2,392,452**	((((**TOPIC:** ((("service delivery system") OR "service delivery process") OR "service delivery model") OR "service delivery models") OR "delivery system") OR "delivery systems") OR "assistive technology service") OR "assistive technology services") OR "assistive technological service") OR "assistive technological services") OR "device acquisition") OR "device acquisitions") OR "procurement process") OR "procurement processes") OR "provision") OR "prescription") OR "prescriptions") OR "implementation") OR "intervention") OR "referral") OR "referrals") OR "assessment") OR "assessments") OR "needs assessments") OR "needs evaluation") OR "needs

		evaluations") OR "evaluation") OR "evaluations") OR "goal setting") OR "goal settings") OR "user involvement") OR "user involvements") OR "user influence") OR "user influences") OR "client centered") OR "client centred") OR "selections") OR "customization") OR "customizations") OR "customisation") OR "customisations") OR "fitting") OR "fittings") OR "train") OR "training") OR "instruction") OR "instructions") OR "delivery") OR "deliveries") OR "follow-up") OR "follow up") OR "followup") OR "repair") *OR* (**TOPIC:** ("referral and consultation") *OR* **MeSH HEADING:** ((Referral and Consultation)))) *OR* (**TOPIC:** ("needs assessment") *OR* **MeSH HEADING:** (Needs Assessment))) *OR* (**TOPIC:** ("education") *OR* **MeSH HEADING:** (Educational Status) *OR* **MeSH HEADINGS:** (/education) *OR* **MeSH HEADING:** (Teaching) *OR* **MeSH HEADING:** (Educational Status) *OR* **MeSH HEADING:** (Education))) *OR* (**TOPIC:** ("follow-up studies") *OR* **MeSH HEADING:** (Follow-Up Studies))) *OR* (**TOPIC:** ("maintenance") *OR* **MeSH HEADING:** (Maintenance)) *Indexes=MEDLINE Timespan=2008-2017*
# 1: Population	**95,583**	(**TOPIC:** ((((((((((("people with impairment") OR "disabled people") OR "impaired people") OR "old people") OR "older people") OR "elder people") OR "elderly people") OR "consumer") OR "consumers") OR "device user") OR "device users") OR "client") OR "clients") *OR* (**TOPIC:** ("people with disability") *OR* **MeSH HEADING:** (Disabled Persons))) *OR* (**TOPIC:** ("people with disabilities") *OR* **MeSH HEADING:** (Disabled Persons)) *Indexes=MEDLINE Timespan=2008-2017*

Table 1. Description of the included studies

Reference (First author, year, country (number in reference list))	**Population** (Number, age, gender, diagnosis)	**Type of assistive device**	**Study design**	**Intervention/control or Factors analysed**	**Outcome measure**	**Effects or factors associated with outcomes**
Borg, 2012, Bangladesh (26)	Hearing aid users: n=136, mean age 26.5 years (range 15-55), 62.5% men. Manual wheelchair users: n=149, median age 31.8 years (range 15-55 years), 73.8% men. Diagnosis: Not reported.	Hearing aids and manual wheelchair	Cross-sectional	Analysis of whether AT-SDP factors (user preference, measurement of hearing or body dimensions, received training about use and maintenance of hearing aid or wheelchair, training in pressure sore prevention) were associated with outcomes (daily device use, improved activity, residual activity limitations, satisfaction, residual participation restrictions, impact on others, quality of life).	International Outcome Inventory for Hearing Aids (IOI-HA) and for wheelchairs an adapted version of the IOI-HA. Scores 1-5 where "5" represents the most favourable outcome.	AT-SDP factors associated with Hearing aid outcomes: - Been asked: less activity limitations (OR 2.96, 95% Cl 1.20-7.34) - Measured: no association - Trained: more improved activity (OR 2.66, 95% Cl 1.20-5.91) and less participation restrictions (OR 3.72, 95% Cl 1.68-8.22) Wheelchair outcomes associated with AT-SDP factors: - Been asked: less activity limitations (OR 2.46, 95% Cl 1.04-5.82) and more satisfaction (OR 0.36, 95% Cl 0.13-0.99) - Measured: more satisfaction (OR 3.91, 95% Cl 1.50-10.2) - Trained: less activity restrictions (OR 2.47, 95% Cl 1.02-5.94), more

						satisfaction (OR 7.79, 95% Cl 3.00-20.2), less participation restrictions (OR 4.27, 95% Cl 1.63-11.2), and more improved quality of life (OR 2.55, 95% Cl 1.18-5.51).
Federici, 2014, Italy (27)	N=201. Mean age 77.25. Diagnosis: not reported.	Hearing devices (36.65%) and mobility devices (63.35%).	Mixed methods, cohort study. Only quantitative cross-sectional survey presented here.	Based on Scherer and Federicis "Ideal model of assistive technology delivery process", four Italian assistive technology centres were categorised into efficiency (use as few resources as possible) oriented and effectiveness (problem solving and person-centredness) oriented. Associations between type of centre and user satisfaction and assistive device abandonment, respectively, were analysed. It was analysed whether 16 other factors were associated with abandonment.	The Quebec User Evaluation of Satisfaction with Assistive Technology (version QUEST 2.0). 8 items about satisfaction with the device and 4 with the AT-SDP. Scores 1-5 where "5" represents "very satisfied". Abandonment and reasons for this were investigated by a study specific questionnaire based on Phillips and Zhao's research.	User satisfaction was higher in the effectiveness-oriented centres than in the efficiency-oriented centres (p=0.001), especially regarding the quality of the service delivery (p=0.021) and the quality of professional service (p=0.01). It was less likely that the devices were abandoned if an effectiveness-oriented centre had been attended (12.26%) compared to an efficiency-oriented centre (24.34%) (p=0.012). Low satisfaction with service delivery was associated with device abandonment (p=0.001) Low satisfaction with follow-up was associated with abandonment (p=0.005)
Jannink, 2008, The Netherlands (22)	N=10. IG n=5, mean age 58 years, CG n=5,	Powered scooter	Pilot RCT Data collection at the end of training.	IG and CG got 30 minutes training in driving powered scooter 2 times a week for 5 weeks. Half of the time the IG got conventional training and the other half of the time	Driving ability in the real world was measured by means of the Functional Evaluation Rating Scale (FERS). Score	After training IG scored 7.2% progression and the CG 6.9%. No statistically significant difference and no difference were experienced in driving ability, safety and comfort.

	mean years of age 61.8. Gender not reported. Diagnosis: stroke.			virtual reality training consisting of three levels with increasing complexity. The CG only got conventional training, which was not described further.	12-48, higher score represents poorer ability.	
Johnston, 2014, Canada (28)	N=225. 48% men, mean 51 years of age. 52% women, mean 53.3 years of age. Diagnosis: not reported.	Most types of devices	Cross-sectional	The association between self-assessment / professional assessment / collaborative device assessment according to a described participation program, and the devices' usefulness as judged by the participants. Assessment is equal to the service delivery process.	Study specific survey instrument.	The devices that the participants ranked as the most useful were associated with collaborative assessment of need for a device (p=0.001) compared to self-assessment or professional assessment.
Kirby, 2015, Canada (18)	N=116. Experienced powered wheelchair users. IG n=54, mean age 53.8 years, 70.4% men. CG n=62, mean age 53.1 years, 56.5% men.	Powered wheelchairs	RCT Data collection at the end of training and at 3 months' follow-up.	IG: up to 5 30-minute individual Wheelchair Skills Training Program 4.1 training sessions at a targeted frequency of 1–2 sessions per week. CG: usual care, which could be no training.	The Questionnaire version of the Wheelchair Skills Test (WST-Q 4.1). Pass/fail scores for 32 skills and total percentage scores for capacity ("can do") and performance ("does do"). Goal Achievement—Training goals by means of a study specific instrument. Goal-Attainment Scores (GAS) were calculated in %.	After training had ended: no difference between groups in wheelchair skills capacity; the wheelchair skills performance improved with 10.8% in the IG but did not improve in the CG (p=0.016). The improvement in the IG was not retained 3 months after training had ended. No clinically significant difference between the groups in injury rate and no statistically significant differences in wheelchair confidence or mobility-related participation.

	Diagnosis: not reported.				Satisfaction with training. 6 study specific yes/no questions. Injury Rate. Study specific question about number of injuries. The Wheelchair Use Confidence Scale for Power Wheelchair Users (WheelCon). A 59 item self-report instrument resulting in a 0–100 score. Higher scores represent higher confidence with wheelchair use. As an indicator of mobility-related participation a component of the Life Space Assessment (LSA) was used. Scores of 0–5, higher scores represent better functioning.	The intervention group had a goal attainment of 92.8% after training had ended and 92% found the training useful.
MacGillivray, 2017, Canada (19)	N=17. Mean age 54.1 years, 47.1% men. Experienced powered wheelchair users (mean months of	Powered wheelchairs	Cohort study. Subgroup study of Kirby 2015 Data collection at the end of training and	Training of personal goals with powered wheelchair driving: up to 5 30-minute individual Wheelchair Skills Training Program 4.1 training sessions at a targeted frequency of 1–2 sessions per week.	Satisfaction with goal attainment measured by the Wheelchair Outcome Measure (WhOM). Score of 0-10 where 10 represents highest satisfaction with ability to perform the goal in question.	Satisfaction with goal attainment increased from 4.7 at baseline to 8.0 after training had ended and to 8.4 three months after training had ended. Most goals concerned the broader category “manoeuvring”.

	experience 67). Diagnosis: SCI (n=5), Stroke (n=2), Parkinson's (n=1), MS (n=2), Arthritis (n=1), Other (n=6)		at 3-months' follow-up			
Martin, 2011, USA (29)	N=145. Age 17-70 years (mean 45.9). 55.3 men. Various diagnoses.	Most types of devices	Cross-sectional	Association between reported level of being informed and satisfaction with the device. A model for analysis of factors contributing to feeling informed and to be satisfied with the device was created and data analysed, including relationship between feeling informed and being satisfied.	Study specific instrument reviewed by an expert panel.	Feeling informed and being satisfied with the device were associated ($F(3278)=27.79$, $p<0.0001$). Device type and funding source were not associated with either feeling informed or being satisfied with the device. Proper assessment was nearly significantly associated with satisfaction with the device ($p=0.07$).
Mirza, 2009, USA (23)	N=75 (IG: n=30, CG: n=45), mean age 51.3/47.8 years, 63.3%/62.2% men. Intellectual disability:	Various types of device, e.g. rollator; talking books; computer and computer games,	RCT Data collection at end of the problem-solving process.	A consumer-directed, collaborative problem-solving approach theoretically based upon the Competence-Environmental Press Framework. The intervention included 5 sessions for the participants and their social supports, each lasting up to 2 hours, held over 3 months' time with focus on the participant's current living situation and	The Canadian Occupational Performance Measure (COPM): - Number of problem areas related to community living and participation	Each group identified a mean of 2.2 activity problems. At baseline there was no difference between the two groups in activity performance (IG: mean 2.37 (SD 1.1), CG: mean 2.53 (SD 1.3) and satisfaction with performance (IG: mean 2.4 (SD 1.3), CG: mean 2.5 (SD 1.4)). The activity performance (IG: mean 0.8 (SD 2.5),

	34.7% mild, 29.3% moderate, 36.0% severe level.			neighbourhood. 4 sessions were used to identify issues and subsequent goals and to address these issues through environmental strategies (physical modifications, technology, social environment changes, information access, systems advocacy, etc.). In session 5, a disability advocate worked with the team to strategise disability-related information, resources and networks. Standard assistive technology services (control): Assessment of mobility, communication and basic functional needs followed by delivery of device.	- Activity Performance. Score 1-10, where 10 represents the highest score - Satisfaction with activity performance Score 1-10, where 10 represents the highest score.	CG: mean -0.1 (SD 1.6), difference p=0.018) and satisfaction with activity performance (IG: mean 0.6 (SD 2.6), CG: mean -0.2 (SD 1.9, difference p=0.006) improved significantly for the IG. Strategies like assistive devices, physical modifications, task organisation and time management were used more to address basic self-care goals, while systems level advocacy and action followed by assistive devices were the strategies of choice for addressing participation／environmental／systems level goals.
Mortenson, 2018, Canada (40)	N=90 (IG n=44, CG n=46), mean age 74.5/75.45 years, 43.2%/47.8% men. Various diagnoses.	Devices for mobility or daily activities.	RCT Data collection at baseline and at 6, 22, and 58 weeks follow-up	IG: Systematic inclusion of the caregiver in the assistive technology intervention. CG: Caregiver was not systematically included in the assistive technology intervention.	Assistive technology users: *Primary outcome measure:* 13 items assessing mobility and performance of activities of daily living (ADL) drawn from two subscales of the revised version of the Functional Autonomy Measurement System (SMAF). *Secondary outcome measures:* - The SMAF IADL	Caregivers' involvement did not differ as much as expected between the two groups, mainly because they usually were involved in usual practice. The IG received more assistive devices (p=0.01) and had a significantly higher percentage of problematic activities targeted by the provision of assistive devices compared to the CG (p=0.006). No difference between outcomes in the two groups was found: - IADL (SMAF IADL) and independence (SR-FIM) over time.

					- The Self-Reported Functional Independence Measure (SR-FIM) - The Reintegration to Normal Living Index (RNLI). Family caregivers: *Primary outcome measure:* The Caregiver Assistive Technology Outcomes Measure (CATOM), items 1-14. *Secondary outcome measures:* - CATOM, items 15-18 - European Quality of Life descriptive system (EQ-5D DS) - European Quality of Life visual analogue scale (EQ-5D VAS).	- Significant declines over time in daily activity- and mobility-related functional autonomy (SMAF ADL & mobility). - Reintegration (RNLI) improved over time - Caregivers had significant reductions in burden scores over time Correlation between changes in AT users' functional autonomy (SMAF ADL & mobility) were significantly correlated with changes in caregivers' activity-specific burden (CATOM 1-14) for the IG at the two first follow-ups and not for the CG. At the third follow-up there was a correlation for the CG and not for the IG.
Schein, 2010a, USA (20)	N=98. IG n=48, mean age 54.9 years, 27.5% men. CG n=50, mean age 50.3	Manual wheelchairs, powered wheelchairs, powered scooters	Quasi experimental study. Group allocation by centre. Data collection at	IG: got wheeled mobility and seating assessment by a generalist occupational and/or physical therapy practitioner with consultancy from a wheeled mobility and seating expert via a videoconferencing system. CG: got usual in person assessment by a wheeled mobility and seating expert.	User function related to wheelchair/scooter use was measured by the Functioning Everyday with a Wheelchair scale (FEW). 10 items, score 1-6, where "6" represents the best functioning.	Both groups' functioning concerning mobility device use was improved with at least 1.85, the clinically significant difference value. The tele rehabilitation assessment was equally effective as the in-person assessment, except from one item about

	years, 54% men. Various diagnoses.		the end of the process.			transportation where the CG scored better.
Schein, 2010b, USA (21)	N=48: the intervention group from Schein 2010a. Mean age 54.9 years, 27.5% men. Various diagnoses.	Manual wheelchairs, powered wheelchairs, powered scooters	Cross-sectional. Part of Schein 2010a	Study participants' satisfaction with telerehabilitation evaluation and prescription for wheeled mobility and seating was evaluated by comparing this with the evaluation and prescription that had taken place before the telerehabilitation evaluation and prescription	Study specific instrument: Satisfaction score 1-5, where "5" represents "very satisfied".	There was a high level of satisfaction with telerehabilitation Satisfaction with earlier evaluation mean 2.73, with telerehabilitation mean 4.98, $p<0.05$ Satisfaction with earlier prescription mean 2.81, with telerehabilitation mean 4.98, $p<0.05$
Sund, 2013, Norway and Denmark (25)	N=136. Norway n=86, Denmark n=50, mean age 73.8 years, 52% men. Diagnosis: not reported.	Powered scooters	Cohort study comparing different service delivery systems Data collection at follow-up 49.4 SD 49.4 days after the end of the AT-SDP	Two service delivery systems were compared: One having assistive technology centres and powered scooters free of charge (Norway) and another having a system with no assistive technology centres and partly user payment for the scooter (Denmark) in terms of time use for the AT-SDP and whether time use was associated with user satisfaction with the AT-SDP.	Time use was recorded by means of a study specific instrument. Satisfaction with the AT-SDP was measured with the "Satisfaction with Service Delivery System" (SATS) instrument with a score 1-5 and don't know. "5" represents "very satisfied".	Time use differed for the entire AT-SDP with Norway using a median of 205 minutes and Denmark a median of 399 minutes, $p<0.001$. In Denmark, more time was used for assessment ($p<0,001$) and administration ($p<0.001$) while Norway spent more time on follow-up services ($p<0.001$). There was no association between time spent on the different steps of the service delivery process and user satisfaction.

Abbreviations:

ADL: Activities of Daily Living; AT-SDP: Assistive technology service delivery process; CATOM: The Caregiver Assistive Technology Outcomes Measure; CG: Control group; CI: confidence interval; EQ-5D DS: European Quality of Life descriptive system; EQ-5D VAS: European Quality of Life visual analogue scale; FERS: Functional Evaluation Rating Scale;

FEW: Functioning Everyday with a Wheelchair scale; GAS: Goal-Attainment Scores, IADL: Instrumental Activities of Daily Living; IG: Intervention group; IOI-HA: Inventory for Hearing Aids; LSA: Life Space Assessment; n: Numbers; NR: Not reported; OR: Odds Ratio; OT: Occupational therapist; p: P-value; PT: Physical therapist; QUEST: The Quebec User Evaluation of Satisfaction with Assistive Technology; RCT: Randomised controlled trial; RNLI: The Reintegration to Normal Living Index; SATS: Satisfaction with Service Delivery System; SD: Standard Division; SMAF: Functional Autonomy Measurement System; SR-FIM: The Self-Reported Functional Independence Measure; WhOM: Wheelchair Outcome Measure; WST: Wheelchair Skills Test

Table 2. Critical assessment of experimental studies

Citation (First author, year of publication, (number in reference list))	Q1 Random Alloca-tion	Q2 Con-cealed alloca-tion	Q3 Groups compa-rable at baseline	Q4 Partici-pants blinded	Q5 Alloca-tor blinded	Q6 Assess-ors blinded	Q7 Groups treated equally	Q8 Follow-up com-plete	Q9 Partici-pants analysed in original group	Q10 Outcom es meas-ured the same way for all groups	Q11 Outcom es meas-ured reliably	Q12 Appro-priate Statisti-cal analyses	Q13 Trial design	Total
Jannink, 2008 (22)	U	U	N	U	U	N	Y	Y	Y	Y	U	U	N	4/13
Kirby, 2015 (18)	Y	Y	Y	U	Y	Y	Y	N	Y	Y	Y	Y	Y	11/13
Mirza, 2009 (23)	Y	Y	Y	N	N	U	Y	Y	N	Y	U	Y	Y	8/13
Mortenson, 2018 (40)	Y	Y	Y	N	N	Y	Y	N	N	Y	U	Y	Y	8/13
Schein, 2010a (20)	N	N	N	U	N	N	Y	N	N	Y	U	Y	Y	4/13

Y: Yes; N: No; U: Unclear; NA: Not Applicable

Table 3. Critical assessment of observational cohort studies

Citation (First author, year of publication, (number in reference list))	Q1 Groups similar from same popula-tion	Q2 Expo-sures measured similarly	Q3 Exposure measured in a reliable and valid way	Q4 Con-founding factors identified	Q5 Strate-gies to deal with con-founding stated	Q6 Partici-pants free of outcomes	Q7 Out-comes measured in a reliable and valid way	Q8 Appro-priate follow-up time	Q9 Complete follow-up	Q10 Incom-plete follow-up strategies used	Q11 Appro-priate statistical analysis	Total
MacGillivray, 2017 (19)	Y	Y	U	N	NA	U	Y	Y	Y	NA	Y	6/11
Sund, 2013 (25)	Y	Y	Y	Y	Y	Y	Y	Y	Y	NA	Y	10/11

Y: Yes; N: No; U: Unclear; NA: Not Applicable

Table 4. Critical assessment of descriptive analytical cross-sectional studies

Citation (First author, year of publication, (number in reference list))	Q1 Clearly defined inclusion criteria	Q2 Subjects and setting described in detail	Q3 Exposure measured in a reliable and valid way	Q4 Objective standard criteria for measurement	Q5 Confounding criteria identified	Q6 Strategies to deal with confounding stated	Q7 Outcomes Measure in a reliable and valid way	Q8 Appropriate statistical analysis	Total
Borg, 2012 (26)	Y	Y	N	NA	Y	Y	N	Y	5/8
Federici, 2014 (27)	Y	N	Y	Y	N	Y	Y	Y	6/8
Johnston, 2014 (28)	Y	Y	N	Y	N	NA	N	Y	4/8
Martin, 2011 (29)	Y	Y	N	Y	Y	Y	N	Y	6/8
Schein, 2010b (21)	Y	Y	Y	Y	N	NA	Y	Y	6/8

Y: Yes; N: No; U: Unclear; NA: Not Applicable

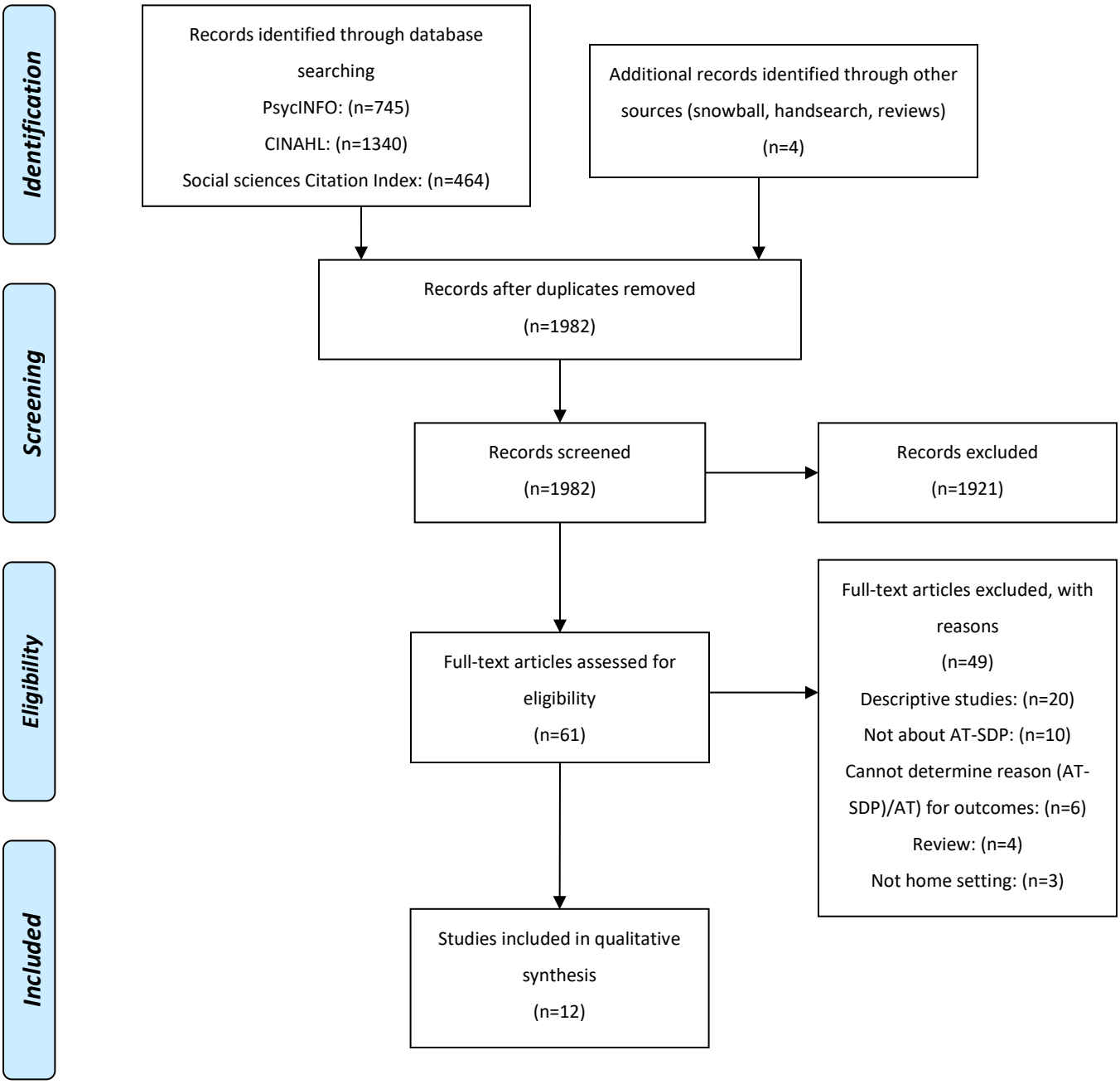

Figure 1. Flowchart showing the search and selection of studies

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). *P*referred *R*eporting *I*tems for *S*ystematic Reviews and *M*eta-*A*nalyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

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