Praxis Care

QUEEN'S UNIVERSITY BELFAST

A RAPID EVIDENCE REVIEW

Digital interventions in social care: supporting service users

February 2024

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This report can be cited as:

McCartan, C., Davidson, G., Best, P., Webb, P. (2024) Digital interventions in social care: supporting service users. A rapid evidence review. Belfast: Praxis Care and Queen's University Belfast.

Glossary

ABA	Applied Behaviour Analysis
ASD	Autism Spectrum Disorder
BMI	Body Mass Index
CBT	Cognitive Behavioural Therapy
K	Number of studies included in a review
MDD	Major Depressive Disorder
N	Number of participants
PTSD	Post-Traumatic Stress Disorder
RCT	Randomised Controlled Trial
SMI	Severe mental illness; severe and enduring mental illness e.g. bipolar disorder, psychosis, schizophrenia, personality disorder
VR	Virtual Reality

Contents

1 Background

The aims of this study are to explore evidence from systematic evidence reviews to establish:

(a) What technology is available?

(b) What are the most effective uses of technology?

(c) What are the facilitators and barriers to the implementation of this technology?

(d) Are there any ethical issues about the use of this technology?

(e) What further research is needed in this area?

2 Methods

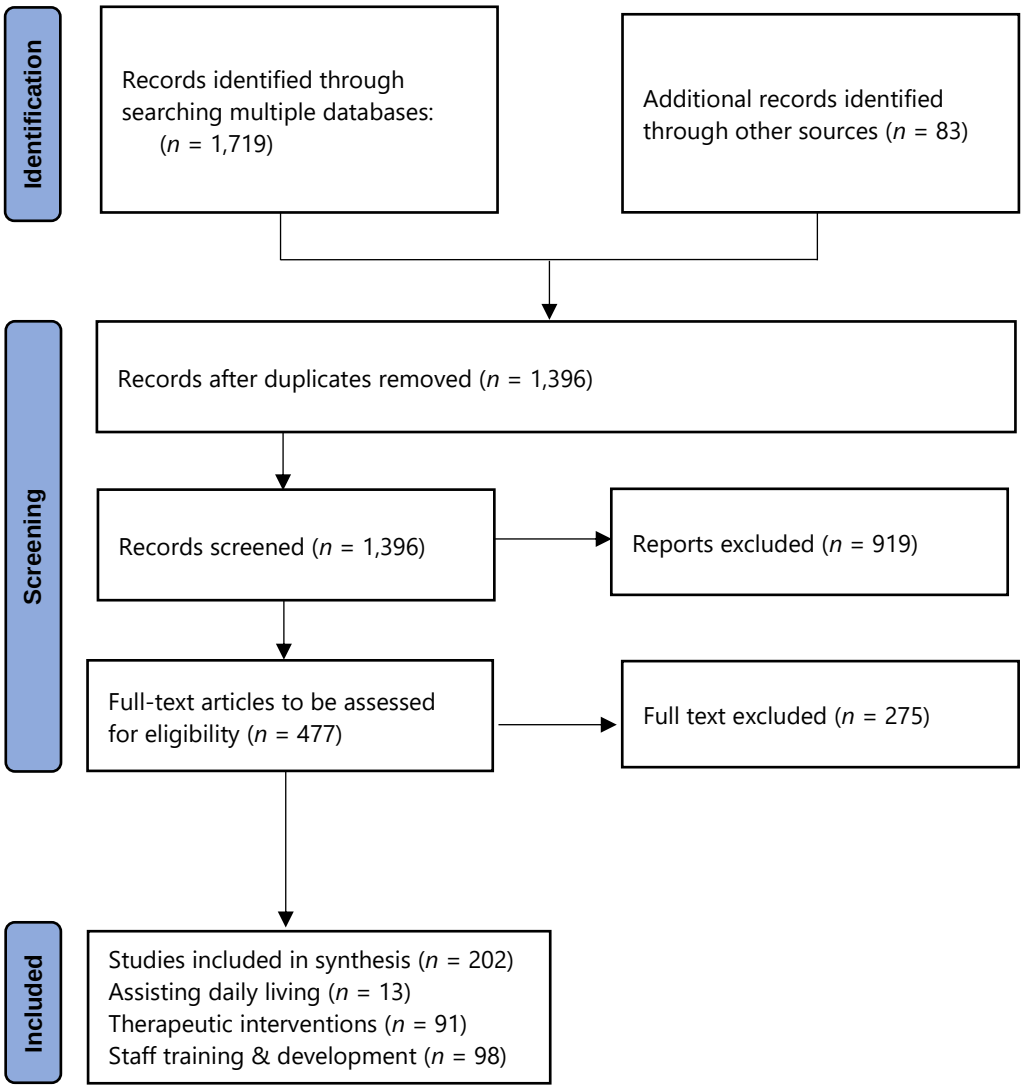
This review is one of three examining the role of digital technology in social care. This paper focuses on the use of digital interventions and the two other reviews report on: assisting daily living and; technology for staff training and development. Searches were conducted to cover all three topic areas. Recommended scoping review methods (Arksey & O'Malley, 2005; Levac et al., 2010) were used and results are reported using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) extension for scoping reviews guidelines (PRISMA ScR; Tricco et al., 2018). Studies were eligible for inclusion if they were published in the English language and focused on digital technology for (a) assisting daily living, (b) staff training and development, (c) therapeutic interventions to support service users with mental health problems, Autism Spectrum Disorder (ASD), intellectual/learning disability, or dementia. As this is a fast-changing environment, results were limited to systematic reviews, narrative reviews, and qualitative evidence syntheses published between 1 January 2015 and 28 February 2023. Reviews that were published outside these dates or in a language other than English were excluded.

Searches were conducted in MEDLINE, PsycINFO, Social Sciences Citation Index (SSCI) and Social Care Online. Searches were derived from key terms (See Appendix 1) and tailored for each database. Search results were exported to EndNote and titles and abstracts of the results were screened to be considered for full text review. Ten per cent of the search results were double screened. Disagreements on inclusion at full text review were resolved through team discussion. Data were extracted from included studies including: author information; study design; sample characteristics; the type and range of technology used; its effectiveness and acceptability; facilitators and barriers; ethical considerations; and recommendations for future research. Results were summarised and reported using a narrative synthesis approach. Key findings from studies were then compared, contrasted and synthesised to illuminate important themes.

3 Results

The searches retrieved 1,802 studies, 406 duplicates were removed. 1,396 titles and abstracts were screened and 919 were excluded at this stage. 477 were considered for full text review and 275 were excluded because the focus was not relevant to social care, did not include the population of interest, did not meet the aims of the review or did not meet the methodological inclusion criteria. The PRISMA diagram format for scoping reviews (ScR) is provided in Figure 1. Details of the 91 studies included in the review are provided in Table 1. A narrative synthesis of review results is detailed below.

Figure 1. PRISMA-ScR Diagram



4 Findings

Therapeutic digital interventions

The first section of the findings is categorised under different mental health problems or disorders and details the type and range of interventions where there is adequate research to report evidence from systematic reviews and/or meta-analyses. We have not recommended any specific products or apps, this is a rapidly developing landscape however the general consensus appears that while interventions show promise and acceptability, the research evidence is lacking in a number of areas. Therefore, we will give some indication of the effectiveness and acceptability of types of interventions where this is available.

Psychological readiness for therapy is an important consideration and forms a crucial element of assessing an individual's treatment needs and ensuring the right form of care and support is made available. Jardine et al. (2022) reviewed the research evidence on digital interventions designed to enhance treatment readiness for a range of different mental health problems including depression, anxiety, eating disorders, suicide, substance use, gambling and psychosis. Around half of the 48 interventions were web-based programmes but other formats included screening tools, videos, apps and websites. Intervention components involved psychoeducation, symptom assessment and feedback, information on treatment options and the referral process, client testimonials, expectation management and lists of pros and cons. Only 16 studies measured behaviour change or intervention effectiveness. Conclusions were difficult to draw given the heterogeneity of design and studies populations but there were some encouraging potential based on the easy accessibility and non-stigmatising appeal of digital platforms.

Mental health

Depression

Online CBT

Digital solutions to improve the prevention and treatment of depression have been evolving since the early 2000s. Burger, Neerincx and Brinkman (2020) reviewed the research landscape and concluded that CBT has been the most widely implemented online intervention for depression. Even though the technology has been developing since 2000, they saw little evidence of technological capabilities increasing (the data ranged between 2000 and 2017) despite an increase in the number of studies. They found that while developers focused on the implementation element of the therapeutic treatment, they paid less attention to providing adherence support.

Gaming

Serious games (Giunti et al., 2015), a type of digital intervention that combines aspects of video games and education or rehabilitation, has been used to reduce depressive symptoms in older adults by promoting cognitive functioning, physical activity or both (Kim et al., 2022). Kim et al.'s meta-analysis demonstrated that serious games reduced depression in older adults with a more significant effect size observed in community or home settings than in hospital settings. Among the types of games, games for physical activity or cognitive training and games for both had a significant effect on reducing depression in older adults. Games including physical activity had a significant impact on reducing depression. Higher quality randomised controlled trials are needed to establish substantial evidence for the effectiveness of serious games on depression in older adults.

Exergaming involves games that require bodily movements to play, creating an active gaming experience that is considered a form of physical activity (Benzing & Schmidt, 2018). Drazich et al. (2020) reviewed exergaming in older adults with depression and found evidence for symptom improvements. One of the methodological limitations identified in the research was the lack of routine measurement of depression as a primary outcome in study designs. Further research to explore the association between depression and exergaming is required.

Severe & enduring mental illness (SMI)

Smartphone apps

Interventions for personality disorder were evaluated in a review by Xie and colleagues (Xie et al., 2022). Mostly delivered via smartphones and based on Dialectical Behaviour Therapy, interventions were generally viewed positively but evidence for efficacy was limited. This is an under-researched population and RCTs to establish effectiveness would be beneficial.

Virtual Reality

The growth of VR is rapidly expanding with the greatest research evidence currently for its use in exposure therapy for SMI including anxiety disorders, PTSD and substance use however better evidence is required before it becomes a feature of regular patient care (Cieslik et al., 2020; Wiebe et al., 2022).

Avatar Therapy

Antipsychotic medication are the main treatment for schizophrenia but some symptoms are treatment-resistant such as auditory hallucinations (Kane, 1996). Virtual reality has been used for people with schizophrenia for social skills training, to improve cognition and to provide treatment support but Avatar Therapy has been suggested as an adjunct treatment for treatment-resistant auditory hallucinations. Avatar Therapy involves a psychiatrist assisting a patient to create an avatar using a computer programme modified to match the characteristics/voices that trouble the patient. The therapist uses the avatar to interact with the patient in order to practise exercises to manage the voices and become resistant to the hallucination. The therapist manipulates the avatar to gradually become controlled by the patient, changing the perception from persecutor to supporter. Audio recordings are made so the patient can listen to them at home. The theory behind the approach aims to tackle feelings of helplessness and lack of control over the voices and that by interacting and talking with the hallucination may increase control and lead to reduced suffering (Leff et al., 2013). The avatar creates an audio and visual interactive image that is easier to engage with compared to an invisible character. A 2020 Cochrane review (Aali et al., 2020) included four studies comparing Avatar Therapy with treatment as usual and supportive counselling. The evidence was rated as low quality, with outcome data only available over short-term follow up. Although some positive effects were suggested, further research is required to understand if it has benefits for people with schizophrenia. In a separate review by Dellazizzo et al. (2019), Avatar Therapy and VR cognitive therapy reported that VR interventions can help reduce the risk of violence in young people with schizophrenia. Other reviews of VR have demonstrated its effectiveness in reducing some of the negative symptoms associated with schizophrenia (Novo et al., 2021).

VR head-mounted displays

VR head-mounted displays for psychosis were evaluated in a review by Rus-Calafell and colleagues (2018), concluding that VR can be useful in the assessment of neurocognitive deficits and the study of relevant clinical symptoms with some preliminary evidence that it can be used successfully for cognitive rehabilitation, social skills training interventions and virtual reality-assisted therapies.

Perra et al. (2023) reviewed fully immersive virtual-reality-based cognitive training programmes for people with SMI. While results were positive, interventions were poorly described, with little detail presented on the active components. Perra concludes that this evidence base undermines understanding and will impede the development of the technology.

Nature-based virtual environments VR have been used to promote relaxation and reduce stress and anxiety for a range of mental health problems including eating disorders, depression, bipolar disorder and psychosis (Riches et al., 2023). Studies provided evidence of feasibility, acceptability, and short-term effectiveness to increase relaxation and reduce stress and shows some potential as a low-intensity intervention to promote relaxation especially for anxiety and stress-related problems. Further research would be beneficial.

VR relaxation

Designed to reduce stress and increase relaxation, VR relaxation technology draws on a range of nature-based virtual environments to promote relaxation. Riches et al.'s (2023) recent review found evidence for this low-intensity approach beneficial for anxiety and stress-related problems.

Supporting wellbeing

Peer support

Peer support can help reduce social isolation and loneliness often experienced by people with psychotic disorders (Biagianti et al., 2018). Technology has been used to increase peer-to-peer contact ranging from online forums to social networks. Biagianti et al. (2018) reviewed the evidence from six trials and five interventions and found that interactions that were facilitated by moderators were more successful in retaining, engaging and effectiveness than those without a facilitator. A second review (Fortuna et al., 2020) concluded that peer support interventions were feasible and acceptable for people with serious mental illness with strong potential for clinical effectiveness but well-designed and powered studies are required.

Weight management

Oliveira and colleagues (2022) evaluated the efficacy of studies designed to reduce weight, BMI, and abdominal circumference in people with severe mental illness. Sixteen studies were included in the review which concluded that digital devices or strategies may be feasible and useful in reducing sedentary behaviour. Most interventions used digital pedometers and mobile contact (text messaging or phone calls) and six of the nine hybrid interventions reported significant outcomes in favour of intervention including healthier lifestyle and increased physical activity.

Reducing stigma

Rodriguez-Rivas et al. (2022) included 9 RCTs in their review of a range of different approaches to help reduce mental health stigma. Methods included video games, audio-visual simulation of hallucinations, VR and e-contact with mental health service users through video-conferencing and online chats. Public stigma in the studies was measured through different scales, with the most commonly used being the Attribution Questionnaire and the Questionnaire on Student Attitudes Toward Schizophrenia. The meta-analysis (n=1832 participants) demonstrated that these interventions had a consistent medium effect

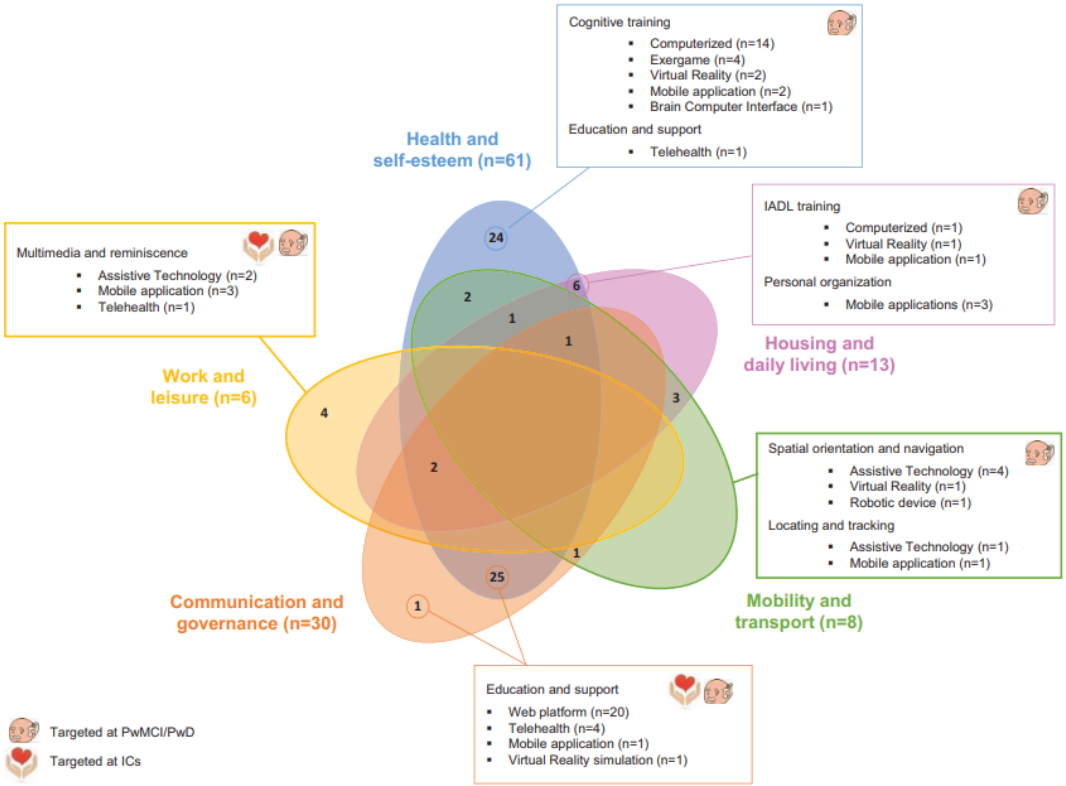
on reducing the level of public stigma. Further research that considers different contexts and countries for stigma-reducing interventions could inform scalability.

Dementia

Digital interventions designed for people with dementia and those who provide informal care target a range of different domains. Reminiscence therapy apps that provide visual and audio experiences can provide relief against depression and behavioural and psychological symptoms of dementia. Others tackle cognitive decline, promote social connections to reduce loneliness or help maintain physical activity.

Dequanter et al. identified 70 unique e-Health solutions in their systematic review for ageing with cognitive impairment, and identified significant overlap across application domains.

Figure 3. Categorisation of e-Health interventions by application domain (Dequanter et al., 2021)



Evidence was greatest for cognitive training solutions, demonstrating benefits for objective and subjective functioning but also having positive effects on depression. More solutions for leisure and reminiscence activities were recommended and evaluation of other outcomes than cognition.

Reminiscence apps

One of the studies included in Brown and Connor's (2020) dementia review was the Our Story app that allows people living with dementia the ability to store, access and generate memories based on text or audio content (Critten & Kucirkova, 2019). In another study, authors used computers with screen and sound amplifiers, a pressure micro-switch and voice detecting sensor with a throat microphone to allow individuals to interact and encourage

them to talk about photos or video clips of relevant people (including themselves) and special places/events (Lancioni et al., 2016). Significant improvements in verbal engagement and mild physical activity were observed as a result of the intervention.

Gaming

In Brown and Connor's review (2020), findings from Groenwoud's (2017) study of iPad games reported mixed outcomes. Positive experiences of gaming were related to a sense of achievement, connection, belonging and identity, improved self-esteem and being occupied. However, others reported negative aspects including insecurity and lower self-esteem if they struggled with playing the games or encountering games that did not meet the needs of the user (too difficult/too easy). A number of the studies did report that engaging with apps also increased communication and interaction with others overall. In Hill et al.'s (2017) review of computerized cognitive training in older adults, findings suggest that this approach can improve global cognition and psychosocial functioning but long-term and larger-scale trials are required. Only a few controlled studies have been conducted into the effectiveness of exergaming, and these show very little significant benefits (Van Santen et al., 2018). More well-designed studies are necessary to examine the effects of exergaming for dementia.

Social engagement

Interventions that aim to improve social engagement in advanced stage Alzheimer's Disease were described in a review by Cammisuli et al. (2022). Interventions included a tablet-based activity that could respond to hand movements and allow patients to independently access music of their choice enabling both formal and informal caregivers to engage with them more easily (Lancioni et al., 2019). Heins et al. (2021) reviewed social participation interventions primarily delivered via social networking technology or ICT training programmes for people with dementia. Limited effects were reported for loneliness, social isolation and social support. However qualitative findings showed greater levels of social interaction, face-to-face contact and intergenerational engagement.

In another review of non-pharmacological interventions for dementia, Cho et al. (2023) also examined music and memory activity engagement using technology (D'Aniello et al., 2021; Davison et al., 2016; İnel Manav & Simsek, 2019; Moon & Park, 2020; Perez-Ros et al., 2019; Sautter et al., 2021) and interventions to promote social engagement using robotic pets ((Chen et al., 2020; Jøranson et al., 2015; Liang et al., 2017; Moyle et al., 2017; Valentí Soler et al., 2015). The overall conclusions drawn from the pooled trial data showed that technology could help manage behavioural and psychological symptoms, help reduce depression significantly, and had a moderate effect on agitation and overall behavioural and psychological symptoms associated with dementia. However, evidence for the effect on anxiety and apathy was inconclusive. There was also some evidence that interventions were more effective for younger participants.

Online musical interventions delivered via videoconferencing technology including online group singing was the focus of Dowson and Schneider's review (2021) which concluded that

it is a relatively inexpensive aid to wellbeing and social inclusion. However, in order to scale up provision, software improvements are required to overcome audio latency as well as tackling digital exclusion often experienced by older adults.

Technology has also been developed to provide dialogue/conversational agents using AI such as chatbots designed for people with cognitive disorders including autism, dementia, and Parkinson's disease but the evidence is mixed (Ruggiano et al., 2021). In a review by Huq et al. (2022), most interventions were described as being designed to assist to deal with the 'disability and helplessness' in those with cognitive impairment. Some problems were identified with the technology, mainly relating to rule-based chatbots that could not respond to user input. Most of speech recognition technology relies on common languages (e.g. English) and where individuals had language impairments, single letter rather than single words were better understood by the technology which has obvious limitations. Systems that could decode non-verbal communication (e.g. via face-to-face interactions using Avatars) had greater potential especially when other communication pathways were impaired. Multimodal interfaces have also been the focus of research development – these rely on a range of communication means including voice, mouse, pen, and touch. Despite this focus, the conversational agent technology currently has limitations within health and social care settings. It doesn't allow for much user input flexibility but it is anticipated that significant research is underway based on deep learning and neural networks which should transform agent-based approaches. Huq et al. (2022) recommend that future development should enable voice and text input and output for service users, HCPs and the technology itself. Further recommendations also include the storage of older people/people with mental health problems health-related information on a natural language (NL) database which can then be processed by machine learning.

Cognitive training

A number of recent systematic reviews have explored whether digital interventions can improve cognition in dementia (Ge et al., 2018; Jung et al., 2021; Papaioannou et al., 2022; Sayma et al., 2020; Sohn et al., 2022). Ge et al. (2018) looked at technology-based training and rehabilitation for cognitive impairment and included a range of different platforms including computerised software, tablets, gaming consoles and VR. Being able to adjust the technology to meet individual capabilities was important. Cognitive training and rehabilitation technology interventions had a significant effect on global cognitive function in 8 out of 22 included studies; 8 out of 18 studies found positive effects on attention, 9 out of 16 studies on executive function, and 16 out of 19 studies on memory. Some cognitive interventions improved non-cognitive symptoms such as anxiety, depression, and ADLs. The authors conclude that while these interventions are promising, it is difficult to synthesise the evidence because of variability in research design and quality. Another review reported statistically significant positive effects on cognitive functioning in comparison to a range of control groups (Jung et al., 2021). The benefits of VR physical exercise was also associated

with improvements in general cognitive function in older adults with and without cognitive decline (Sakaki et al., 2021).

Video gaming for promoting cognition was explored by Ferreira-Brito and colleagues (2021) and included outcome data which was pooled for attention, memory/learning, visual working memory, executive function, cognition, functional capacity and quality of life. Results were promising however better quality research is required.

Psychological outcomes

A number of reviews of VR have been published recently reflecting the rapid development of research within this field (Flynn et al., 2022; Ho et al., 2022; Kim et al., 2019; Kruse et al., 2022; Krysta et al., 2017). Flynn et al. (2022) considered stakeholders' experiences of VR highlighting the importance of sensitively designing and introducing VR to this population, as older adults living with dementia often have no prior experience of using this technology. VR can be a positive experience for older adults living with dementia and can provide meaningful interactions, positive expressions, and long-term impacts on everyday functioning. However, it should be acknowledged that some negative associations must be accounted for before, during, and after use.

Domenicucci et al. (2022) focused their review on psychological outcomes in ICT-based interventions for adults with mild cognitive impairment and dementia. They included 48 studies (N = 1,488). Given the high heterogeneity, only nine studies were included in meta-analyses divided by outcome and type of cognitive decline, significant changes were only found for anxiety (small effect size) and behavioural symptoms (medium effect size) in people with dementia. The results show that research has concentrated on exploring quality of life and mood and to a lesser extent behavioural symptoms, anxiety and psychological wellbeing but less is understood about self-esteem, self-efficacy, social interaction, stress, loneliness and engagement despite all of these factors associated with cognitive decline. The need for more rigorous research is recommended.

Ho et al. (2022) systematically reviewed existing evidence on the use of VR interventions for managing apathy in people with cognitive impairment (k = 6). The level of immersion ranged widely and individual studies showed significant improvement in apathy (medium to large effect sizes). Minor adverse effects were reported. The VR content mostly included natural scenes (often using a background soundtrack), followed by city views and game-based activities. Most of the studies were conducted in a residential care setting and implemented by HCPs or researchers. In a review of VR interventions, Moreno et al. (2019) reported improvements in psychological functioning, including reduction in anxiety, improved well-being and coping skills. Although preliminary evidence shows that VR interventions may be effective and feasible for alleviating apathy in people with cognitive impairment, the methodological limitations in the included studies make it difficult to reach a firm conclusion on these points. More research is required.

Physical activity

Exergaming technology has been successfully used to promote physical activity and increase gait stability in stability (Swinnen et al., 2021). VR has also been used successfully in care home settings to improve physical health-related outcomes but once again study designs make conclusions difficult to reach (Li et al., 2022). Kim et al.'s (2019) review also reported small-medium effect sizes for improvements in physical activity as well as cognition; these findings were similar to more recent published reviews (Yan et al., 2022; Yen & Chiu, 2021; Zhao et al., 2020).

Caregiver support

The caregiver burden for family members of dementia patients can be considerable and having contact with others in similar caring roles can be an important source of help, advice and support. Armstrong and Alliance (2019) reviewed different types of virtual support for informal caregivers of dementia. Twenty-five studies included teleconferences or internet-based videoconferences, typically for 4-6 participants, lasting around 60 minutes on a weekly or monthly basis. Professionals facilitated the groups and content included support and/or education on dementia knowledge, caregiving skills, coping and resources. Caregivers reported benefits from their involvement but none of these were statistically significant. Barriers to engagement included technology and access problems, services considering this approach should factor in adequate resourcing and technical support to help deliver better outcomes. In a separate review, Deeken et al. (2019) conducted a meta-analysis of caregiver depression and burden outcome measures for technology-based interventions for informal caregivers for people with dementia. A small but significant post-intervention effect was observed, with combined interventions demonstrating the strongest effects.

Digital interventions targeting self-efficacy in dementia caregivers were more effective in reducing caregiving burden, stress, depression and improving quality of life in a systematic review of 12 studies (1,013 caregivers) (Soylemez et al., 2023). Interventions included phone and web-based applications that provided counselling support, motivational interviewing, behavioural coaching, psychoeducation and skills training were included. Jackson et al. (2016) concluded that combined telephone and internet delivery reported more successful outcomes for caregivers. Although there is a range of eHealth interventions for caregivers, study quality remains poor (Bui et al., 2022) with a lack of standardisation in outcome measurement (Lucero et al., 2019).

Intellectual disability

Only two studies were retrieved in the search that reviewed the evidence of digital interventions for intellectual disability. Suarez-Iglesias and colleagues (2021) evaluated video-gaming for improving physical and cognitive function in people with ID, concluding that is it a useful approach. Exergaming was associated with increasing fitness and motor skill levels, while sedentary video-gaming demonstrated potential for stimulating cognitive function. Further research is required to analyse its feasibility and its impact on mental and physical health outcomes. Zhong et al. (2021) similarly recommended research to establish the longer-term benefits of VR cognitive training for improving global functioning and executive functioning in cognitive impairment.

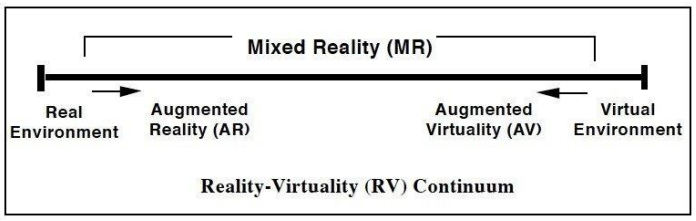
In Torra Moreno's (2021) review of digital devices in users with ID, 60% of executive function studies reported significant improvements, most commonly related to working memory. Within the cognitive skills, 47% of the studies reported significant improvements, 30% of them in language. Significant improvements in the social (50%) and behavioural domains (30%) were also reported. These results suggest that digital interventions are effective in improving working memory and academic skills, and positively affect both the social and behavioural domains. Little information has been published regarding the duration of the effects, which could be limited in time. Further research is necessary to assess long-term effectiveness, the influence of comorbidities, and the effects on subjects with severe ID. The inclusion of smartphones and special education centres is also necessary.

Autism Spectrum Disorder

Extended Reality (XR): Augmented, Mixed & Virtual Reality

Augmented Reality (AR) is a type of immersive technology that adds virtual objects to a real-world environment, and is used primarily within educational settings. Mixed Reality (MR) combines VR and AR technologies (Freeman et al., 2005) enabling virtual 3D objects to be included in a real environment or include real objects within in a virtual environment (Pan et al., 2006). Milgram and Kishino (1994) have described this as the 'virtuality continuum'.

Figure 2. Reality-Virtuality Continuum (Milgram & Kishino, 1994)



The efficacy of VR head-mounted displays for ASD shows some potential although the quality of the research is poor (Skjoldborg et al., 2022). One of the advantages of AR for people with ASD is that maintains the user's connection with the real world and doesn't involve some of the practical difficulties associated with wearing VR headsets but instead relies on mobile phones or tablets which are relatively easy to use (Denizli-Gulboy et al., 2021). AR interventions are promising for teaching social, self-care, daily life academic skills for children and young people with ASD (Baragash et al., 2020; Berenguer et al., 2020). Denizli et al.'s (2021) systematic review included interventions to assist people to recognise body language, facial expressions and emotional recognition/expression. Practising social cues for meeting and greeting people, and navigation aids were also the focus of some research. Most of the studies comprised small sample sizes (often single cases), but proved to be both effective and acceptable to participants. Greater collaboration between special educational needs specialists and software specialists could improve the design and development of technology to support people with ASD.

Video games

Jimenez-Munoz and colleagues (2022) reviewed video games for treating ASD in children and included 24 articles, demonstrating evidence for alleviating ASD symptoms. Rates of acceptability and adherence to treatment were acceptable.

Applied Behaviour Analysis (ABA) Telehealth

Ferguson, Craig and Dounavi's (2019) review of telehealth ABA interventions included 28 studies, quality was rated as low. However positive outcomes were reported in all of the studies in at least one area.

Implementation of digital interventions

Attitudes & beliefs

Negative attitudes and beliefs of both staff and service users can affect motivation to engage with interventions or complete associated tasks (Aref-Adib et al., 2019). Of interest, Berry et al.'s (2016) review of the acceptability of interventions delivered online or via mobile phones found that the thought of using the app had relatively low acceptability but, in reality, once using the apps, acceptability rates were much higher. Rates were higher again where remote online support was available. Common areas of concern included safety and privacy.

Complexity of interventions

The complexity of digital interventions can be a barrier to implementation, particularly where psychiatric symptoms affect cognition or a lack of technology skills (Aref-Adib et al., 2019; Berry et al., 2016). Wu et al. (2022) explored the factors influencing behaviour change and study retention in web-based interventions for informal caregivers for dementia. Almost half of the included studies were not informed by behaviour change theories. Involvement of spouses and a higher number of behaviour change techniques were each associated with lower retention rates, while the involvement of adult children caregivers was associated with higher retention. Future studies should consider participant characteristics and the intended intervention to improve retention rates.

Digital skills

Some level of digital literacy is required to engage with the technology available (Aref-Adib et al., 2019; Brown & O'Connor, 2020). Some groups will be at a disadvantage in accessing these skills including older adults or people with SMI who may not have the resources to have smart phones/tablets for example.

Time & resources

Insufficient resources, finances and staff time were barriers to implementation in Aref-Adib et al.'s (2019) systematic review. Linardon et al. (2020) examined attrition in 70 RCTs of smartphone interventions for people with mental health problems. The mean attrition rate in the meta-analysis was 24.1% at short-term follow-up, rising to 35.5% at longer-term follow up. Rates varied according to the mental health problem. Attrition rates were significantly lower in trials that offered an acceptance-based intervention, monetary compensation and reminded participants to engage. Significantly higher attrition was associated with trials that used online enrolment methods compared to telephone or in-person. Attrition and adherence behaviours are not fully understood in some populations (Patoz et al., 2021).

User-friendly interfaces

Interventions need to be user friendly and adaptable to different population groups e.g. people with psychosis or bipolar disorder and the staff who support them (Aref-Adib et al., 2019). In a review of adherence to electronic health tools in vulnerable groups by Arsenijevic et al. (2020) the researchers found limited use and the eHealth tools that used multimodal content (e.g. videos) and facilitate direct communication with providers improves adherence. Berry's (2016) review of the acceptability of online or mobile interventions highlighted the importance of an engaging and appealing interface. How well an application was designed and the quality of the information influenced use in Brown and Connor's (2020) systematic qualitative review of mobile apps for people with dementia. Ge et al. (2018) also identified the importance of tailoring difficulty levels in order to provide individualised interventions.

Moody et al. (2022) identified three common conditions that affected uptake of technology: assessing individual needs; trust, privacy and data sharing; and achieving accessible and aspirational design. The user experience will often dictate whether an intervention is used or not. However this is often underused as technology is developed and tested (Lemon et al., 2020).

Further understanding of older adults' perceptions, experiences and acceptance of technology-based cognitive interventions is needed. The Technology Acceptance Model (older adult's perceptions of the utility and ease of use) influences decisions about using technology (Venkatesh & Davis, 2000) is based on the theory that people will accept technology if they are satisfied with the experience. There is evidence that older adults enjoy immersive technology (Clay et al., 2020), and find interactive tools such as humanoid robots engaging and motivating but not everyone will have a positive experience. Interfaces that find it difficult to recognise speech or handwriting can be frustrating to use (Boot et al., 2013) and others have experienced VR-related sickness in immersive settings (Bauer & Andringa, 2020).

For individuals with schizophrenia, interventions designed to improve cognitive function were much more effective when implemented in a face-to-face setting using online devices and sensory stimuli (Song & Song, 2022). Findings were similar in another review with the findings showing that mixed delivery methods for caregivers appear to promote engagement, especially if personal contact is facilitated e.g. by telephone (Morgan et al., 2022).

Co-production

Similar to the conclusions of the review of digital interventions for staff training and development, there is little evidence of co-production of interventions which could improve development and implementation (Aref-Adib et al., 2019). Berry et al. (2016) also reported the importance of peer support for mobile and online interventions. A more recent review by Cole and colleagues (2022) examined co-design approaches involving older adults in the

development of electronic healthcare tools, identifying a number of research gaps that limit the collaboration and empowerment of service users in the design and delivery process.

Criticism has also been targeted at the design of digital interventions which aim to improve basic physiological needs for people with dementia but neglect higher level needs including self-esteem and agency. A greater requirement to prioritise person-centred methods, ethically, to develop technology is required (Koo & Vizer, 2019). Digital support for some caregivers (e.g. serious mental illness) has also been an under-researched area and focus of technology development (Meyer et al., 2018; Onwumere et al., 2018).

Rai and colleagues (2020) recommend best practice guidelines for involving people with dementia in developing technology-based interventions:

Prepare for involvement

- Make this a positive experience for participants by creating a friendly environment, where people can ask questions and feel supported
- Involve a variety of stakeholders and users to collect a range of feedback and perspectives
- Ensure all practicalities for involvement are in place to meet the needs of participants
- Participants should be made aware of the purpose and relevance of their involvement to meet their expectations and encourage honest feedback
- Explore the available methods for collecting feedback and select the ones best suited for the goal of involvement

Practice involvement

- Use appropriate terminology and words when asking questions to promote understanding and generate more in-depth feedback
- Offer participants the opportunity to learn a new skill through their involvement to enhance well-being and empowerment
- Involve participants throughout the development process to create a more suitable piece of technology for wider uptake
- Keep participants informed after their involvement so they can stay up to date on further development and implementation of the technology

Organisational implementation

Christie et al. (2018) highlight the gap between research and practice and the dearth of implementation research in their review of eHealth interventions for caregivers of people with dementia. While much research is being conducted about the effectiveness and efficacy of interventions, better understanding of how organisations can successfully implement intervention approaches is needed.

5 Conclusions

We have not recommended any specific products or apps, this is a rapidly developing landscape but the general consensus suggests that while interventions show promise and are acceptable, the research evidence remains lacking.

Readiness for therapy is a key consideration and it may be that interventions designed to help prepare individuals in an easy accessible and non-stigmatising approach offered by digital platforms. There is some evidence for digital delivery of interventions to support people with depression including online CBT, video games that promote physical activity (exergaming), and improve cognition but higher quality research is required. The same is found for technology to support those with ASD. Interventions delivered via smartphone apps are accessible as long as people can afford to buy the technology and service wifi contracts. Issues about infrastructure and availability and reliability of connections can limit their use.

Virtual reality is a rapidly expanding area of development including avatar therapy that targets psychosis symptoms, offers de-stress and relaxation, and cognitive and life skills training for example show some promise. However evidence of implementation within real-life home based settings remains elusive. The evidence base to support individuals with an intellectual disability remains very limited.

Supporting wellbeing can be achieved via technology through peer support, help with lifestyle changes including weight loss management and delivered within a context where stigma is lessened.

Supporting the significant life changes that the onset and development of dementia creates is an area of focus and technology delivers a range of options for both service users and their carers. Interventions designed to promote cognitive abilities, reduce stress and anxiety, improve wellbeing and provide opportunities to connect and reminisce about happy memories have been under development. Examples include gaming technologies, to self-directed movement sensors that can trigger sounds/music/images to help individuals retain some level of control to engage with others. Chatbots and robotic animals that provide social engagement require further research.

Supporting caregivers is equally important and delivery of psychoeducation and peer support has generated some promising initial results.

Negative attitudes and beliefs remain one of the main barriers to development and implementation as well as the complexity of some of the technological approaches. Service users and staff need reassurance that the technology is safe and secure, maintains privacy, doesn't replace personal contact but enhances care. The infrastructure, affordability of the technology and organisational buy-in and investment in staff training and support is required. There has been little involvement of service users in the design and development

of technology and this should be addressed. Co-production will help to deliver user-friendly interfaces that are easy to use, easy to recognize the benefits that technology can offer and can be tailored to meet individual needs.

Table 1. Summary of evidence

Autism Spectrum Disorders				
Study ID	**Technology used**	**Population**	**Potential benefits**	**Evidence**
Baragash 2020; Berenguer 2020; Jimenez-Munoz 2022	Augmented reality (AR); video games	Children & young people with ASD	Teaching social, self-care, daily life academic skills.	Interventions are promising but more research is required.
Denizli-Gulboy 2021	AR using mobile phones/tablets	ASD	Assisting people to recognise body language, facial expressions and emotional recognition/expression and practising social cues for meeting and greeting people, and navigation aids.	Most of the studies comprised small sample sizes (often single cases), but proved to be both effective and acceptable to participants. Greater collaboration between special educational needs specialists and software specialists could improve the design and development of technology to support people with ASD.
Ferguson 2019	ABA telehealth interventions	ASD	Innovative alternative to deliver applied behaviour analysis & reduce staff resource. Positive outcomes reported.	Low quality evidence.
Skjoldborg 2022	VR head-mounted displays	ASD	Some evidence for improvement in life skills but no consistent approaches in methodological design to develop evidence base.	Low quality evidence.
Wiebe 2022	VR	SMI, ASD & dementia	VR exposure therapy shows some signs of effectiveness in anxiety disorders, PTSD and substance use problems. Can also be used for cognitive training in dementia and social skills training in ASD.	Better evidence required to become part of regular patient care.
Mild cognitive impairment				
Study ID	**Technology used**	**Population**	**Potential benefits**	**Evidence**
Domenicucci 2022; Flynn 2022; Ho 2022;	VR	Mild cognitive impairment and dementia	VR can be a positive experience and can provide meaningful interactions, positive expressions, reduce apathy and have long-term impacts on everyday functioning. May improve	Research has concentrated on quality of life and mood and to a lesser extent behavioural symptoms, anxiety and psychological wellbeing. The need for more rigorous

Kim 2019; Kruse 2022; Krysta 2017; Zhong 2021			global cognitive and executive function. It should be acknowledged that some negative associations must be accounted for before, during, and after use.	research is recommended, in real-life settings.
Huq 2022; Ruggiano 2021	Conversational/ chatbots	Autism, dementia & Parkinson's disease	Mixed evidence and limitations associated with the technology using rule-based chatbots. Systems that can decode non-verbal cues can have potential where communication may be impaired	This is a fast developing area which should allow for greater user input.
Suarez-Iglesias 2021	Video games	Intellectual disability	Exergaming was associated with increasing fitness and motor skill levels. Sedentary video-gaming demonstrated potential for stimulating cognitive function.	Further research is required to analyse its feasibility and its impact on mental and physical health outcomes.
Torra Moreno 2021	Digital interventions	Intellectual disability	Significant improvements in executive function, especially working memory, cognitive skills and language.	Further research is necessary to assess long-term effectiveness, the influence of comorbidities, and the effects on those with severe ID.
Dementia				
Study ID	**Technology used**	**Population**	**Potential benefits**	**Evidence**
Armstrong 2019; Bui 2022; Deeken 2019; Jackson 2016; Lucero 2019; Soylemez 2023	Carer support including online psychoeducation & peer support.	Carers/family members of dementia patients	Virtual peer support facilitated by professionals reported positive benefits. Barriers to technology, access and adequate resourcing and technical support is required.	Qualitative feedback is positive from caregivers who described many benefits of participation. Small but statistically significant improvements observed in caregiver depression, caregiver burden and quality of life. However more research is required.
Brown 2020; Critten 2019; Lancioni 2016	Reminiscence apps	Dementia Moderate & severe Alzheimer's disease	Allows people with dementia to store, access and generate memories using text or audio content. Significant improvements in verbal engagement and mild physical activity. Quality and design influences use but some level of digital skills are required to use effectively. Co-design approaches required.	Small sample sizes make generalizable conclusions difficult to reach, more research is required.

Cammisuli 2022; Heins 2021	Social engagement apps	Advanced stage dementia	Social networking technology and ICT training to reduce loneliness and social isolation.	Limited effects were reported for loneliness, social isolation and social support however qualitative findings showed greater levels of social interaction, face-to-face contact and intergenerational engagement. Evidence base is small, with methodological limitations. More co-production approaches required and larger, high quality studies.
Cho 2023; D'Aniello 2021; Davison 2016; İnel Manav 2019; Lancioni 2019; Moon 2020; Perez-Ros 2019; Sautter 2021	Music and memory activity engagement using technology	Dementia & carers, mild dementia, advanced Alzheimer's disease, nursing home residents	Includes: tablet-based activities that respond to hand movements to allow patients to independently access music of their choice and engage with formal/informal caregivers and online group singing.	Technology could help manage behavioural and psychological symptoms, help reduce depression significantly, and had a moderate effect on agitation and overall behavioural and psychological symptoms associated with dementia however, evidence for the effect on anxiety and apathy was inconclusive. There was also some evidence that interventions were more effective for younger participants.
Dowson 2021	Online group singing	Dementia	Online group singing is inexpensive and promotes wellbeing and social inclusion.	Better software may help to scale up and improve provision. Tackling digital exclusion for older adults requires consideration.
Dequanter 2021	Reminiscence therapy	Aging with cognitive impairment	Can provide visual and audio experiences to counteract depression, behavioural and psychological symptoms of dementia. Others tackle cognitive decline, promote social connections to reduce loneliness or help maintain physical activity.	Evidence greatest for cognitive training, improving objective and subjective functioning and positive impact on depression. More solutions for leisure and reminiscence activities required including evaluation of other outcome domains.
Ferreira-Brito 2021; Ge 2018; Hill 2017; Jung 2021; Papaioannou 2022;	Cognitive training	Dementia	Computerised software, tablets, gaming consoles and VR that can be adjusted to meet individual needs is recommended. Cognitive training and rehabilitation technology can improve global cognitive function, attention, executive function and memory. Other benefits	Interventions are promising but it is difficult to synthesise the evidence because of variability in research design and quality.

Sakaki 2021; Sayma 2020; Sohn 2022			for anxiety and depressive symptoms and ADLs also demonstrated.	
Groenwoud 2017; Van Santen 2018	iPad games	Dementia	Positive experiences of gaming associated with a sense of achievement, connection, belonging and identity, improved self-esteem and being occupied and social connections/communication. Others reported negative aspects including insecurity and lower self-esteem if they found the play difficult or did not meet their needs.	Better quality research needed, few demonstrating significant benefits.
Kim 2019; Li 2022; Moreno 2019; Swinnen 2021; Yan 2022; Yen 2021; Zhao 2020	VR physical activity apps	Mild cognitive impairment or dementia, older residents in long-term care, older adults	Successful in promoting physical activity and increasing gait stability and improving cognition. May also help to reduce anxiety, promote well-being and increase coping skills.	VR has also been used successfully in care home settings to improve physical health-related outcomes but once again study designs make conclusions difficult to reach.
Wiebe 2022	VR	Dementia	VR exposure therapy shows some signs of effectiveness in anxiety disorders, PTSD and substance use problems. Can also be used for cognitive training in dementia and social skills training in ASD.	Better evidence required to become part of regular patient care.
Depression				
Study ID	**Technology used**	**Population**	**Potential benefits**	**Evidence**
Burger 2020	Online interventions	Adults with MDD	CBT most widely implemented but further work required on providing adherence support.	Further work is required by developers to support adherence, cross-collaboration with others working in the field may improve outcomes.
Drazich 2020	Exergames	Older adults	Active gaming experiences that promote physical activity improved depressive symptoms.	Lack of routine measurement of depression as primary outcome limits evidence. Further research recommended.
Kim 2022	Serious games	Older adults	Serious games that combine elements of video games and education/rehabilitation that	Higher quality randomised controlled trials are needed to establish substantial evidence

			promote physical activity or cognitive training can reduce depression in older adults, particularly in community/home settings compared to hospital settings.	for the effectiveness of serious games on depression in older adults
Personality disorder				
Study ID	**Technology used**	**Population**	**Potential benefits**	**Evidence**
Xie 2022	Smartphone apps	PD	DBT interventions.	Under-researched population, RCTs required to establish efficacy.
Psychosis/schizophrenia				
Study ID	**Technology used**	**Population**	**Potential benefits**	**Evidence**
Aali 2020	Avatar Therapy	Schizophrenia & related disorders	Few, if any, consistent effects of Avatar Therapy for auditory hallucinations.	Uncertain. Randomised trials required.
Aref-Adib 2019	Digital health interventions for physical &/or mental health problems	Psychosis or bipolar disorder	Complex to use for those with psychiatric symptoms, low IQ, or minimal IT skills. Service users & staff should be involved in the development & implementation.	Reasonable evidence base to build on.
Biagianti 2018	Peer-to-peer contact	Psychosis	Technology designed to reduce social isolation and loneliness can be feasible and acceptable with those facilitated by moderators more successful in retaining, engaging and effective than those without.	Emerging evidence base to build on.
Dellazizzo 2019	Avatar Therapy & VR cognitive therapy	Young people with schizophrenia	Can reduce risk of violence in young people.	Preliminary research is positive but the evidence base is very limited.
Novo 2021	VR	Schizophrenia	Reduction in negative symptoms.	Limited available data but what is available shows promise.
Rodriguez-Rivas 2022	Gaming, VR & e-contact	Schizophrenia	Video games, audio-visual simulation of hallucinations and online chats reduce the level of public stigma.	Further research that considers different contexts and countries for stigma-reducing interventions could inform scalability.
Rus-Calafell 2018	VR	Psychosis	Utility in assessment of neurocognitive deficits & clinical symptoms. Some evidence for cognitive rehabilitation, social skills training and assisted therapies.	Included 50 studies, but more research is required in real-life settings and with larger sample sizes.

SMI				
Study ID	**Technology used**	**Population**	**Potential benefits**	**Evidence**
Fortuna 2020	Peer support	SMI	Peer support digital interventions feasible and acceptable.	Well-designed and adequately powered studies required.
Perra 2023	Fully immersive VR cognitive training	SMI	Positive results but the interventions are poorly described which fails to establish active components.	Evidence base undermines current understanding and will impede development of technology.
Riches 2023	Nature-based VR	Eating disorders, depression, bipolar disorder & psychosis	Evidence for low-intensity feasible, acceptable and short-term effectiveness for relaxation and stress reduction especially for anxiety and stress-related problems.	Further research would be beneficial.
Cieslik 2020; Riches 2023; Wiebe 2022	VR	SMI	VR exposure therapy shows some signs of effectiveness in anxiety disorders, PTSD and substance use problems. Can also be used for cognitive training in dementia and social skills training in ASD.	Better evidence required to become part of regular patient care.
Weight management				
Study ID	**Technology used**	**Population**	**Potential benefits**	**Evidence**
Oliveira 2022	Digital devices/strategies to reduce weight, BMI & abdominal circumference	SMI	Digital interventions e.g. pedometers and mobile contact (text messaging/phone calls) are feasible and useful in reducing sedentary behaviour and improving health lifestyle behaviours.	Even though the evidence base is limited, interventions targeting weight loss and health lifestyles do demonstrate positive effects.
Issues for implementation				
Study ID	**Technology used**	**Population**	**Issues to consider**	
Aref-Adib 2019; Berry 2016; Boot 2013; Brown 2020	Screening or monitoring telehealth; online/mobile behavioural/ psychoeducation interventions; video games; social skills	Impaired cognition/dementia	Complexity of digital interventions where cognition or technology skills may be poor. Availability of suitable infrastructure to support delivery including access to computers, printers, space, equipment and WiFi access. Cybersecurity is an ongoing concern for many.	

	training & cognitive training via mobile devices/apps		
Aref-Adib 2019; Berry 2016; Boot 2013; Brown 2020; Ge 2018	As above	Dementia Psychosis/bipolar disorder	Creating user friendly and adaptable interfaces that are easy to use.
Arsenijevic 2020; Clay 2020; Linardon 2020; Patoz 2021	Electronic health tools; immersive virtual reality (iVR); smartphone interventions	SMI Older adults Dementia Bipolar disorder	Factors influencing participation/reducing attrition – technology is not embedded with health care systems so is always an add-on and are focused on single issues (e.g. diabetes, obesity) and as a result don't offer a comprehensive health care tool for service users. Study attrition and low adherence are common.
Song 2022; Morgan 2022; Wu 2022	Online devices and sensory stimuli	Dementia Schizophrenia Caregivers	Factors influencing behaviour change include face to face contact to help develop and deliver the technology. Many digital interventions are not based on a behaviour change logic model which may impact on their effectiveness. Retention and attrition requires matching participants more carefully with potential participants to offer relevant and appropriate interventions.
Aref-Adib 2019; Meyer 2018; Onwumere 2018	Screening or monitoring telehealth; remote interventions.	SMI, Psychosis Caregivers	Insufficient resources, finances and staff time. Technical support for carers to support implementation. Limited technology to support carers and family members who are central to promoting wellbeing and also require help to foster their own self-care/wellbeing.
Moody 2022	Self-monitoring, education, reminders/feedback, goal setting, coaching, treatment plans & social support	Older adults	Addressing concerns about security, data sharing and building trust. Technology is rarely designed with older adults in mind and greater focus on co-production is required. Products should not look too clinical, to help reduce stigma, and be attractive to use. Ongoing support is required.
Aref-Adib 2019; Berry 2016; Cole 2022; Koo 2019; Lemon 2020; Rai 2020	Screening or monitoring telehealth; online/mobile behavioural/ psychoeducation interventions; video	Dementia Psychosis/bipolar disorder Older adults	Lack of co-production, working with service users to improve interface is required. Evidence suggests that involving people with dementia is both necessary and feasible and best practice guidelines have been developed to support their involvement. The human needs of service users are often neglected instead focusing on basic needs. Great rigour in testing is recommended.

	games; social skills training & cognitive training via mobile devices/apps		
Bauer 2020	Telehealth collaborative care	Bipolar disorder	Design, support and infrastructure key to successful development and delivery.
Christie 2018	eHealth	Dementia	Organisational implementation is necessary and frameworks to support implementation is required to deliver effective interventions.

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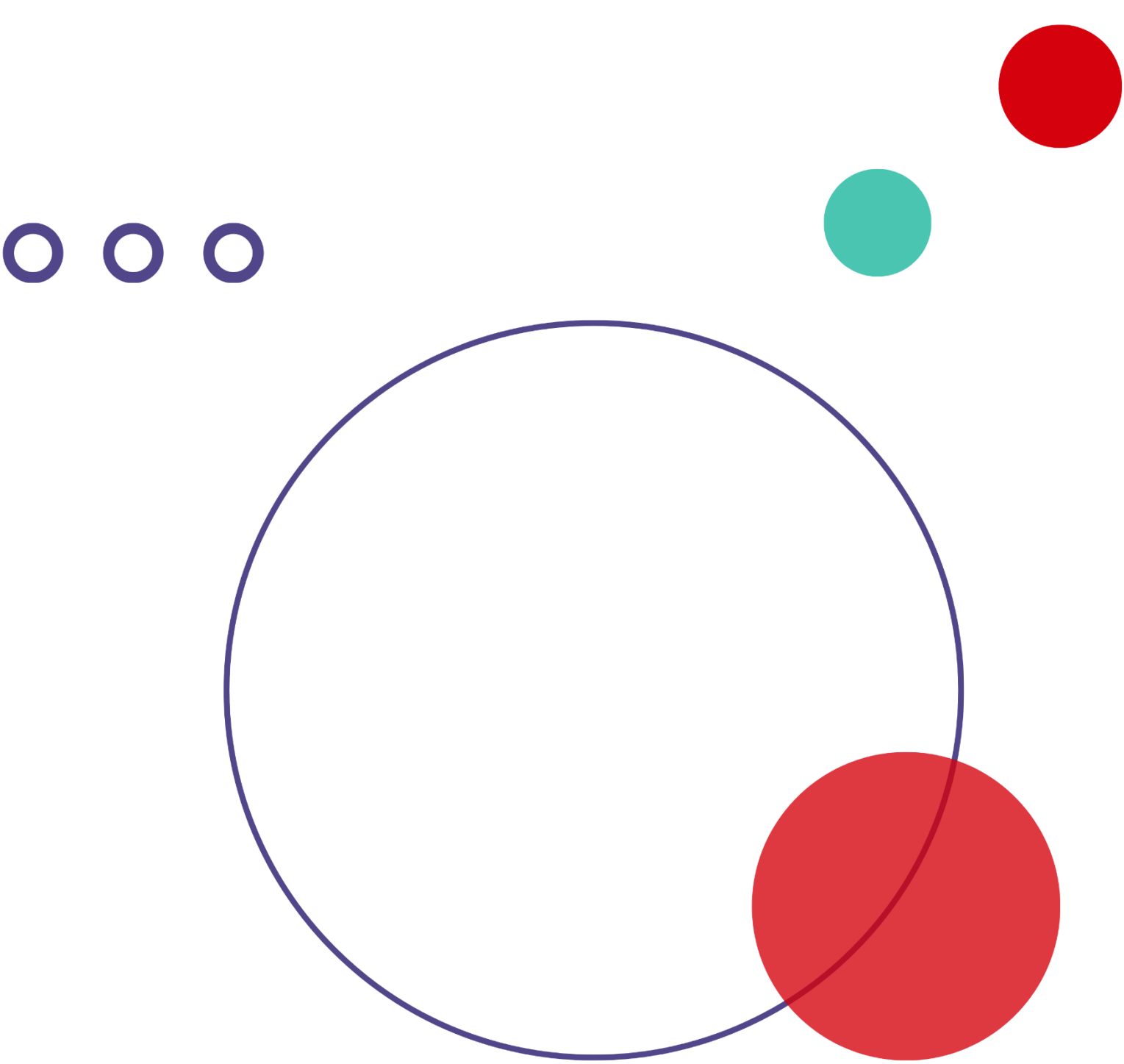

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