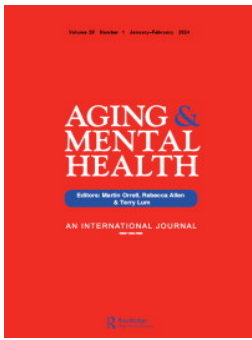




## Use and uptake of technology by people with dementia and their supporters during the COVID-19 pandemic

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## Use and uptake of technology by people with dementia and their supporters during the COVID-19 pandemic

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### ABSTRACT

**Objective:** This rapid review aims to identify the types of technologies used by people with dementia and their supporters during the COVID-19 pandemic, and the issues which influenced technology adoption within their usual care routines.

**Methods:** PubMed, PsychInfo, Scopus, and Cochrane COVID reviews were searched to identify peer-review studies published since 2020. A total of 18 studies were included and synthesised thematically.

**Results:** Of these, most were conducted in the community ( $n=15$ ) with people with dementia only ( $n=11$ ) and involved qualitative methods ( $n=11$ ). The majority ( $n=12$ ) focused on digital off-the-shelf and low-cost solutions, such as free video conferencing platforms, to access care, socialise or take part in interventions. Whilst often well-accepted and associated with positive outcomes (such as improved social connectedness), lack of digital literacy or support to use technologies, limited access to appropriate technology, individuals' physical, cognitive, or sensory difficulties, were highlighted and likely to threaten the adoption of these solutions. The quality of the evidence was mixed, neither very robust nor easily generalisable which may be attributed to the challenges of conducting research during the pandemic or the need to rapidly adapt to a new reality.

**Conclusion:** While COVID-19 has fast-tracked the adoption of technology, its use is likely to continue beyond the pandemic. We need to ensure this technology can leverage dementia support and care and that people with dementia are enabled and empowered to use it.

### ARTICLE HISTORY

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### KEYWORDS

Dementia; technologies; assistive technology; COVID-19 pandemic

## Introduction

In the last two years, there has been increased evidence of the impact of COVID-19 and related restrictions on people with dementia and their supporters (the latter term is used throughout this review to refer to informal caregivers, such as families and/or friends. This term was preferred by people with dementia consulted for this work). The control and safety measures instituted in most countries to mitigate the viral spread, such as physical distancing, stay-at-home and curfew orders, and travel restrictions have negatively impacted people's lives. They have disrupted people's well-established daily routines, reduced social interactions and usual support networks, and limited access to vital support services. The impact of these measures has been felt harder by people with dementia, who are particularly vulnerable to isolation and stimulus deprivation (Giebel et al., 2021a; Hanna et al., 2022; Suárez-González et al., 2020; Tuijt et al., 2021a). People with dementia faced an increased risk of social isolation and negative health outcomes such as

worsening symptoms and severe behavioural disturbances, and increased cognitive and functional decline (Manca et al., 2020; Numbers & Brodaty, 2021). Along with these, challenges faced by family supporters have also increased, raising concerns about their mental well-being (Wei et al., 2022).

The mainstay of COVID-19 management has relied on containment and mitigation strategies, implying that various types of activities (e.g. shopping, working, and leisure) were interrupted with many shifting from in person to online (Talbot & Briggs, 2022). This has resulted in an accelerated spread and use of assistive and everyday technology.

Assistive technology refers to 'any item, piece of equipment, product or system whether acquired commercially, off-the-shelf, modified or customised, that is used to help persons with disability' (ISO, 2011). Assistive and everyday technology can play an important role in promoting independent living, safety, and autonomy of people with dementia, and supporting the quality of life of this population and their supporters (Gibson et al., 2015; van der Roest et al., 2017). Technologies for assisting

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This article has been corrected with minor changes. These changes do not impact the academic content of the article.

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people with dementia and/or their supporters can be categorised into: memory support, treatment and interventions, safety and security, training, care delivery, social interaction and networking (Carretero, 2015; Lorenz et al., 2019).

Assistive technology has been claimed to be of great value to help manage and respond to current and future dementia care issues, such as care staff shortages. Studies have shown that the pandemic has heightened the need for and boosted the uptake of assistive and everyday technology in various social and health domains for people with special needs (Layton et al., 2021). It is not clear, however, whether uptake of technology in dementia care has increased and what its impact is.

The aim of this rapid review was therefore to explore how people with dementia and their supporters have been using assistive and everyday technology during the COVID-19 pandemic. We wish to identify the types of technologies used by people with dementia and their supporters at any stage of the disease trajectory, and the factors that influenced technology adoption within their usual care routines. Specifically, this rapid review sought to answer the following questions:

- What technologies used by people with dementia and their supporters have been subjected to research during the COVID-19 pandemic?
- What is the impact of technologies used during the COVID-19 pandemic on people with dementia and their supporters?
- How has the uptake of technologies by people with dementia and their supporters changed during the COVID-19 pandemic?
- What is the current knowledge about the acceptability, facilitators and barriers that affect the effective use of technologies by people with dementia and their supporters during the COVID-19 pandemic?

The pandemic reminded us all how rapidly things can change. Evidence gathered during COVID-19 must be synthesised without undue delays to avoid the risk of getting outdated. In such circumstances, rapid reviews are recommended by the World Health Organisation (WHO) (Tricco et al., 2017). Through this rapid review we expect to gather actionable evidence to fuel the discussion on care practice innovation, contribute to expanding knowledge on the topic, and increase public awareness of technologies and its role in dementia care during unprecedented times.

## Materials and methods

The protocol of this review was registered in PROSPERO (CRD42022298935) and conducted as part of a larger project led by the INTERDEM taskforce on assistive technology. Two experts by experience (i.e. people with dementia) were consulted at different points during the development of this review. We used recommended general guidance for rapid reviews to support the conduct of this work (Garritty et al., 2021). The Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) checklist (Page et al., 2021) was used as a basis for the reporting.

### Eligibility criteria

Studies were selected according to the inclusion and exclusion criteria outlined below.

### Participants

Participants included people with dementia (all types) and their supporters (i.e. family and/or friends that provide informal care). While not all individuals with mild cognitive impairment (MCI) will progress to dementia, MCI may still be considered a prodromal or 'pre-dementia' stage and was therefore included in this review.

### Intervention

Products included technological devices, such as computers, tablets, and reminders. Devices that were piloted and had not yet been commercialised were considered. Non-technological devices, such as basic aids (for example, walking sticks and grab rails), were excluded from the searches.

### Context

Studies published since 2020, when the COVID-19 started, at all levels of social and healthcare settings (i.e. primary, secondary, and tertiary healthcare) or in the community were considered. Studies exclusively based on or reporting data obtained before the COVID-19 pandemic were excluded from this review.

### Outcomes

Studies reporting on all outcomes pertaining to patients and their supporters' health, quality of life and related constructs, and that were associated with the use of technologies were considered. These outcomes come directly from participants and may be measured using a variety of tools and instruments.

### Study design

Reviews (all types), randomised controlled trials, cohort studies, case studies, and cross-sectional studies published in peer-review journals were included. Conference abstracts were not deemed appropriate to be included in this rapid review as most of these are not peer-reviewed. In addition, identifying relevant conferences, and locating their abstracts can be time and resource-intensive which contradicts the purpose of a rapid review.

### Information sources

A rapid electronic search strategy was used to identify English, Spanish, Portuguese, Dutch, and German published studies and indexed in the following databases: PubMed, PsychInfo, Scopus, and Cochrane COVID reviews. We searched for studies published since 2020, when the COVID-19 pandemic started. Reference lists of the identified papers were checked to ensure that relevant eligible studies were not excluded.

### Search strategy

The following terms were developed with the support of a professional librarian and piloted and optimised before being used in the current review:

(dementia or alzheimers or cognitive impairment or memory loss) AND (technology or technological or technologies) AND (COVID-19 or coronavirus or 2019-ncov or sars-cov-2 or cov-19). The detailed search strategy for the three first databases is fully reported in [Appendix A](#).

## Selection process

References identified were exported and managed with the EndNote software. Searches were conducted by one review author (AB) who also screened the titles and abstracts of all identified references. Duplicates and titles and abstracts that did not meet the inclusion criteria were excluded. For records where eligibility was unclear, the full texts were obtained and scrutinised. The full text of all reports marked as *include* or *unsure* were retrieved by one reviewer (AB) and assessed for eligibility independently by two other researchers (MC and CS). Any disagreement between them was resolved through discussion with the whole team. Reasons for exclusion were recorded as part of the screening process (Figure 1).

## Data charting process

A standard, pre-piloted form was used to extract data from the included studies for evidence synthesis. Extracted information included: study setting, country, design, type of patient and public involvement, and details of the technologies, including function, stage of development, target beneficiaries, outcomes and ethical issues, and limits regarding the uptake of technologies. Two review authors independently extracted data (ARF and FMH). Discrepancies were solved by consensus, referral to a third review author (LF) or to the wider team. The authors of the primary studies were contacted if further information was

deemed necessary. An author was contacted but no answer was received.

## Risk of bias assessment

One reviewer (AB) assessed the methodological quality of eligible studies using the latest Mixed Methods Appraisal Tool (Hong et al., 2018) and results were discussed with all authors. The MMAT is a generic critical appraisal tool that covers qualitative, quantitative, and mixed methods research studies. The tool is considered appropriate for this review given the anticipated heterogeneity of study designs to be included.

An overall score was calculated for each study. The scores are presented in Table 1 using stars (\*): 5\*\*\*\*\* or 100% quality criteria met; 4 \*\*\*\* or 80% quality criteria met; 3 \*\*\* or 60% quality criteria met; 2 \*\* or 40% quality criteria met; 1 \* or 20% quality criteria met. No studies were excluded based on this assessment. The decision whether each item was fulfilled or not was based on the information provided in the paper. The MMAT can be seen in Appendix B.

## Synthesis methods

Given the broad scope of the review, a wide range of study designs were included. A formal statistical meta-analysis was not deemed appropriate. Instead, results were summarised in tabular and narrative form. All quantitative and qualitative data

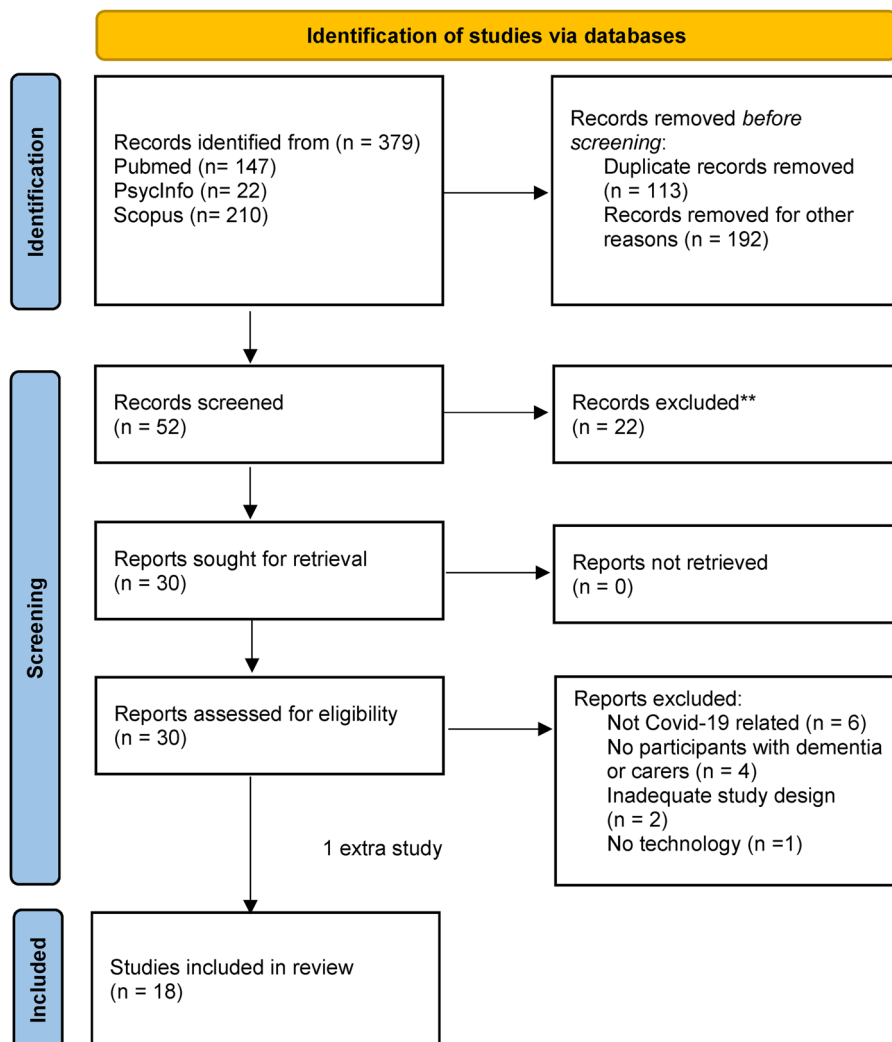


Figure 1. PRISMA flow diagram (Page et al., 2021).

Table 1. Studies included in the rapid review.

Authors /country	Design	Setting	Target population	Participants	Technology and intended use	Stage of development	PPI	Ethical concerns	Measures and Outcomes	Key results	Barriers/limitations	MMAT
Arighi et al. (2021) Italy	Quantitative	Community	People with dementia	n = 108 Characteristics according to tele visit outcome: 1) successful televisit: age 73.5 (SD 7.15), male (51.4%), education in years 11.1 (SD 4.39), MMSE mean 18.7 (SD 8.47) 2) failed tele visit: age 75.7 (SD 7.2), male (41.2%), education in years 11.8 (SD 4.66), MMSE mean 19.8 (SD 9.32)	Video conference for online consultations	Implemented			Socio demographic information, characteristics of the supporter, medical history, and quality of connection	Participants with a younger supporter showed higher success rate	Not owning technology; problems with Internet connection	****
Collins et al. (2021) UK	Feasibility study	Community	Patients in a Memory Clinic waiting list	n = 72 Mean age: 77.5	Video and telephone for online consultations	Implemented			Consultation success, administration times, attendance rates	Most participants chose to be seen face-to-face (n = 45). Those opting for remote consultations mentioned its convenience	Not owning or being unable to use an internet-enabled device	****
Farhang et al. (2022) Chile	Qualitative	Community	Adults with MCI	n = 10 No other specification	Telephone and video calls for socialisation	Implemented			Video/phone interviews to understand impact on social isolation	Technology allowed people to communicate with family/friends, and to participate in social activities. Most used telephone	Lack of access and difficult in using technologies	****
Gedde et al. (2021) Norway	Qualitative	Community	People with dementia and family supporters	n = 126 dyads People with dementia: mean age 82 (SD 6.95), female (61%); living alone (40%), co-residing with caregiver (44%); Alzheimer's Disease (39%), unspecified dementia (46%) Supporters: mean age 66 (SD 12.35), female (66%); spouse (46%), children (52%)	Non-specific	Implemented			Telephone interviews with supporters to understand how the pandemic affected resource and service utilisation and interest in technology	Technology available to 71% of participants pre-pandemic. During COVID-19, 14% of the supporters reported more digital contact with relatives and 17% show increased interest in technologies	Limited involvement of people with dementia in product development	****
Giebel et al. (2021b) UK	Qualitative	Community and Institutions	People with dementia and family supporters	16 supporters: female (93.8%), mean age 55.3 (SD 6.2 years); child (62.5%); lived with the person with dementia (44.7%) Alzheimer's disease (50%), mixed dementia (12.5%), vascular dementia (12.5%)	Non-specific	Implemented	Interview developed with a person with dementia		Interviews to assess experience with support service	Few services provided remote support. Remote support did not replace in-person support	Support to use technology; visual impairments; digital illiteracy	****

(Continued)

Table 1. Continued.

Authors/country	Design	Setting	Target population	Participants	Technology and intended use	Stage of development	PPI	Ethical concerns	Measures and Outcomes	Key results	Barriers/limitations	MMAT
Goodman-Casanova et al. (2020) Spain	Quasi experimental Control group -treatment as usual.	Community	Adults with MCI or mild dementia and supporters	72 people with MCI or mild dementia and 21 supporters People with MCI/ dementia: mean age 73.34 (SD 6.07); female (65%), lived accompanied (74%) n=43 Mean age 85.7 (SD = 6.8), male (90.7%), white (81.4%) MCI (16.3%), mild dementia (27.9%), moderate (4.7%), moderate - severe (23.3%)	Television-based assistive integrated technology	Undergoing validation			Telephone interviews to assess physical and mental health and well-being	Technology can improve recreation and cognitive stimulation. No significant differences for health and well-being		****
Iyer et al. (2021) USA	Mixed-methods	Community	Adults who attended a geriatrics clinic	n=43 Mean age 85.7 (SD = 6.8), male (90.7%), white (81.4%) MCI (16.3%), mild dementia (27.9%), moderate (4.7%), moderate - severe (23.3%)	Video for online consultations	Implemented			Survey to assess feasibility, acceptability, and satisfaction with appointments	All participants satisfied over the time efficiency, cost, and travel time savings	Digital illiteracy; lack of devices with cameras; inability to follow instructions; sensory impairments	**
Kalicki et al. (2021). USA	Survey	Community	Older people including people with dementia	n=873 Mean age 82.7 (SD: 13.7), female (74.8%), dementia (46.6%); White (32.2%); Black/ African American (13.4%); partnered (married/life partner) (19.8%); un-partnered (68.6%)	Video for online consultations	Implemented			Survey to assess experience with telehealth.	Most participants (65%) had not used a video-consultation before. 15% used MyChart, 46% used FaceTime, 44% used another service; 37% were assisted by supporters	Cognitive and sensory impairments; lack of access to a supporter or to appropriate technology	***
Masoud et al. (2021). USA	Qualitative	Community (3 Memory Cafes)	People with dementia and family supporters	n=17 5 people with dementia (early to mild dementia) 12 supporters: Female (64.7%); spouses (66.7%); adult children (33.3%)	Memory Café through video conference	Implemented		Challenges with consenting individuals in virtual environments	Remote interviews to assess experiences of social connectedness	Improved social connectedness	Lack of access to technology/internet; limited engagement from people with advanced dementia; disinterest	****
Mattos et al. (2021). Brasil	Qualitative	Community	Family supporters	10 supporters: Female (70%), spouses (30%), adult children (60%), granddaughter (10%); all but one lived with the person with dementia n = 135 MCI (42.2%), female (72.6%); mean age 75.9 (SD = 6.1); living with spouses (48.9%) No differences between groups	Virtual support groups	Implemented	Participants identified session topics	Privacy issues as shared their space with the person with dementia	Interviews to assess impact of pandemic on support networks	Important for information and guidance about dementia and self-care. Positive impact on emotional state, well-being, social isolation, and loneliness	Old technology; unfamiliarity with technology; no internet access	****
Park et al. (2021) South Korea	Randomised controlled trial groups- traditional cognitive training; and no intervention	Institutions (Dementia Centres)	People with MCI and at risk of dementia	n = 135 MCI (42.2%), female (72.6%); mean age 75.9 (SD = 6.1); living with spouses (48.9%) No differences between groups	Humanoid robot featured with a cognitive training system.	Available by Robocare		Questionnaires for cognitive function, neuropsychological functions; and depression	Questionnaires for cognitive function, memory complaints, neuropsychological functions; and depression	Greater short-term effect than the controls on depression, language production, short term memory, and attention	Unfamiliarity with robots; requires training and assistance	****

(Continued)

Table 1. Continued.

Authors/country	Design	Setting	Target population	Participants	Technology and intended use	Stage of development	PPI	Ethical concerns	Measures and Outcomes	Key results	Barriers/limitations	MMAT
Quail et al. (2021), UK	Case report	Community	People with dementia and family supporters	n = 2 1 person with Alzheimer's Disease (male) and 1 supporter (spouse)	Video and telephone to deliver cognitive stimulation and reminiscence therapy	Implemented		Safety-netting concerns around remote assessment	Observations. No specific outcomes defined	Reduced apathy, improved mood, cognition, and engagement	Lack of guidance on digitally delivered assessment and care; limited tools for online assessment; unfamiliarity with technology	**
Talbot and Briggs (2022), UK	Qualitative	Community	People with dementia	n = 19 people with mild-to-moderate dementia (12 male)	Non-specific	Implemented			Interviews conducted remotely	Technology used to enhance social connection, self-actualisation, and wellbeing. Can reduce isolation, facilitate access to support groups, and to cognitive stimulation.	Perceptual difficulties: online spaces not always dementia-friendly and training needed	*****
Tam et al. (2021), Canada	Survey	Community	People with dementia and family supporters	n = 417 395 care partners (310 female) 22 people with dementia 376 White/Caucasian	Telephone and video calls for socialisation	Implemented	Survey was piloted with people with dementia	Privacy concerns raised	Survey to assess resource needs, mental health and well-being needs, the use of technology for social connection	Technology helped to improve social connectedness. Participants felt comfortable using technology, however it did not feel the same as in-person	Problems logging in, unfamiliarity with technology, video/audio issues, limited internet quality and privacy concerns	***
Tuijit et al. (2021b), UK	Qualitative	Community	People with dementia and informal supporters	n = 61 30 people with dementia: 17 female; 9 Alzheimer's Disease, 7 mixed and 5 vascular; 20 lived with the supporter 31 supporters: 20 female, 15 adult children, 14 spouses, 2 friends	Telephone for online consultations	Implemented	Feedback on interview schedules collected from a supporter and a person with dementia		Telephone/video interviews to understand experiences of people with dementia and supporters with telephone consultations	46 interviews analysed; Remote consultations seem feasible, but participants preferred in-person consultations	Sensory problems; supporter often needed	*****
Van Orden et al. (2022), USA	Qualitative	Community and Dementia centre	Older adults including people with dementia	n = 289 Female (82%), lived alone (72%) mean age 81 (SD: 11.49)	Robotic pets	Commercially available for companionship			Interviews with 29% of participants to assess isolation and loneliness; observations of 8 staff members to assess engagement with the robotic pets	Robotic pets provide companionship and tackle loneliness. Anxiety reduction and/or increased socialisation due to positive group interactions and with staff	The degree to which people believe the robotic pets are real may be harmful	***
Weems et al. (2021), USA	Mixed methods	Community	Family supporters	n = 28 2 in-person; 9 video and 17 telephone; spouses (85.7%), female (96%), mean age 68 years	Video conferencing to deliver support groups and webinars	Implemented			Questionnaires for burden and depression; supporter's comments on satisfaction; interviews with 2 programme facilitators	Virtual support groups well received. Enhanced connectedness and support. Supporters had better scores on burden post-programme; no difference found for depression	Unfamiliarity with the platform, limited internet access and participant distractions due to caregiving tasks. Problems in reading non-verbal communication	**
Yahara et al. (2021), Japan	Case report	Day care	People with MCI	2 adults with MCI (1 male – 80 years; 1 female – 92 years)	Remote reminiscence	Undergoing validation		Effectiveness and safety of technology was tested in people with MCI	Anxiety, burden, and attitudes towards participation assessed via questionnaires before and after each session	Effects of remote reminiscence comparable to in-person. Can reduce anxiety and caregiver burden	Unfamiliarity with technology	**



were analysed using thematic synthesis and organised according to the questions posed by the review. The thematic synthesis comprised three stages: 1) two reviewers (CS and MC) first analysed the abstracts of each included article and developed a list of codes and key findings. This list was updated and adjusted by two other reviewers (AF and FMH) during data extraction and revised by all authors; 2) similarities between codes were identified. Codes were grouped into 'themes' that captured and described patterns in the data across studies; 3) in a group discussion, all authors finally interpreted the meaning of each theme in relation to the research questions and a narrative description for each one of them was provided.

## Results

A total of 379 records were initially identified through database search. Duplicates were removed ( $n=113$ ) and the titles of the remaining records reviewed. Of these, 52 records were considered appropriate for further screening. The abstracts of these 52 records were reviewed and studies that did not meet the inclusion criteria were excluded. This left 30 full-text articles to be assessed for eligibility. At this stage, reports were excluded based on varying reasons: not COVID-19 related; population that did not suit the inclusion criteria; study design that did not meet the inclusion criteria; no technology assessed. This led to a total of 17 records for final inclusion. The search was repeated three months later, prior to the start of analysis, and one further study was identified and included in this review (Talbot & Briggs, 2022; Figure 1).

### Characteristics of the included studies

The geographical scope of the included studies was varied, with five studies from each of United States of America (USA) and United Kingdom (UK) and one study from each of eight other countries: Brasil, Canada, Chile, Italy, Japan, Norway, South Korea, and Spain. All were published in English. Most studies used descriptive cross-sectional designs ( $n=16$ ). Of these, eight were qualitative, five quantitative and three used mixed methods. Two interventional studies were included - a randomised controlled trial (Park et al., 2021) and a pre-post quasi experimental study (Yahara et al., 2021). The effect sizes were omitted in most quantitative studies. Most studies were conducted in the community ( $n=15$ ); two reported data from care homes (Park et al., 2021; Yahara et al., 2021) and one from both institutional and community contexts (Giebel et al., 2021b). Ten studies involved people with dementia only, six included both people with dementia and their family supporters, and two were concerned with family supporters only. Four studies targeted people with mild cognitive impairment (Farhang et al., 2022; Goodman-Casanova et al., 2020; Park et al., 2021; Yahara et al., 2021). Talbot and Briggs (2022) involved people living with mild-to-moderate dementia; the severity of dementia was not clearly reported in the remaining studies.

The level of public involvement (PPI) was limited. In four studies, the PPI can be mainly described as advisory/consultative, as per the National Institute for Health Research (NIHR) categorisation. People with dementia contributed to the designing of interview topics (Giebel et al., 2021b) and session themes (Mattos et al., 2021), piloting and refining a survey (Tam et al., 2021), and in providing feedback on draft interview guides (Tuijt et al., 2021b). The remaining studies did not report on PPI.

Reference to ethical issues was scarce and limited to: dilemmas between promoting autonomy and avoiding risk, or

maintaining privacy (Mattos et al., 2021; Tam et al., 2021) and increasing safety measures (Farhang et al., 2022) difficulties in obtaining informed consent when people with dementia do not understand or are unaware of the presence of the technology (Masoud et al., 2021); and safety-netting concerns around collecting data online (Quail et al., 2021), as this may not clearly detect causes for distress and restlessness. The quality of the evidence was mixed, and neither robust nor easily generalisable.

### Type and impact of technologies

Three studies focused on the use of non-specific digital technologies during the pandemic (Gedde et al., 2021; Giebel et al., 2021b; Talbot & Briggs, 2022). The remaining studies involved: i) Video conferencing or telephone for social connection, remote consultations, and intervention delivery (Arighi et al., 2021; Collins et al., 2021; Farhang et al., 2022; Iyer et al., 2021; Kalicki et al., 2021; Masoud et al., 2021; Mattos et al., 2021; Quail et al., 2021; Tam et al., 2021; Tuijt et al., 2021a; Weems et al., 2021; Yahara et al., 2021) ii) Robots - Humanoid (Park et al., 2021) and Pet robots (van Orden et al., 2022); and iii) Telemedicine (Goodman-Casanova et al., 2020).

The framework by Carretero (2015) and Lorenz et al. (2019) was used to organise the technologies by typology. The largest number of technologies identified in the literature were within the categories 'treatment and interventions' (Mattos et al., 2021; Park et al., 2021; Quail et al., 2021; van Orden et al., 2022; Weems et al., 2021; Yahara et al., 2021) and 'care delivery' (Arighi et al., 2021; Collins et al., 2021; Goodman-Casanova et al., 2020; Iyer et al., 2021; Kalicki et al., 2021; Tuijt et al., 2021b), followed by 'social interaction and networking' (Farhang et al., 2022; Masoud et al., 2021; Tam et al., 2021).

*Treatment and interventions* ( $n=6$ ). This category covers technologies that are intended to provide psychosocial support and improve participants' wellbeing.

One study focused on pet robots to promote socialisation (van Orden et al., 2022). The study shows that robotic pets can help reduce loneliness and anxiety and increase socialisation by promoting positive group interactions and experiences (van Orden et al., 2022). Park et al. (2021) evaluated the impact of a robot-assisted cognitive training programme. Compared to traditional cognitive training, this programme, conducted over 6 weeks with people living with MCI, showed a greater effect on depression and global cognitive function in the short-term. Positive effects were also reported for language production, memory, and attention (Park et al., 2021).

Yahara et al. (2021) evaluated the use of remote reminiscence and Quail et al. (2021) a remote therapeutic intervention which included amongst others, cognitive stimulation activities, reminiscence, and music therapy, to improve general cognition. Short-term benefits on people with dementia included reduced apathy, better mood, cognition, and engagement (Quail et al., 2021). No significant differences were found between remote reminiscence and face-to-face reminiscence, with the former also showing a reduction in supporters' anxiety and burden (Yahara et al., 2021).

The two studies targeting supporters were focused on distance support groups aiming to provide emotional support and to minimise the impact of COVID-19 pandemic on their mental health (Mattos et al., 2021; Weems et al., 2021). These studies showed that remote support groups can be an important tool to access information and guidance concerning dementia and improve families' self-care. They were well received by

supporters and a positive impact on emotional state and well-being was reported, together with a reduction of social isolation and loneliness (Mattos et al., 2021).

*Care delivery* ( $n=6$ ). The category 'care delivery' covers telecare and telehealth interventions. Technologies classified under this category aimed to facilitate direct contact and exchange of relevant information between professionals, people with dementia and their supporters. Five studies used remote consultations with care professionals via telephone (Tuijt et al., 2021b), video (Arighi et al., 2021; Kalicki et al., 2021) or both (Collins et al., 2021; Iyer et al., 2021). Collins et al. (2021) refer that most participants in their study opted for video conference consultations as an alternative to telephone consultations. Reasons included increased ability to visualise the context and to enable the entire care team to meet the patient at the same time (Iyer et al., 2021). Collins et al. (2021) suggest that people using video conferences tend to be younger than those using telephone. According to the study conducted by Kalicki et al. (2021) in the USA, FaceTime was the most used platform for video conferences.

A further study (Goodman-Casanova et al., 2020) investigated a television-based platform service designed to provide telecare services at home using the TV. Whilst no differences were seen in health and wellbeing, the potential of the product to enhance recreation levels was highlighted.

*Social interaction and networking* ( $n=3$ ). This category includes technologies that used distance communication, via mobile phone or Internet applications, or online platforms to exchange experiences (Lorenz et al., 2019). They can play an important role for people with dementia and their supporters by supporting the maintenance of social interactions despite the COVID-19 related stay-at-home orders and travel restrictions.

Masoud et al. (2021) report on the experiences of those who have attended virtual Memory Cafes. Farhang et al. (2022) and Tam et al. (2021) explored the experiences of living with dementia during the pandemic, reflecting on the use of phone and video calls to maintain social connectedness. Participants in these studies considered technology essential to promote social connectedness (Giebel et al., 2021b; Masoud et al., 2021; Talbot & Briggs, 2022). Overall, people with dementia and their supporters reported feeling comfortable using technology to connect with others, however, both groups reported that virtual connections did not feel the same as in-person (Tam et al., 2021). Some people with dementia reported a struggle to manage online conversations (Talbot & Briggs, 2022). While people with dementia have demonstrated ability to learn technological skills, they also expressed a need for training on how to use digital technologies. In Talbot and Briggs (2022), dementia-friendly leaflets containing information on how to use technologies, such as Zoom, was mentioned as a specific helpful resource (Talbot & Briggs, 2022).

### **Uptake of technologies during COVID-19**

Only two of the identified studies focused on the changes in the use of technologies by people living with dementia and their supporters during the COVID-19 pandemic (Gedde et al., 2021; Kalicki et al., 2021). Gedde et al. (2021) provide a snapshot of access to assistive technology by people living with dementia and their family supporters before and during the pandemic. The study, involving 126 dyads (people with dementia and family supporters), showed that 14% of the family supporters reported more digital contact with people living with dementia, and approximately 20% showed increased interest in technologies. In a study conducted in USA, Kalicki et al. (2021) reported

that 35% of 310 people living with dementia in the community engaged in video-based telehealth encounters for the first time during the pandemic.

### **Facilitators and barriers**

Thirteen studies identified several factors that affected the use of technologies during the pandemic. These were categorised into barriers and facilitators related to the technology itself, the individuals using the technology and their supporters.

*Technology-related factors*. Participants expressed a high degree of satisfaction over convenience (Collins et al., 2021; Weems et al., 2021), time efficiency, adaptability (i.e. ability to minimise time away from families and friends) (Weems et al., 2021) and cost savings of technologies (Iyer et al., 2021). However, studies also identified several technology-related barriers. Most barriers were related to poor internet connection and lack of access to technology (Farhang et al., 2022; Iyer et al., 2021; Masoud et al., 2021; Mattos et al., 2021; Quail et al., 2021; Tam et al., 2021; Weems et al., 2021), followed by studies reporting that technology uptake did not exempt the help or presence of a caregiver or assistant (Giebel et al., 2021b; Kalicki et al., 2021; Park et al., 2021; Quail et al., 2021; Tuijt et al., 2021b). Four studies reported the lack of capable devices (including old computers or devices without cameras) (Iyer et al., 2021; Kalicki et al., 2021; Masoud et al., 2021; Mattos et al., 2021), and one mentioned lack of guidance on digitally delivered assessment and care (Quail et al., 2021). Four studies raised questions related to experiences of impersonal care delivery and interaction (Masoud et al., 2021; Mattos et al., 2021; Quail et al., 2021; Weems et al., 2021), and one study (van Orden et al., 2022) mentioned emotional implications that should be safeguarded when using robot companion pets, including the degree to which adults believe the robotic pets to be real.

Kalicki et al. (2021) found that care professionals were often unaware of these *non-medical* barriers to telehealth access. In addition, Giebel et al. (2021b) noted that few community and institutionalised dementia care services in the UK were able to provide support via technology. Of those that did, many were delayed in getting set up, leaving people with dementia in need of support for some time.

*Individual-related factors*. The most frequently reported individual-level barriers comprised difficulties with technology use, either due to unfamiliarity, lack of experience and knowledge about technology use, or digital illiteracy (Farhang et al., 2022; Gedde et al., 2021; Giebel et al., 2021b; Iyer et al., 2021; Mattos et al., 2021; Park et al., 2021; Quail et al., 2021; Talbot & Briggs, 2022; Tam et al., 2021; Tuijt et al., 2021b; Weems et al., 2021). Compared to people with dementia, supporters reported less issues when using technology, including less problems logging in or in understanding how the technology works (Tam et al., 2021).

Difficulties related to the dementia and dementia stage, including cognitive impairment and behavioural disturbances (Iyer et al., 2021; Kalicki et al., 2021; Masoud et al., 2021; Quail et al., 2021; Tuijt et al., 2021b) together with visual and hearing limitations (Giebel et al., 2021b; Iyer et al., 2021; Kalicki et al., 2021) were also common. Lack of interest by the person with dementia in using technology was reported by one study

(Masoud et al., 2021), whereas another (Gedde et al., 2021) reported that only a minority of supporters (17%) showed an increased interest in technology under COVID-19 pandemic restrictions.

To overcome these barriers, people with dementia relied on their relatives to support them to use the technology (Tuijt et al., 2021b). Consequently, barriers related to time-consuming demands and the overburden of caregiving responsibilities were also mentioned by supporters (Mattos et al., 2021; Weems et al., 2021).

## Discussion

Against a backdrop of unprecedented challenges in access, availability and utilisation of medical assistance, social support and care services, this rapid review aimed to explore how people with dementia and their supporters have been using technology during the COVID-19 pandemic.

Recent recommendations stress the importance of identifying the needs of those with dementia and their supporters in order to establish technological strategies for their assistance and support (Cuffaro et al., 2020). The studies included in this review focused on a variety of assistive and everyday technologies. The most common ones fell into the categories 'treatment and interventions' (technologies aiming to provide psychosocial support and improve participants' wellbeing) and 'care delivery' (technologies aiming to facilitate direct contact and exchange of relevant information between professionals, people with dementia and their family supporters) and focusing on the remote delivery of care or psychosocial interventions. Available evidence on technology for supporters is focused on technology-based interventions i.e. remote programmes aiming to improve the provision of care. Supporters use these services to obtain information about their needs, to share experiences, and to get emotional support.

The above evidence shows that technology is often well-accepted by people with dementia and their supporters. It is associated with positive outcomes, including social connectedness, and improved mood, and can help to buffer the negative impacts of caregiving. Albeit the benefits that have been reported, several barriers are also highlighted and are likely to threaten the engagement and adoption of these solutions. These include lack of digital literacy or limited access to a supporter to assist with the technologies, limited access to appropriate technology, the overreliance on supporters' abilities, and individuals' cognitive or sensory impairments. Whilst the potential of technologies in alleviating caregiving burden, burden itself is reported by supporters to be a barrier to the use of technologies.

Overall, these barriers overlap with the ones identified in previous studies (Egan & Pot, 2016; Guisado-Fernández et al., 2019; Meiland et al., 2017), and suggest that there are common factors that undermine a more extensive adoption of assistive and everyday technologies. In this respect, one may expect that by targeting efforts to address these modifiable barriers the adoption of these solutions will likely be promoted and increased. Whilst these challenges also existed in a pre-pandemic era, they have become more apparent during COVID-19, due to an increased need for digital contact to overcome the reduced availability of community and in-person support services (Gedde et al., 2021; Kalicki et al., 2021). Although a huge effort was made to keep services running, in the UK, for example, Giebel et al. (2021b) noted that many dementia care services were unable or were significantly delayed in setting up

technology to support people during the pandemic. It became evident in the identified studies that only a minority of people with dementia were able to use the technologies independently; most participants needed assistance from an engaged supporter. Addressing technological issues (such as lack of internet access) and providing individual support when introducing a technology are encouraged, but difficult to meet during a pandemic. It is therefore recommended to fully use the time after the pandemic to design and implement technologies tailored to the needs of people with dementia, particularly to those that live alone or do not have supporters. Over the next few years, clinicians, service providers and policymakers, should seize these opportunities to support the technological transformation in dementia care.

A minority of studies reported on new technologies; most have focused on existing, easily accessible, and low-cost everyday technologies that have been repurposed as an assistive technology during the COVID-19 to counteract the negative impact of the pandemic on people's lives.

Studies conducted during the pandemic have been mostly targeted at people living at home in the community rather than in institutional care settings. People with dementia living in care settings were among the most severely affected by the pandemic. The vulnerability of this population means that they often rely on personal assistance when using technology. Restrictions imposed by the pandemic, such as physical distancing, may have deprived people of the support needed to use some technologies, whilst increasing the use of others. Adding to this, the visiting restrictions, together with the problems posed by the pandemic itself, made it difficult for care settings to take part in research. This same reason, together with differences between countries when it comes to involvement of experts by experience in research, may have accounted for the limited scope of PPI found in the studies. Prior research has already highlighted the pitfalls of deploying technological solutions without proper validation by their target population, pointing to the need for user-centred design and user testing of solutions, particularly if these are aimed at people with dementia and their caregivers (Behera et al., 2021; Evans et al., 2015; Øksnebjerg et al., 2020; Rai et al., 2020). Despite the pandemic-related challenges, we believe the active involvement of people with dementia and their supporters in different stages of the research was still viable. Experts by experience, particularly those living in the community, could have been sourced through national organisations that provide involvement opportunities for patients and the public.

A rapid review was deemed to be the most appropriate method to gather timely evidence related to COVID-19. A systematic review investigating the effectiveness of technologies to support people with dementia and their supporters would provide a full overview over the field, but it could be outdated by the time it would be made available.

In addition, this review provides a retrospective snapshot of what has been researched rather than reflecting the current picture and what the future might hold. Several technologies may have been developed and implemented but not reported due to COVID-19 constraints. Furthermore, this synthesis may be limited by the broad scope of the theme, that led to the inclusion of studies with diverse designs, methods, and outcomes. In particular, the use of various outcome measures made it hard to compare results across studies. This suggests the need for a more judicious application of standardised measures that will support clinicians and researchers to understand how technology can be

used to overcome the immediate and long-term needs of people with dementia and their supporters. Also, the effect sizes were omitted in most quantitative studies, meaning that the magnitude of differences is often unaddressed. Most studies were conducted in the USA and UK which also hinders generalisation, as some of the technologies available or in common use may differ between countries (for example, FaceTime is prevalent in USA).

Finally, identifying the stages of dementia for which the reported technologies were intended was problematic as this was not clearly or consistently reported in the studies. As people with dementia represent a heterogeneous group, it would have been valuable to map technologies against types of dementia, as they present different needs. For example, compared to Alzheimer's Disease and other common types of dementia, people with Posterior Cortical Atrophy (PCA) usually have quite well-preserved memory but are more likely to experience difficulties with vision. This can potentially pose different and additional challenges on using technology (e.g. finding it difficult to engage or to recognise people in an online meeting).

Despite these limitations, frameworks were used to frame and synthesise evidence regarding typology of technologies and PPI, which are believed to strengthen the intelligibility and replicability of our methodology. In addition, the review team consisted of dementia researchers from a range of disciplines from different health and social backgrounds. Screening, full-text review, and data extraction were performed independently by at least two reviewers, minimising the potential for single-reviewer bias, while we have also reduced the potential for selection bias by using a broad comprehensive search strategy. With this we expect the rapid review can contribute to expanding knowledge on the topic and increase public awareness of technologies and its role in dementia care.

## Conclusion

Evidence generated during the COVID-19 pandemic suggests that off-the-shelf and low-cost solutions, including online platforms, have been used by people with dementia and their supporters to respond to the negative impacts of physical and social restrictions imposed by the pandemic. While the pandemic has fast-tracked the adoption of this technology, its use is likely to continue beyond the pandemic. Future studies should be targeted at the age-related digital divide, as well as at health-related conditions such as sensory impairments that are likely to be experienced by the end users of such technologies. It became evident that only a minority of people with dementia were able to use the technologies independently. Future studies need to ensure that technologies can leverage dementia support and care and that people with dementia are enabled and empowered to use it.

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## Appendix A. Scopus search strategy

(TITLE-ABS-KEY (dementia OR dement\* OR alzheimer\* OR 'lewy body' OR creutzfeldt OR binswanger OR korsakoff OR frontotemporal OR 'vascular dementia' OR 'pick disease' OR 'cognitive impairment' OR 'cognitive decline' OR 'memory loss') AND TITLE-ABS-KEY (covid OR 'covid-19' OR corona\* OR 'sars cov 2') AND TITLE-ABS-KEY (technolog\* OR 'assistive technolog\*' OR

'assistive device\*' OR device\* OR electronic\*)) AND (LIMIT-TO (PUBSTAGE, 'final') OR LIMIT-TO (PUBSTAGE, 'aip')) AND (LIMIT-TO (PUBYEAR, 2022) OR LIMIT-TO (PUBYEAR, 2021) OR LIMIT-TO (PUBYEAR, 2020)) AND (LIMIT-TO (DOCTYPE, 'ar') OR LIMIT-TO (DOCTYPE, 're')) AND (LIMIT-TO (LANGUAGE, 'English') OR LIMIT-TO (LANGUAGE, 'Portuguese') OR LIMIT-TO (LANGUAGE, 'Dutch') OR LIMIT-TO (LANGUAGE, 'German') OR LIMIT-TO (LANGUAGE, 'Spanish'))

## Appendix B. MMAT tool (Hong et al., 2018)

Category of study designs	Methodological quality criteria	Responses			Comments
		Yes	No	Can't tell	
Screening questions (for all types)	S1. Are there clear research questions? S2. Do the collected data allow to address the research questions? <i>Further appraisal may not be feasible or appropriate when the answer is 'No' or 'Can't tell' to one or both screening questions.</i>				
1. Qualitative	1.1. Is the qualitative approach appropriate to answer the research question? 1.2. Are the qualitative data collection methods adequate to address the research question? 1.3. Are the findings adequately derived from the data? 1.4. Is the interpretation of results sufficiently substantiated by data? 1.5. Is there coherence between qualitative data sources, collection, analysis and interpretation?				
2. Quantitative randomized controlled trials	2.1. Is randomization appropriately performed? 2.2. Are the groups comparable at baseline? 2.3. Are there complete outcome data? 2.4. Are outcome assessors blinded to the intervention provided? 2.5. Did the participants adhere to the assigned intervention?				
3. Quantitative non-randomized	3.1. Are the participants representative of the target population? 3.2. Are measurements appropriate regarding both the outcome and intervention (or exposure)? 3.3. Are there complete outcome data? 3.4. Are the confounders accounted for in the design and analysis? 3.5. During the study period, is the intervention administered (or exposure occurred) as intended?				
4. Quantitative descriptive	4.1. Is the sampling strategy relevant to address the research question? 4.2. Is the sample representative of the target population? 4.3. Are the measurements appropriate? 4.4. Is the risk of nonresponse bias low? 4.5. Is the statistical analysis appropriate to answer the research question?				
5. Mixed methods	5.1. Is there an adequate rationale for using a mixed methods design to address the research question? 5.2. Are the different components of the study effectively integrated to answer the research question? 5.3. Are the outputs of the integration of qualitative and quantitative components adequately interpreted? 5.4. Are divergences and inconsistencies between quantitative and qualitative results adequately addressed? 5.5. Do the different components of the study adhere to the quality criteria of each tradition of the methods involved?				