

BMJ Open Technology-based interventions for nursing home residents: a systematic review protocol

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ABSTRACT

Introduction A growing number of technology-based interventions are used to support the health and quality of life of nursing home residents. The onset of COVID-19 and recommended social distancing policies that followed led to an increased interest in technology-based solutions to provide healthcare and promote health. Yet, there are no comprehensive resources on technology-based healthcare solutions that describe their efficacy for nursing home residents. This systematic review will identify technology-based interventions designed for nursing home residents and describe the characteristics and effects of these interventions concerning the distinctive traits of nursing home residents and nursing facilities. Additionally, this paper will present practical insights into the varying intervention approaches that can assist in the delivery of broad digital health solutions for nursing home residents amid and beyond the impact of COVID-19.

Methods and analysis Databases including the PubMed, PsycINFO, CINAHL and Scopus will be used to identify articles related to technology-based interventions for nursing home residents published between 1 January 2010 to 30 September 2021. Titles, abstracts and full-text papers will be reviewed against the eligibility criteria. The Cochrane Collaboration evaluation framework will be adopted to examine the risk of bias of the included study. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses procedures will be followed for the reporting process and implications for existing interventions and research evaluated by a multidisciplinary research team.

Ethics and dissemination As the study is a protocol for a systematic review, ethical approval is not required. The study findings will be disseminated via peer-reviewed publications and conference presentations.

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BACKGROUND

Nursing homes have been described as a ‘ground zero’ throughout the COVID-19 outbreak.^{1–4} While the final impact of COVID-19 on short-term and longer-term health outcomes is still unclear as the pandemic continues to unfold,⁵ what is clear is that nursing home residents have

Strengths and limitations of this study

- This systematic review protocol follows the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols guidelines.
- Our review will systematically evaluate the impact of technology-based interventions for nursing home residents.
- The social ecological model will be adopted to theoretically and systematically guide our review process.
- The current study is limited to evidence within the scope of nursing home residents and technology-based interventions.
- Non-English databases will not be searched, which might limit the representativeness of the research findings.

suffered some of the gravest consequences of this pandemic so far.⁶ Contributing to over 40% of COVID-19 deaths within the USA, 100 033 residents and workers in nursing homes have passed away from COVID-19 (as of 24 November 2020).⁷ Worse still is the fact that the nursing home residents who have succumbed to COVID-19 mostly died without the care or company of their family members.^{8–10} These staggering numbers underscore the urgent need for healthcare researchers to understand factors that make nursing home residents more vulnerable to emergency events such as COVID-19¹¹ and to identify practical solutions that can address these factors in a timely fashion.

Nursing homes and nursing facilities provide long-term service and support for individuals living with chronic or disabling conditions who are unable to live at home independently.^{12–14} Often living with multiple morbidities, in the USA, approximately 85.1% of nursing home residents are 65 years and older, with 75.8% of these individuals



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experiencing hypertension, 58.9% living with Alzheimer's disease and 53.0% of residents living with depression.¹⁴ Three sets of factors likely contribute to the alarming COVID-19 death rates seen in nursing homes: (1) the characteristics of nursing home residents, (2) the capabilities of nursing home facilities and (3) the microlevel and macrolevel supports available to nursing home residents.¹¹ On both microlevel and macrolevel, research indicates that nursing home residents are more susceptible to infection and fatal outcomes from COVID-19 because they are often older adults living with medical conditions that compromise the immune systems and lowers their ability to combat the virus.^{14–17} Additionally, they often lack specific self-care skills, such as using telemedicine tools, or they may have a physical or cognitive impairment that impedes their ability to take care of their health and well-being.^{18–22} The macroperspective focuses on the unique characteristics of nursing home facilities, as they are typically operating in a close and shared-living environment—conditions that are ideal for the spread of the virus.^{10 17 23} Further, nursing homes often lack adequate healthcare resources or infrastructure needed to curb the impact of COVID-19. For example, numerous studies have indicated a lack of investment in training programmes for nursing home staff, in addition to high turnover rates,^{24 25} that management teams are often ineffective^{26 27} and that the nursing home infrastructure is often too outdated.^{23 28–30}

The third set of factors that contribute to nursing home residents' vulnerability to COVID-19 centres on social support available to these adults.¹¹ Nursing home residents often have limited access to microlevel social support, including support from formal (eg, doctors and nurses) or informal caregivers (eg, family, friends and acquaintances),³¹ local community³² and organisations

(eg, inexperienced or inadequately trained staff).³³ Furthermore, nursing home residents often have limited macrolevel social support. This is evidenced by harmful social norms (eg, age-related discrimination)^{34–36} and inadequate policy support that facilitates healthy ageing and quality of life (eg, insufficient regulatory oversight to ensure quality care in nursing homes).^{4 37–39} These factors combined could result in severe health consequences in nursing home residents, such as wide viral spread.¹

The above areas of inquiry resonate with the core principles of the socioecological model,^{40–43} which highlights the way individuals are influenced by a series of synergistic interactions between intrapersonal and interpersonal factors (eg, residents, resident families), organisational characteristics (eg, nursing homes), policy (eg, legislative response) and the social/community (eg, ageism) context and how these processes can change over time (see figure 1.) To successfully and effectively protect nursing home residents from global health crises such as COVID-19, stakeholders such as policy-makers, healthcare professionals, researchers informal caregivers and older adults themselves all need to contribute to the change-making process (eg, research safeguards or underscores the importance of COVID-19 protective measures).^{44–49} While some effective changes are resource intensive, time consuming and need concerted efforts from multilevel stakeholders to achieve, there are cost-effective, efficient and accessible health solutions available to nursing home residents, such as technology-based interventions.^{50 51}

Technology-based interventions can be considered as the use of technology (eg, digital devices such as tablets and wearable devices, communication platforms) to manage or support health promotion strategies that could offer accessible, affordable, convenient, and user-friendly health solutions to a target audience.⁵² Compared with

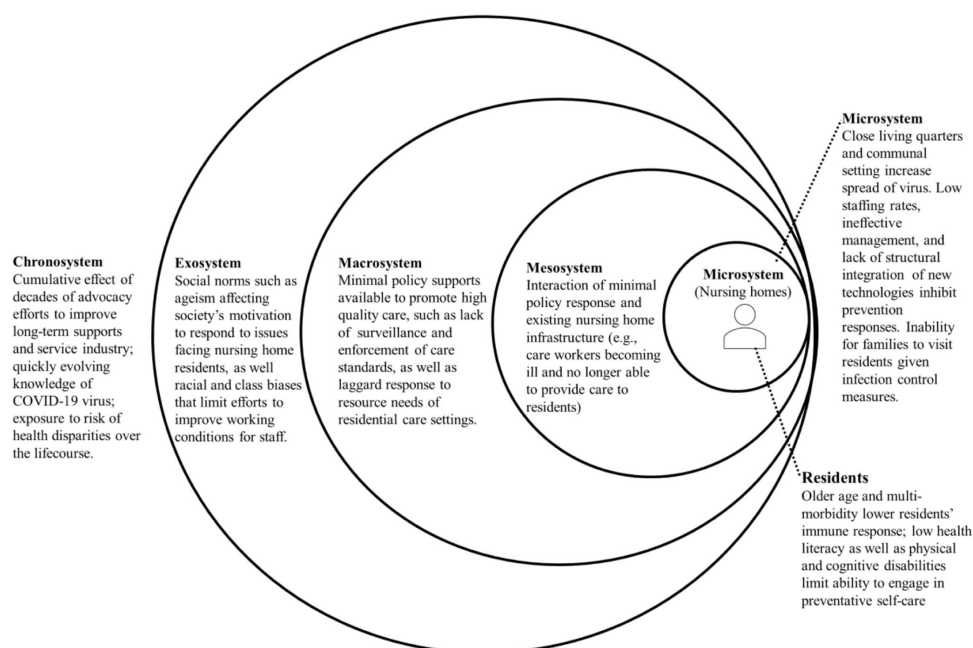


Figure 1 An ecological model of factors increasing nursing home resident vulnerability to COVID-19.

traditional health solutions, such as face-to-face consultations, technology-based interventions have the potential to deliver healthcare more effectively and can mitigate geographic and access-related limitations that, as studies show, can play a significant role within nursing homes.^{53–59} The evidence further suggests that technology-based interventions can help free healthcare professionals from repetitive work and allow them to make more meaningful contributions in delivering healthcare solutions to the care recipients.^{60–62}

Telemedicine and other technology-based solutions are particularly crucial given circumstances rendered by the COVID-19 pandemic, such as the limited ability for some healthcare providers to enter residences or for residents to visit their healthcare team for primary care visits. Limiting the exposure to infection through the use of telemedicine may assist in situations where a resident is required to attend a hospital appointment and return to a residence, thus alleviating the potential risk for a virus to spread to others.⁶³ Further, technologies that support residents' ability to remain in contact with families and friends outside of skilled care settings may reduce the adverse effects of loneliness and social isolation that are more common among nursing home residents compared with community-dwelling older adults.^{64 65}

While technology-based solutions have the potential to deliver health solutions to nursing home residents,^{66 67} there is limited awareness of the benefits and delivery options for state-of-art technology-based interventions specifically designed for nursing home residents. By factoring in the distinctive characteristics of nursing home residents and nursing home facilities, the main focus of this systematic review is to identify and evaluate technology-based interventions tailored explicitly for nursing home residents. Additionally, our study will

examine the delivery mode of the interventions, such as mobile-based versus computer-based interventions and interventions that require nursing home residents' input/engagement versus those that do not require users' input/engagement (eg, sensor-based interventions) amid the COVID-19 pandemic. Overall, our research aims are:

- ▶ To identify the characteristics and effects of technology-based interventions for nursing home residents.
- ▶ To identify effective technology-based interventions for nursing home residents that can be applied in the COVID-19 context.

METHODS

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) procedures will be adhered to in the reporting process (please see the online supplemental file).⁶⁸ This systematic review is registered with the International Prospective Register of Systematic Reviews system; these measures are to avoid unnecessary study duplication,^{69 70} increase research rigour,^{71 72} improve study comparability and replicability⁷³ and ultimately, promote quality and transparency in research.⁷⁴ The review will be carried out in line with the Cochrane Handbook.⁷⁵

Inclusion and exclusion criteria

Based on the research aims, inclusion criteria were set a priori (table 1). Articles published between 1 January 2010 to 30 September 2021 will be included in the review. This time period was selected to ensure a focus on up-to-date technologies, given the tendency of technology-based interventions to evolve and become out of date. The timeline will also make sure both studies conducted before and amid COVID-19 will be included in the

Table 1 Study inclusion criteria

Category	Criteria
Study population	Adults (≥18 years) living in nursing homes
Language	English
Intervention/health solution	Technology-based interventions (eg, educational materials delivered via smartphones and tablets, sensor devices, internet-based programmes, etc)
Key variable	Detailed descriptions of the technology-based interventions (ie, purpose of the intervention (to evaluate the aims of existing interventions), use of technology (to examine how different types of technologies have been applied among nursing home residents), application of the interventions (to investigate the degree to which the interventions have involved nursing home residents in the adoption/application of technologies), intervention exposure (to study how different interventions have been used among nursing home residents), outcome variables assessed/measured (to evaluate the outcomes of technology-based interventions, such as improved physical or psychological health or well-being; more satisfactory patient-provider communication) and whether the design of the intervention material is tailored to nursing home residents (to examine to degree to which the design technology-based interventions has taken the unique attributes of nursing home residents into consideration)
Study type	Empirical studies
Study design	Randomised controlled trials, experimental design, pre-post, quasi-experimental design and observational studies
Study outcome	Empirical reporting of the effect of the intervention (ie, qualitative designs excluded)

review. In this study, nursing home residents are defined as people ‘having a length of stay in a nursing home for more than 90 days at any point’.⁷⁶ Technology-based interventions are defined as ‘the use of technology to design, develop and/or deliver health promotion contents and strategies that aim to induce or improve positive physical or psychological health outcomes’ in nursing home residents.⁵² In other words, interventions that: (1) incorporate technology (eg, mobile applications), (2) use health promotional contents or strategies (eg, information or emotional appeals) and (3) aim to improve nursing home residents’ health outcomes (eg, mental health status) will be included in the review.

It is important to note that, in this study, technology-based interventions are considered conceptually different from phenomena such as digital solutions. Compared with concepts such as digital solutions, technology-based interventions are unique as they are: (1) evidence based: one of the main objectives of this study is to investigate and identify interventions that could offer the most benefits to nursing home residents based on empirical evidence, (2) purposeful: technology-based interventions are designed, developed and/or delivered often tailored to the unique attributes of the target audience (eg, nursing home residents) and (3) broader in scale and scope: technology-based interventions include interventions that are developed based on non-digital technologies (those that are based on systems that generate and process binary data such as 0 and 1), such as landline telephones and audiotapes, which adopt analogue technology (stores and interprets information in line with the devices physical properties).⁷⁷

Overall, articles will be excluded if (1) the study sample did not include a majority of nursing home residents (ie, nursing home residents $\leq 50\%$ of the total research

population), (2) the study did not focus on technology-based interventions (eg, conventional interventions such as face-to-face therapies), (3) study did not provide detailed information on the characteristics and effects of technology-based interventions (eg, little or no information on the design or outcomes of the interventions), (4) the study did not report original and empirical findings on intervention outcomes (eg, research protocols and systematic review studies) and (5) the study’s main research method was not randomised controlled trials, experimental design, pre–post, quasi-experimental design or observational studies.

Search strategy

Databases including PubMed, PsycINFO, CINAHL and Scopus will be searched for eligible articles. We will also search ProQuest Dissertations to examine grey literature sources. A search strategy was developed in consultation with a librarian experienced in systematic review methods. Search terms used to locate articles will centre on three concepts: nursing home residents, technology-based interventions and randomised controlled trials. An example PubMed search string is illustrated in [table 2](#). Similar search terms will be adopted that are in accordance with: (1) the scale and scope of the databases and (2) insights and evidence accumulated in the review process.

Study selection

Following the search, all citations will be collated and uploaded to Mendeley and duplicate studies will be removed. Titles and then abstracts will be screened by two principal reviewers independently. The same screening procedure will be adopted in the full-text article review process on selected article abstracts. Reasons for exclusion

Table 2 Example PubMed search string

Concept	Search string
Nursing homes	‘nursing home’[MeSH] OR ‘nursing home’[TIAB] OR ‘nursing homes’[MeSH] OR ‘nursing homes’[TIAB] OR ‘residential home*’[MeSH] OR ‘residential home’[TIAB] OR ‘caring home*’[TIAB] OR ‘home for the aged’ [MeSH] ‘home for the aged’ [TIAB] OR ‘long term care’[MeSH] OR ‘long term care’[TIAB] OR ‘senior housing’[TIAB] OR ‘assisted living facilities’[MeSH] OR ‘assisted living facilities’[TIAB] OR (senior[TIAB] OR geriatric[TIAB] OR elderly[TIAB] OR aged[TIAB] OR elder[TIAB] ‘older adults’[TIAB]) AND (housing[TIAB] OR living[TIAB])
Technology-based Interventions	‘technology’[MeSH] OR ‘technology’[TIAB] OR ‘eHealth’[TIAB] OR ‘telemedicine’[MeSH] OR ‘telemedicine’[TIAB] OR ‘tele-medicine’[MeSH] OR ‘tele-medicine’[TIAB] OR ‘telehealth’[TIAB] OR ‘telehealth’[TIAB] OR ‘connected health’[TIAB] OR ‘digital health’[TIAB] OR ‘mHealth’[TIAB] OR ‘mobile health’[TIAB]
Randomised controlled trials	randomized controlled trial[PT] OR randomized controlled trials as topic[MH] OR random allocation [MH] OR double-blind method[MH] OR single-blind method[MH] OR random*[tw] OR ‘Placebos’[MeSH] OR placebo[TIAB] OR ((singl*[tw] OR doubl*[tw] OR trebl*[TW] OR tripl*[TW]) AND (mask*[TW] OR blind*[TW] OR dumm*[TW]))
COVID-19	((coronavirus OR ‘corona virus’ OR coronavirinae OR coronaviridae OR betacoronavirus OR covid19 OR ‘covid 19’ OR nCoV OR ‘CoV 2’ OR CoV2 OR sarscov2 OR 2019nCoV OR ‘novel CoV’ OR ‘wuhan virus’) OR ((wuhan OR hubei OR huanan) AND (‘severe acute respiratory’ OR pneumonia) AND (outbreak)) OR ‘Coronavirus’[Mesh] OR ‘Coronavirus Infections’[Mesh] OR ‘COVID-19’[Supplementary Concept]OR ‘severe acute respiratory syndrome coronavirus 2’[Supplementary Concept]OR ‘Betacoronavirus’[Mesh])

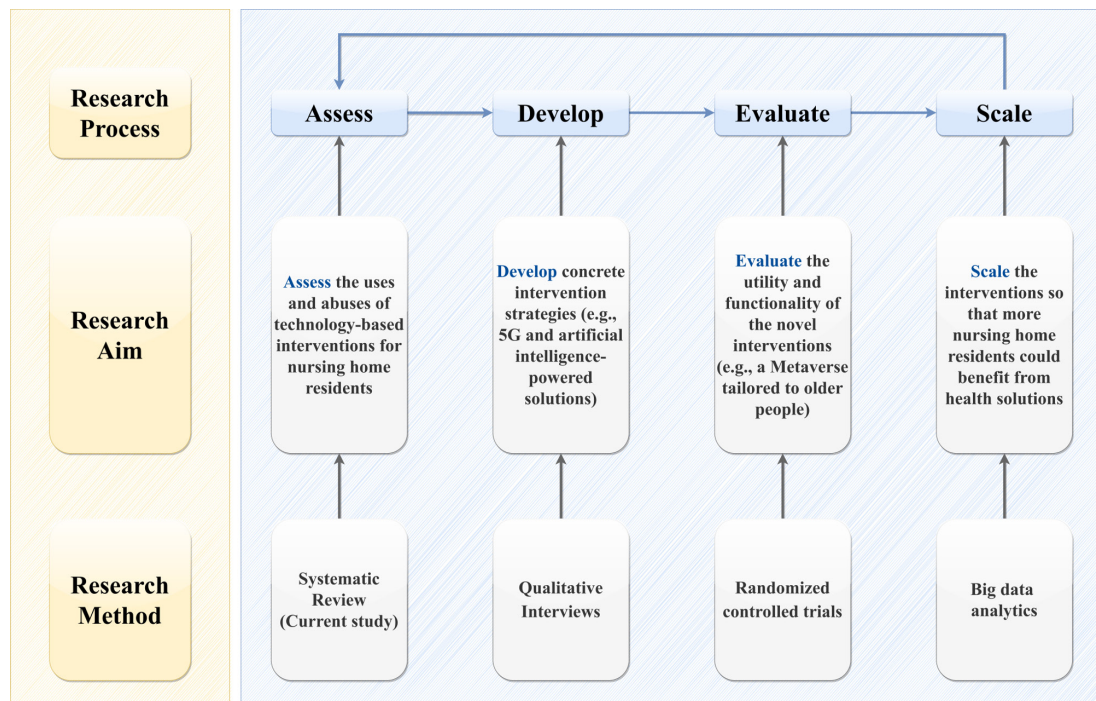


Figure 2 A schematic representation of the overarching research plan

will be recorded and detailed in the PRISMA flowchart. Discrepancies between reviewers will be resolved via group discussions using videoconferencing and email correspondence to reach a consensus.

Study quality assessment

The Cochrane Collaboration evaluation framework will be adopted to examine the risk of bias of the included study.⁷⁸ The framework has seven domains: random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective reporting and any other source of bias. The risk of bias will be evaluated independently by two reviewers (ZS and XL), who will qualitatively evaluate the risk of bias and provide a score (high, medium, low). Any discrepancy regarding the risk of bias will be resolved by consensus via group discussions. Most, if not all, members of the team will be involved in the discrepancy review process, wherein, if agreement cannot be reached, outside counsel will be invited to further shed light on the issue.

Data extraction and synthesis

Data on study design, sample characteristics (ie, sample size and sample details), intervention characteristics (ie, technology type, intervention application, intervention exposure and intervention materials), outcome variables assessed and research findings will be extracted by two main reviewers (ZS and XL). Findings from the included studies will be narratively synthesised to examine the characteristics and effects of the interventions. Gaining a more structured understanding of the interventions, the multidisciplinary study team will organise insights on intervention application and outcomes in tandem with

the distinctive traits of nursing home residents and the overall nursing home environment. Due to the heterogeneity found within the articles identified during a preliminary review of search results, meta-analyses are not considered.

Ethics and dissemination

As the study is a protocol for a systematic review, ethical approval is not required. Ethical research practices, such as the guideline proposed by the United States National Institutes of Health,⁷⁹ will be observed and abided by throughout the research continuum. The study findings will be disseminated via peer-reviewed publications and conference presentations.

Patient and public involvement

None.

DISCUSSION

There is a growing body of technology-based interventions designed to support the health and quality of life of nursing home residents.^{53–59} The onset of COVID-19 and recommended social distancing policy led to an increased interest in reliance on technology-based solutions.^{80–82} However, research has yet to provide comparative insight into the recent state of development of these interventions and how current evidence can be applied to the context of COVID-19. The use of the socioecological model, combined with multidisciplinary expertise, provides a framework to present practical insights on how these interventions can be used to deliver health solutions to nursing home residents amid and beyond the impact of COVID-19.

This research fills a critical gap in the literature by consolidating, in one place, the evidence for technology-based interventions empirically tested with nursing home populations. As the older adult population grows, there is an urgent need to identify effective technology-based interventions that can address the distinctive characteristics and preferences of nursing home residents.^{83–85} Improving person-centred care and the delivery of effective care solutions to nursing home residents, especially as the pandemic continues, is of critical importance. A comprehensive understanding of how available technology-based health solutions facilitate health-care for nursing home residents can help shed light on approaches that are available to these residents to fend off the negative health consequences amid and beyond the influence of COVID-19. While the COVID-19 pandemic has revealed troubling vulnerabilities in the long-term care system across the globe, it also shows how telemedicine can support nursing home residents and their families. Technology can also assist clinicians in connecting with patients when in-person medical visits are difficult or dangerous (eg, in rural settings, following natural disasters).⁸⁶ Overall, telemedicine and other technology-based interventions have the potential to provide a comprehensive range of benefits⁵² that should be sufficiently, if not fully, explored particularly in times of crises and catastrophes.⁸⁷ In addition to addressing imminent and relevant social emergencies, our overarching research (figure 2) could also inform policymaking on the use and application of technology-based interventions across nursing homes amid the pandemic and beyond. As the "silver tsunami" continues to gain momentum, it is about time for government and health officials to ready a "care tsunami" powered by advanced technologies and an avant-garde solution-focused mindset to improve the health and wellbeing of older people, especially nursing home residents. To live is but to grow old. How well societies take care of their older citizens, in essence, reflects how well humanity can be protected from the daily wear and tear of the forever grind. Following the lead of prior research, we hope this project could create a better present for nursing home residents and a more promising future for ourselves and beyond.

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