



Rapid review of digital technologies to prevent falls in people living with dementia

Charlotte Eost-Telling, Alex Hall, Yang Yang,
Barbara Hanratty, Martin Knapp,
Louise Robinson, Chris Todd

Executive Summary

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Charlotte Eost-Telling^a, Alex Hall^a, Yang Yang^a, Barbara Hanratty^b,
Martin Knapp^c, Louise Robinson^b, Chris Todd^a

NIHR Older People and Frailty Policy Research Unit

^a School of Health Sciences, University of Manchester

^b Population Health Sciences Institute, Newcastle University

^c Care Policy and Evaluation Centre, London School of Economics and Political Science

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Falls are an important public health issue worldwide¹ and one of the most common reasons for potentially preventable death, disability, and loss of independence. Falls also place an annual estimated £4.4bn additional cost for health and social care services, due to the care needed by those who are injured in non-fatal falls². Whilst older age is the strongest predictor of an increased falls risk, people who also have a cognitive impairment are more than twice as likely to fall and nearly four times as likely to have recurrent falls^{3,4}. The reasons for this are complex, and a number of additional fall risk factors have been identified for people living with dementia⁵. This is important because of the number of people currently living with dementia in the UK (approximately 900,000) is predicted to rise to over 1 million by 2025 and 1.6 million by 2040⁶. The research question addressed in this briefing is:

- *What is the evidence that digital technologies can reduce falls and fall risk for people living with dementia?*

This briefing considers the evidence from a rapid review of reviews and a summary of recent primary studies exploring the use of digital technologies for falls prevention in people living with dementia or mild cognitive impairment (MCI). We draw on search strategies from three recent reviews exploring technology, falls and older people^{7,8,9}. Searches undertaken for these reviews were updated and combined with terms from NICE Dementia [NG97] review search guidance¹⁰ to search five databases.

Seven systematic reviews^{11,12,13,14,15,16,17}, and one scoping review¹⁸ focussing on the use of technology, dementia, and falls were identified for inclusion. The scoping review¹⁸ only identified one relevant study, which was also included in the systematic reviews and as it adds no new information this scoping review is not considered further.

Types of technology: The evidence is presented according to key technologies which were identified from the literature and organised following the FARSEEING taxonomy¹⁹. Using this taxonomy all technologies identified would be classified as *Systems* although they differed in terms of *Locations* (i.e., they were all *Systems* technologies which were either body worn/fixed; environmental; or portable). Digital technologies can have various uses²⁰; for prediction (e.g. fall risk assessment), detection (e.g. alarm systems), monitoring (e.g. fall event recording research tools), or prevention (e.g. apps to improve strength and balance, or detectors to identify person out of bed and alert carer).

Environmental sensor-based systems / video systems: Two systematic reviews include studies with environment sensor-based systems (e.g., automated night lights triggered by a movement sensor, bed alarms and tracking bracelets)^{11,12}. The first review¹¹, includes only RCTs of interventions including sensor-based systems as part of caregiver intervention packages. It focuses on people living with dementia in the community and includes two RCTs of assistive technology interventions reporting the number of people who fell at home. The probability of a fall occurring was 50% lower for the groups with assistive technology, but the authors of the review report risk of bias as unclear for this study, specifically because of failure to report on allocation concealment. Also of note is the range of technologies assessed and whether they were delivered as single- or multi-component interventions. One study

included sensor triggered lights as the only assistive technology and found no impact on falls. The second study based on people with dementia in long-term care settings included a range of technology as part of a tele-assistance package. It reported a significant difference in risk of falling between intervention and control groups, but it was not possible to attribute the difference to a specific technology.

The second systematic review¹², based on studies in long term care settings for people living with dementia, includes three papers examining bed-exit alarms for fall prevention and showed mixed results. Two studies (a quasi-experiment and a RCT) showed no significant improvement in falls prevention with alarms, while the third (pre-post non-randomised) contrary to expectation showed a reduction in falls only after the sensors were removed, a finding potentially biased by staff motivation to have what they considered as ‘annoying’ alarms removed.

Exergaming and Commercial Games consoles: Two systematic reviews centred on the impact of exergaming include studies with people living with dementia^{13,14}. The first review¹³ concluded that very little robust research into exergaming and dementia had been published. This review only includes three studies, using ‘FitForAll’ or ‘Wii-Fit’ platforms. Although none of the papers measured fall rate per se, one multi-centre pre-post test control group study with community dwelling older adults reported significant improvements on a number of physical measures which could affect falls rates (surrogate falls outcomes). The second study, a pilot RCT, in an assisted living facility, found no significant differences between groups, and the third, pilot RCT focussed on older adults in the community, found a significant improvement on the Berg balance scale. The second systematic review on exergaming¹⁴ included participants living with dementia or MCI. They included 41 papers investigating a range of diseases and concluded that exergaming improves balance dysfunction and the exergames reviewed were safe for people living with neurological conditions. However, due to the small number of included studies including people living with dementia or MCI, they were unable to draw robust conclusions specifically for these groups.

Virtual reality: A systematic review of the use of Virtual Reality in improving health outcomes for community dwelling older adults¹⁵ included a single quasi-experimental study comparing people living with and without dementia. This study used a virtual reality headset to measure participants’ posture and falls during a simulation of falling downstairs. Findings indicated people living with dementia had significantly worse postural stability, significantly longer lag in cognitive strategies for postural correction and significantly delayed reactions to falling compared to those who were cognitively intact.

Apps: We did not find any systematic reviews specifically looking at app-based interventions, dementia and falls (but see below).

Wearable Tech / sensors: Two systematic reviews found reasonable evidence regarding the use of body worn sensors in relation to falls and older adults living with dementia^{16,17}. Overall, the first review¹⁶ incorporated four observational studies stating inclusion of people living with dementia. A further 10 studies, comprising 7 cross-sectional and 3 prospective studies, did not give information about participants’

cognitive status but were included in the review based on the authors' assertion that they probably included people living with mild dementia.

Their recommendations included:

- Wearable sensors are acceptable tools to assess fall risk for up to eight days, in both lab-based settings and during daily life, for older adults living with or without dementia.
- However, sensor data from daily life gave more valuable information about fall risk and was more useful in predicting or distinguishing between faller status groups. These results were seen in adults living with and without dementia.
- More research is needed to establish which aspects of motor performance are the most accurate and reliable measures to predict falls in older adults living with dementia.

The second review¹⁷ also found wearable sensor devices could be effective in measuring levels of gait activity in people living with dementia. Three included studies focussed on predicting fall (all observational designs); two found sensor-derived data are useful to classify gait episodes of fallers and non-fallers, and the third study indicated that physical activity parameters could be used as independent predictors of fall risk in people living with dementia. However, the review authors suggest that more standardised testing was needed better to measure impact and usefulness of wearable devices for measurement of gait characteristic.

Primary studies: During the search for this review of reviews we also looked for primary research papers published after the most recent systematic review, to ensure the results are up-to-date. We identified 11 studies published during 2020-2021 of which three fulfill eligibility criteria for inclusion in the current review^{21,22,23}. A pilot RCT study explored the effects of assistive home technology (AHT) on quality of life and falls of people living with dementia²¹. The AHT was found to significantly reduce fall incidents during bathroom visits, but showed only non-significant positive trends for fall incidents in other locations. However, the pilot trial used convenience sampling, was underpowered and not blinded and therefore confidence in the results is low. The second study was observational, examining the effect of 'SafelyYou Guardian' (SYG) technology on early post-fall care in long term dementia care facilities²². SYG employs continuous video monitoring and artificial intelligence to detect and notify caregivers about falls in real time, providing immediate access to video footage of falls. Study results indicate both time until staff assistance and time on ground measures were significantly shorter with the real time notification in the SYG system. The third study, a feasibility RCT of a home-based fall prevention exercise programme (Standing Tall) delivered to older people living with dementia through a tablet computer, showed promise²³. Standing Tall had acceptable usability, scored well on enjoyment and was feasible for participants. However, evaluation of effectiveness of the app for people living with dementia needs a fully powered RCT.

Conclusions

Although digital technologies have the potential to reduce risk of falls for older people living with dementia and thus help them to live longer in their own home, there is currently not enough good quality evidence to recommend which technology is best

placed to do this. Despite the fact that people living with cognitive impairment or dementia have a higher risk of falls, and could benefit from fall prevention technology, they are often excluded from such studies²⁴.

Some evidence has shown that people living with dementia can find the use of technology systems unsettling and may become distressed or refuse to use the technology²⁵. Therefore, it is paramount that digital technologies for people living with dementia and other cognitive impairments are designed and tested with the end user in mind, preferably through co-design to ensure it meets their needs, and has high usability and acceptability.

Utilising digital technology to enable older people living with dementia to remain independent in their own home for longer, or to prevent falls amongst older people in residential or nursing care, has been posited to improve quality-of-life and provide cost reductions to health and social care support^{26 27}. However, to date there is a lack of robust evidence supporting this, as both effectiveness and cost-effectiveness of technological approaches to fall prevention for people living with dementia have yet to be established²⁸. This is a fast moving and evolving evidence base, but it is essential new technologies are proven using robust evaluation in relevant contexts, with intended end users, before recommendations regarding their use can be made.

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