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

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Background

DHSC developing a new dementia strategy:

- Focus on how technology can be utilised to support people with dementia.
- Parallel work within NHSX to explore how technology can help people with dementia to live independently in their homes for longer, and how technology can be used to prevent falls among people with dementia and older people more broadly.

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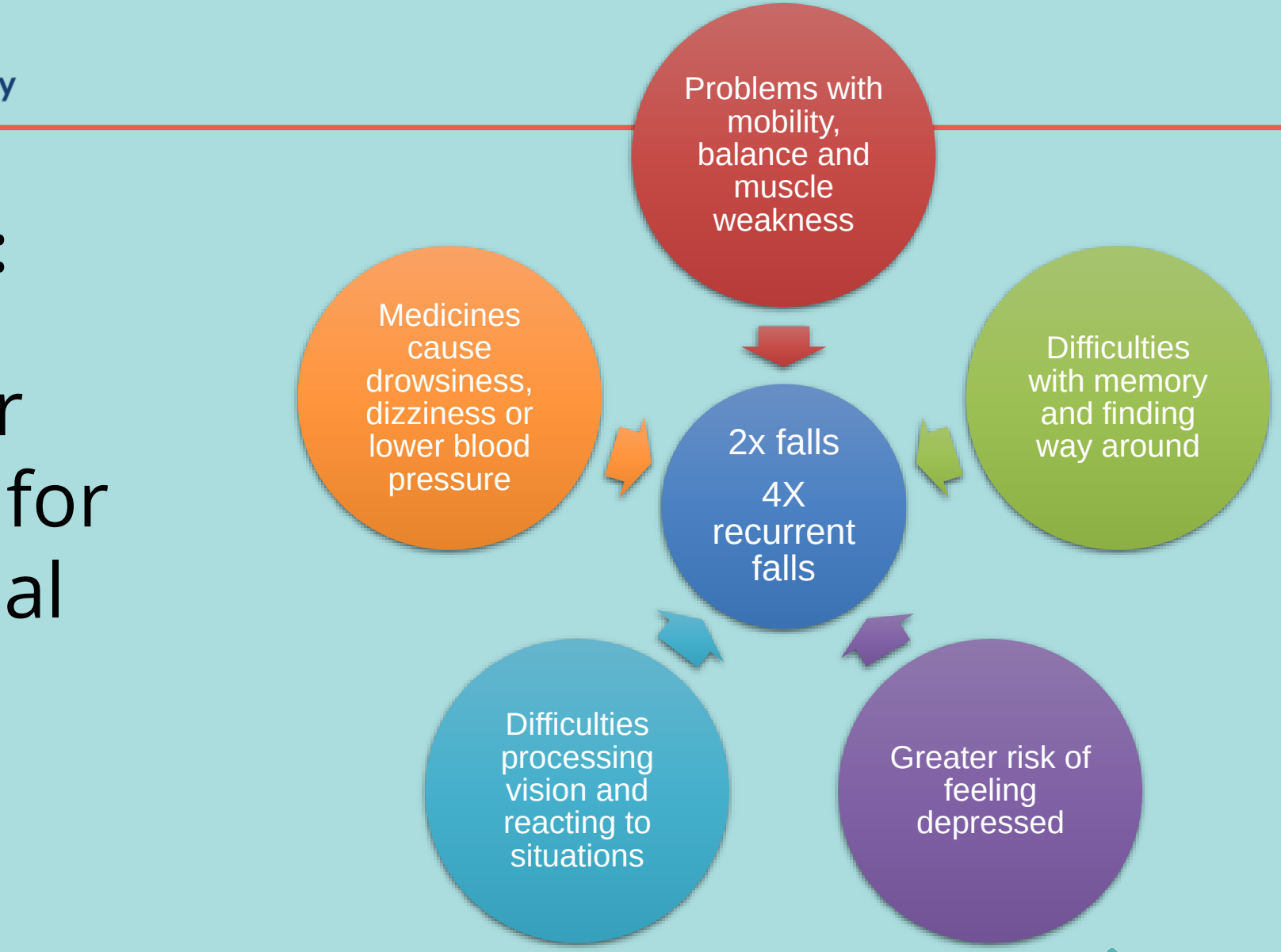
Background:

Falls £4.4bn / yr additional cost for health and social care services



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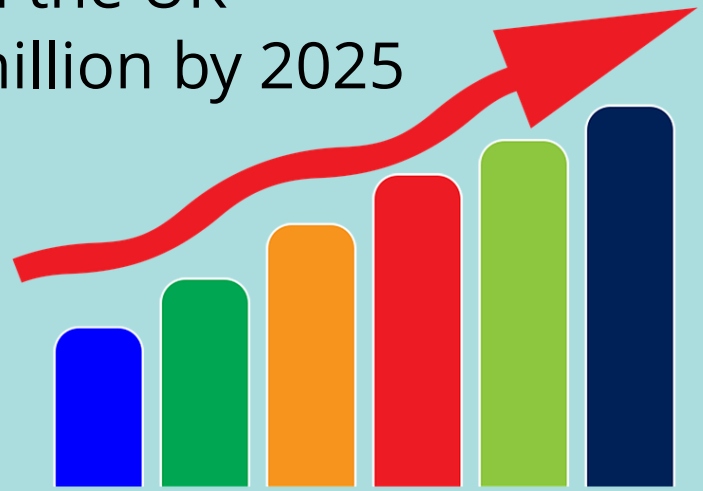
Review question:

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

- 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 2040

- Technology is rapidly evolving but little is known about which technologies are most effective and cost effective



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Relevance to policy

- A review of the existing evidence will inform the implementation of the technology strand of the new dementia strategy, highlighting what and how technology is being used, what works well and what the limitations are, and any barriers to implementing technologies to support people with dementia to live independently and safely.

- The review will also identify gaps in the evidence base, directing future research efforts which will generate new insights for policy decisions on the use and implementation of technology in dementia care.

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Previous work

This review builds on previous work undertaken in OPFPRU and the Healthy Ageing Research Group (HARG):

- Stanmore, E. K., Mavroeidi, A., De Jong, L. D., Skelton, D. A., Sutton, C. J., Benedetto, V., Munford, L. A., Meekes, W., Bell, V. & Todd, C. 2019. **The effectiveness and cost-effectiveness of strength and balance Exergames to reduce falls risk for people aged 55 years and older in UK assisted living facilities: a multi-centre, cluster randomised controlled trial**. *BMC Medicine,* 17**,** 49.
- Mcgarrigle, L., Boulton, E. & Todd, C. 2020**. Map the apps: a rapid review of digital approaches to support the engagement of older adults in strength and balance exercises.** *BMC Geriatrics,* 20**,** 483.
- Mcgarrigle, L. & Todd, C. 2020. **Promotion of Physical Activity in Older People Using mHealth and eHealth Technologies: Rapid Review of Reviews**. *J Med Internet Res,* 22**,** e22201.
- NICE 2018**. Dementia: assessment, management and support for people living with dementia and their carers**. Technical Report Appendix D: Review search strategies. London.

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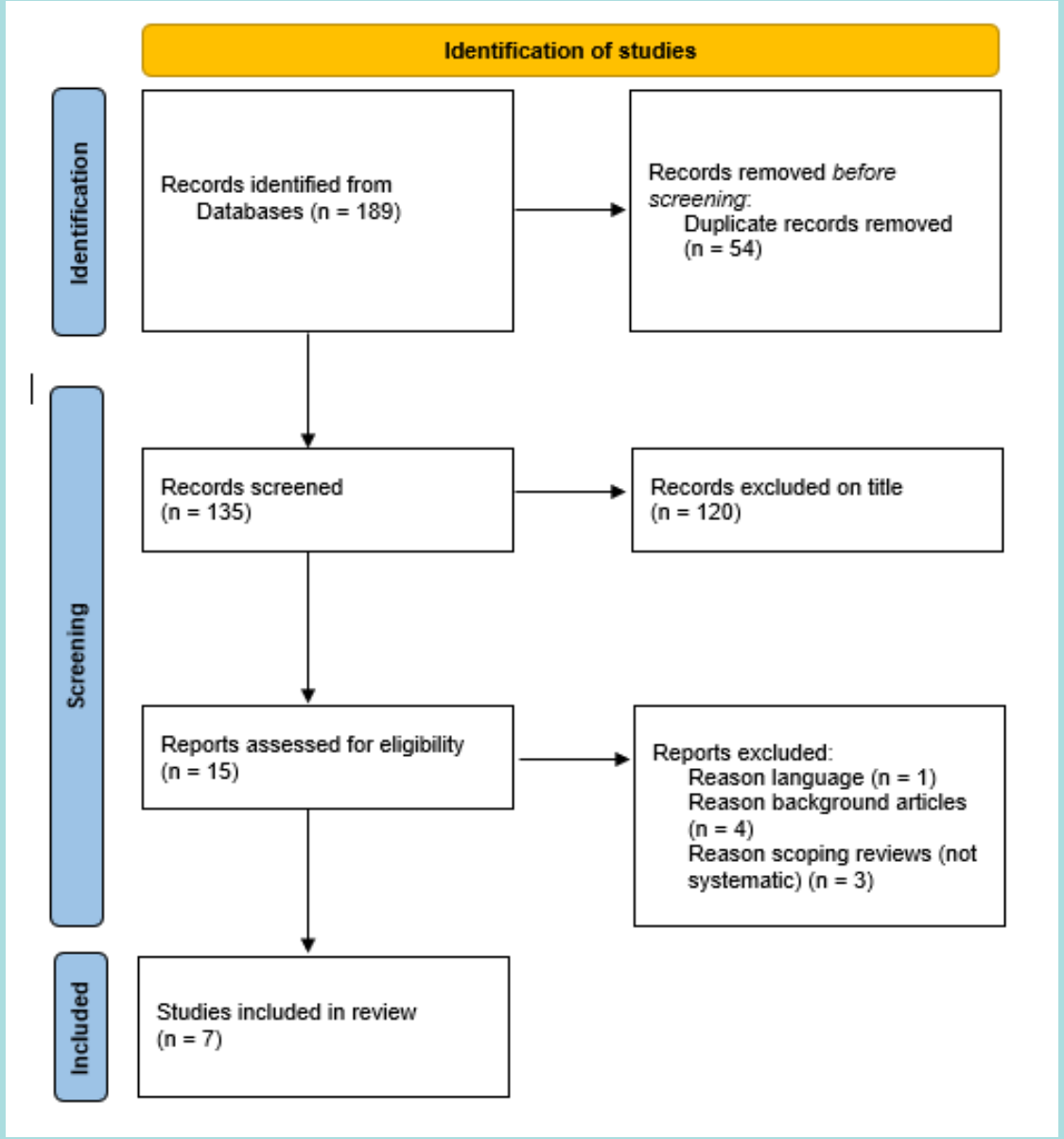
Methodology

Followed a systematic review of reviews approach + primary studies published after most recent review (2020)

Searched following databases

- EMBASE (Ovid)
- MEDLINE (Ovid)
- CINAHL (EBSCO)
- PsychINFO (Ovid)
- Cochrane Database of Systematic Reviews (CDSR) (OVID).
- Scopus

Identified 7 systematic reviews and 1 scoping review which met our inclusion criteria



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Types of technology:

Technologies were classified using the FARSEEING taxonomy: a taxonomy of technologies, which classifies and describes technology use in falls prevention studies.

- All studies included in this review were classified as Systems but differed in terms of locations.

We also found digital technologies across a range of uses

- Prediction, e.g. falls risk assessment
- Detection, e,g. alarm systems
- Monitoring, e.g. fall event recording research tools
- Prevention, e.g. detectors to identify if a person is out of bed and alerts the carer

BOULTON E, HAWLEY-HAGUE H, VEREIJKEN B, CLIFFORD A, GULDEMOND N, PFEIFFER K, HALL A, CHESANI F, MELLONE S, BOURKE A, TODD C for the FARSEEING Consortium Developing the FARSEEING taxonomy of technologies: classification and description of technology use (including ICT) in falls prevention studies. *Journal of Biomedical Informatics*, 2016 doi: 10.1016/j.jbi.2016.03.017

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Environmental sensor-based systems / video systems:

2 systematic reviews include environment sensor-based systems

- First review included sensor-based interventions[1]
  - Community setting
  - Included 2 RCTs of reporting falls
    - One reported probability of falling was 50% lower for group with assistive tech, other reported no difference
    - Differences in technologies assessed

- Second review on bed-exit alarms[2]
  - Long term care setting
  - 3 studies reported falls
    - 2 (1RCT + 1 quasi experimental) showed no difference in falls prevention
    - 1 (pre-post) improved after alarms removed

1. BRIMS, L. & OLIVER, K. 2019. Effectiveness of assistive technology in improving the safety of people with dementia: a systematic review and meta-analysis. Aging & mental health, 23, 942-951.

2. CHAN, D. K. Y., CHAN, L. K. M., KUANG, Y. M., LE, M. N. V. & CELLER, B. 2021. Digital care technologies in people with dementia living in long-term care facilities to prevent falls and manage behavioural and psychological symptoms of dementia: a systematic review. European Journal of Ageing.

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Exergaming and Commercial Games consoles:

2 systematic reviews centred on exergaming:

- First included 3 studies using 'FitForAll' or 'Wii-Fit'[3]
  - Community and assisted living facilities
  - None reported falls rate, but one pre-post test reported significant improvements on surrogate falls outcomes
  - 2 RCTs – one found no significant diffs, other found a significant improvement on Berg balance scale

- Second review included 41 papers investigating a range of diseases (not all dementia)[4]
  - Concluded exergaming improves balance dysfunction and were safe for people living with neurological conditions
  - Due to small number of studies including people living with dementia they were unable to draw conclusions specifically for these groups

3. VAN SANTEN, J., DROES, R.-M., HOLSTEGE, M., HENKEMANS, O. B., VAN RIJN, A., DE VRIES, R., VAN STRATEN, A. & MEILAND, F. 2018. Effects of exergaming in people with dementia: Results of a systematic literature review. Journal of Alzheimer's Disease, 63, 741-760.

4. PROSPERINI, L., TOMASSINI, V., CASTELLI, L., TACCHINO, A., BRICHETTO, G., CATTANEO, D. & SOLARO, C. M. 2021. Exergames for balance dysfunction in neurological disability: a meta-analysis with meta-regression. Journal of Neurology, 268, 3223-3237.

Virtual reality:

Found 1 systematic review on the use of Virtual Reality in improving health outcomes for older adults[5]

- Community dwelling
- Included 1 quasi-experimental study comparing people living with and without dementia
  - Measured posture and falls
  - Those living with dementia had significantly worse
    - Postural stability
    - Longer lag in cognitive strategies for postural correction
    - Delayed reactions to falling

Apps:

Didn't find any systematic reviews looking at app-based interventions, dementia and falls

5. DERMODY, G., WHITEHEAD, L., WILSON, G. & GLASS, C. 2020. The Role of Virtual Reality in Improving Health Outcomes for Community-Dwelling Older Adults: Systematic Review. Journal of medical Internet research, 22, e17331.

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Wearable technology / sensors:

2 systematic reviews found reasonable evidence regarding body worn sensors / falls / dementia

- First review[6]
  - 4 observational studies including people living with dementia
  - Additional 10 studies also included by author – did not explicitly state dementia
  - Concluded
    - Wearables acceptable tool to assess fall risk
    - Sensor data from real life was more valuable and better at predicting falls
    - More research needed to determine which aspects of motor performance best predict falls
- Second review included 3 observational studies focusing on predicting falls[7]
  - 2 found sensory data useful to classify gait of fallers
  - 1 found physical activity measures could predict falls
  - Need more standardized testing

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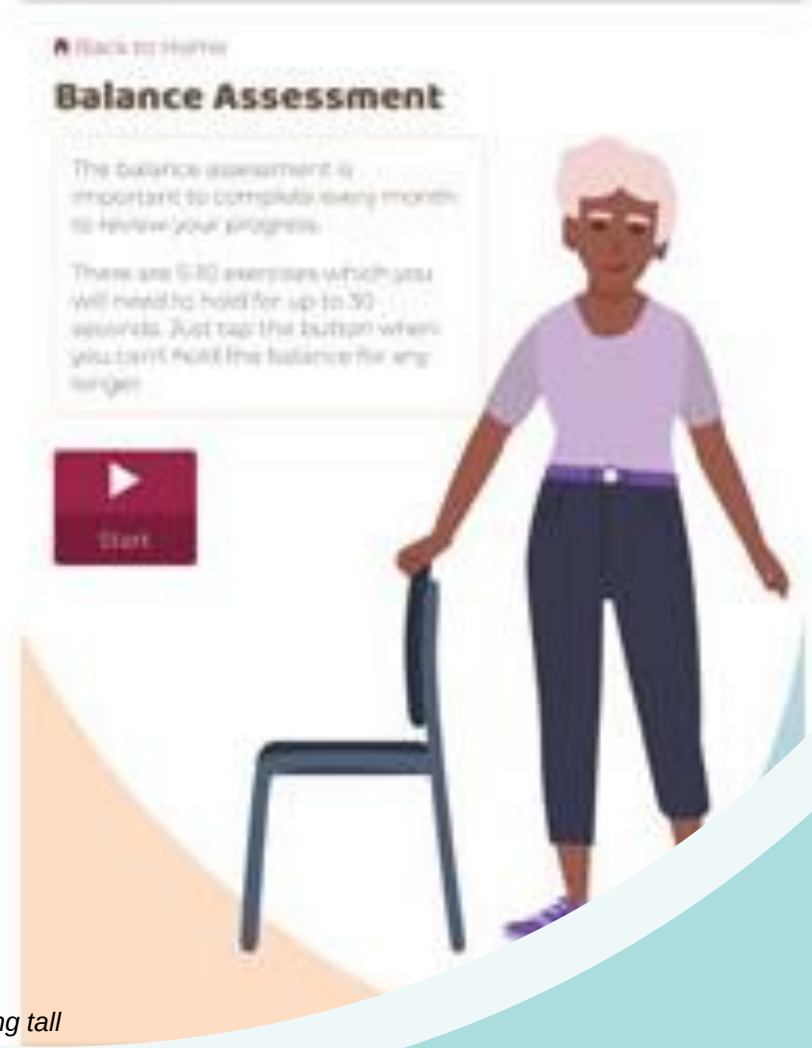
6. BEZOLD, J., KRELL-ROESCH, J., ECKERT, T., JEKAUC, D. & WOLL, A. 2021. Sensor-based fall risk assessment in older adults with or without cognitive impairment: a systematic review. Eur Review of Aging and Physical Activity, 18.
7. WEIZMAN, Y., TIROSH, O., BEH, J., FUSS, F. K. & PEDELL, S. 2021. Gait Assessment Using Wearable Sensor-Based Devices in People Living with Dementia: A Systematic Review. Int J Environ Res Public Health, 18.



Standing tall

Additional primary studies:

Three additional studies reported after those included in the systematic reviews (2020 onwards) met inclusion criteria:

- Pilot RCT on effects of assistive home technology (AHT) showed significant drop in falls in bathroom, but not elsewhere[8]
- 'SafelyYou Guardian' (SYG) – using continuous video monitoring to significantly reduce time to assistance and time on ground[9]
- Feasibility RCT of 'Standing Tall' a home-based fall prevention exercise program delivered on tablet computer[10]
  - Showed acceptable usability, enjoyment and feasibility but need to evaluate effectiveness of app for people living with dementia in fully powered RCT

8. BAYEN, E., NICKELS, S., XIONG, G., JACQUEMOT, J., SUBRAMANIAM, R., AGRAWAL, P., HEMRAJ, R., BAYEN, A., MILLER, B. L. & NETSCHER, G. 2021. Reduction of Time on the Ground Related to Real-Time Video Detection of Falls in Memory Care Facilities: Observational Study. Journal of medical Internet research, 23, e17551.

9. LAURIKS, S., MEILAND, F., OSTÉ, J. P., HERTOGH, C. & DRÖES, R.-M. 2020. Effects of Assistive Home Technology on quality of life and falls of people with dementia and job satisfaction of caregivers: Results from a pilot randomized controlled trial. Assistive Technology, 32, 243-250.

10. TAYLOR, M. E., CLOSE, J. C. T., LORD, S. R., KURRLE, S. E., WEBSTER, L., SAVAGE, R. & DELBAERE, K. 2020. Pilot feasibility study of a home-based fall prevention exercise program (StandingTall) delivered through a tablet computer (iPad) in older people with dementia. Australasian journal on ageing, 39, e278-e287.

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Conclusions:

- Digital technologies have potential to reduce risk falls for older people living with dementia and help them live in their own homes longer
- Not enough good quality evidence to recommend which technology is best
- People with dementia have higher falls risk, but often excluded from such studies[11]
  - Evidence people with dementia can find the use of technology systems upsetting, and may become distressed[12]
  - Need to include people with dementia and other cognitive impairments in design and testing of technology to ensure it meets their needs and has high usability / acceptability.
- Both effectiveness and cost-effectiveness of technology for falls prevention for people living with dementia yet to be established.

More information and full report available at:
https://www.opfpru.nihr.ac.uk/our-research/rapid-responses/

11. LORD, S. R. CLOSE, J. C. T. 2018. New horizons in falls prevention. Age and ageing, 47, 492-498.
12. ABBATE, S., AVVENUTI, M. & LIGHT, J. 2014. Usability Study of a wireless monitoring system among Alzheimer's disease elderly population. International Journal of Telemedicine and Applications.

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