Implementation outcomes for agitation detection technologies in people with dementia: A systematic review protocol

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Introduction

People with dementia often experience cognitive impairment, including memory loss and attention deficits, which disrupt their daily functioning. Neuropsychiatric symptoms like agitation, depression, and anxiety further exacerbate these difficulties and are commonplace. Agitation can be particularly distressing for people living with dementia and their caregivers.

Technology may prove to be a useful means to automatically detect agitation, so to monitor and intervene. The value of such technologies includes removing the need for carers to monitor continuously and subjectively judge instances of agitation. Previous reviews have explored the validity of detection technology, identifying three key types; wearable sensors, computer vision, and multimodal sensors (Khan et al., 2018).

While the validity of these technologies is crucial, we must also consider early-stage implementation outcomes (e.g., acceptability, feasibility) to ensure real-world adoption. Previous reviews have touched on acceptability but did not thoroughly address implementation outcomes. This systematic review aims to explore early-stage implementation outcomes related to the using technologies for detecting of agitation in people with dementia.

Methods

Defining early-stage implementation outcomes:

We will adopt the taxonomy reported by Proctor and colleagues, selecting outcomes that are salient to the early implementation stage (Proctor et al., 2011). These implementation outcomes include acceptability, adoption, feasibility, fidelity, and implementation cost. We are primarily interested in consumer (i.e., the person with dementia), consumer-by-proxy (i.e., the carer) and organisation/setting-level (e.g., care home) outcomes.

Inclusion criteria:

- Studies that implement, evaluate, or validate technology with the intention to detect agitation in people with dementia. The study can use technology to detect agitation for monitoring purposes only, or alongside agitation reduction interventions.
- People with dementia are required to be the target population in receipt of the agitation detection technology. There is no restriction on the subtype of dementia, the severity, or the residential status of the participant.
- Studies that include one or more outcomes related to the acceptability, adoption, feasibility, fidelity, and implementation cost of the agitation detection technology. Studies are not required to frame the research as implementation science or have aims pertinent to these outcomes.
- Studies can report outcomes qualitatively or quantitatively.
- Written in English language.

Exclusion criteria:

- Studies that use agitation detection technologies as a secondary outcome as part of a broader research question (e.g., embedded within cohort studies).
- Studies that exclusively report on the secondary analysis of data from technologies.
- Studies that have designed the technology for use in people with dementia but have not tested it in this population.
- Lab-based studies
- Non-primary data studies (e.g., reviews, protocols, editorials).

Studies that partially meet the criteria (e.g., subset of sample has dementia, subset receive agitation detection technology) will be excluded if data cannot be meaningfully extracted for this group.

Information sources:

We will search PubMed, SCOPUS, PsycINFO, CINHAL Plus and IEEXPLORE. We will also hand search reference lists of included articles, and use functions such as 'cited by' and 'related articles' (e.g., through Google Scholar) to identify other potentially relevant articles.

Search strategy:

We will use search terms that capture the population (e.g., people with dementia), technology (e.g., wearables), function of the technology (e.g., detection) and symptoms (e.g., agitation). No search terms will be used to limit by outcome, because during pre-testing this led to an increase in false negatives. For an example syntax see Appendix A.

Selection process:

Individual hits will be downloaded from databases, and merged into a single platform (e.g., Mendeley), where deduplication will occur. The deduplicated hits will then be uploaded onto ASReview (van de Schoot et al., 2021), to allow for semi-automated screening of the title and abstract by a single reviewer. Screening will be informed by a decision tree (see Appendix B). Screening will stop once a minimum of 10% of title/abstracts are screened, and then following 50 consecutive screen negatives. Shortlisted full texts will be obtained, and then reviewed by two reviewers independently. Disagreements will be discussed, and a third reviewer will make a final decision if consensus cannot be achieved. Agreement statistics will be reported for this stage.

Outcomes:

Primary outcomes:

- Acceptability
- Adoption
- Appropriateness
- Feasibility
- Fidelity
- Implementation cost

Secondary outcome:

- Researcher notes and commentary on primary outcomes

Data extraction and items:

Data extraction will be completed independently by one reviewer, and then verified by a second reviewer.

Descriptive information about the studies will be extracted (see Appendix C for example extraction table). This includes information about author, date of publication, agitation detection technology used, sample size, duration of agitation detection, setting (e.g., community, care home), country of study, aims explicitly refer to implementation outcomes/concepts (Yes/no), funder (e.g. commercial/non-commercial/none).

Acceptability: qualitative themes, subthemes and/or quotes related to the acceptability of the technology. Descriptive data (i.e., Mean and SD, or Median and IQR) related to questionnaires and Likert scales with face validity tied with acceptability. Data is required to come from the person with dementia, carer, or healthcare professional.

Adoption: qualitative themes, subthemes and/or quotes related intention or decision to implement the technology. Descriptive data (i.e., Mean and SD, or Median and IQR) related to questionnaires and Likert scales with face validity tied with adoption. Data is required to come from the organisation or healthcare professional.

Appropriateness: qualitative themes, subthemes and/or quotes related to the perceived fit of the technology. Descriptive data (i.e., Mean and SD, or Median and IQR) related to questionnaires and Likert scales with face validity tied with appropriateness. Data is required to come from the person with dementia, carer, or healthcare professional.

Feasibility: monitoring data related to the extent to which the technology can be used in a given setting. This includes:

- refusal rate – the number of people who refused to participate (n, %). In the absence of this data being described explicitly, this will be calculated by subtracting the number of people consented from the number of people approached.
- adherence to protocol – number of participants and/or instances where the agitation detection technology implementation was not adhered to (n, %).
- retention rate – number of people who dropped out during the study (n, %)
- completeness of data – number and duration of missing monitoring during the course of the study. This includes non-wear time.

Fidelity: descriptive data from checklists or questionnaires related to adherence to the original protocol will be extracted. Summaries of adherence from observational data, in quotes, will be extracted.

Implementation cost: descriptive data related to the cost impact of implementation.

Any researcher notes or commentary related to implementation outcomes will be extracted in quotes. This data will be required to be in the results section of the included article.

In instances where multiple articles report data derived from the same cohort, these will be treated as a single study and relevant data will be extracted from individual articles. If there are discrepancies reported between articles, then data will be extracted from the earliest published article.

Critical appraisal

The QuADS Criteria (Harrison et al., 2021) will be selected to assess the study quality. The QuADS Criteria is advantageous as it can handle studies with a heterogenous study design. The critical appraisal will occur independently by two reviewers, and discussions will be had to come to consensus.

Data synthesis

An initial broad overview of studies included will be provided, alongside the critical appraisal of included studies. Findings will then be synthesised narratively, and split into technology types (i.e., video, wearables, multimodal) as reported by Khan and colleagues (Khan et al., 2018). Within each technology type, we will report each of the implementation outcomes where available.

Meta-bias

No formal analysis will be employed to address meta-bias. However, this will be discussed narratively. Attempts to include non-peer reviewed articles will be used to minimise sources of publication bias.

Confidence in cumulative evidence

No formal assessment of confidence in cumulative evidence will be used due to the heterogeneous nature of the studies and study outcomes (e.g., qualitative and quantitative).

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References

Harrison, R., Jones, B., Gardner, P., & Lawton, R. (2021). Quality assessment with diverse studies (QuADS): An appraisal tool for methodological and reporting quality in systematic reviews of mixed- or multi-method studies. *BMC Health Services Research*, *21*(1), 144. https://doi.org/10.1186/s12913-021-06122-y

Khan, S. S., Ye, B., Taati, B., & Mihailidis, A. (2018). Detecting agitation and aggression in people with dementia using sensors—A systematic review. *Alzheimer's & Dementia*, *14*(6), 824–832. https://doi.org/10.1016/j.jalz.2018.02.004

Proctor, E., Silmere, H., Raghavan, R., Hovmand, P., Aarons, G., Bunger, A., Griffey, R., & Hensley, M. (2011). Outcomes for Implementation Research: Conceptual Distinctions, Measurement Challenges, and Research Agenda. *Administration and Policy in Mental Health*, *38*(2), 65–76. https://doi.org/10.1007/s10488-010-0319-7

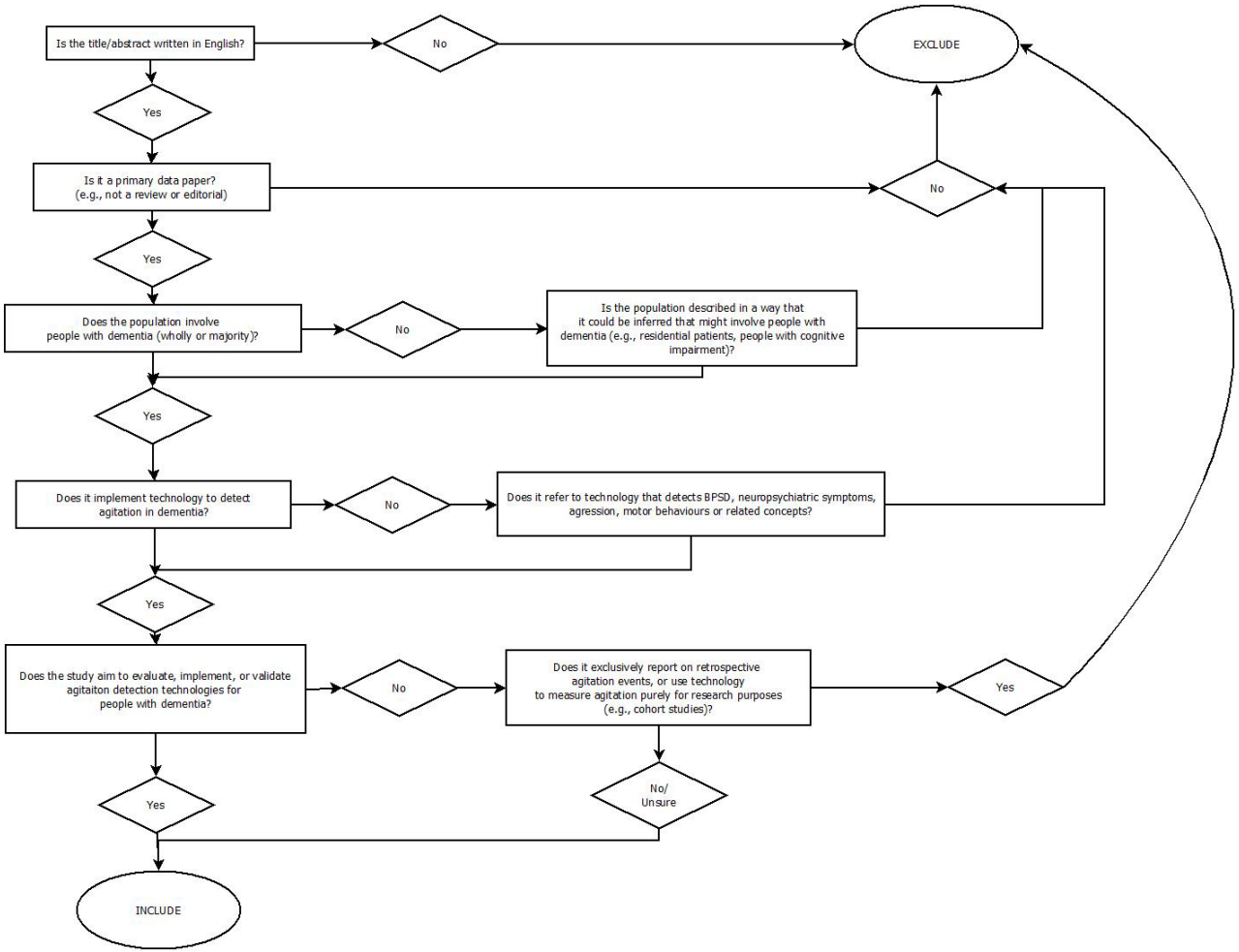
van de Schoot, R., de Bruin, J., Schram, R., Zahedi, P., de Boer, J., Weijdema, F., Kramer, B., Huijts, M., Hoogerwerf, M., Ferdinands, G., Harkema, A., Willemsen, J., Ma, Y., Fang, Q., Hindriks, S., Tummers, L., & Oberski, D. L. (2021). An open source machine learning framework for efficient and transparent systematic reviews. *Nature Machine Intelligence*, *3*(2), Article 2. https://doi.org/10.1038/s42256-020-00287-7

Appendices

APPENDIX A: INDICATIVE SEARCH TERMS

(TITLE-ABS-KEY ((detect* OR monitor* OR automated OR real-time) AND (technology OR monitoring OR physiologic OR "signal processing" OR "computer assisted" OR accelerometry OR actigraph OR "vital signs" OR "heart rate" OR wearable OR sensor OR "machine learning" OR "artificial intelligence" OR electrocardiography OR wrist OR worn OR body OR video OR recording OR camera OR "pressure mat") AND ("Behavioural and psychological symptoms" OR “BPSD” OR agitation OR aggression OR "motor behaviours" OR neuropsychiatric)) AND TITLE ((dementia OR alzheimer OR resident* OR neurocognitive)))

APPENDIX B: SCREENING DECISION PROCESS



APPENDIX C: EXAMPLE DATA EXTRACTION TABLE

Publication					**Sensor & intervention**			**Dementia Population**					**Setting**
First Author *Surname*	**Year**	**Country**	**Aim of study refers to implementation outcomes** *YES/ NO*	**Funder** *Commercial; non-commercial; none; not stated*	**Description of technology**	**Planned (or maximum) detection duration**	**Detection linked to intervention** *YES/ NO*	**Sample Size and dementia type(s)**	**Age:** *Mean (SD)*	**Gender: Female** *N, %*	**Indices of baseline cognitive impairment** *Test: Mean (SD)*	**Indices of baseline agitation** *Test: Mean (SD)*	**Residential care home (inc. long-term &/or care unit); day care home; home/ community**
Wearables													
Camera-based													
Multi-modal													