

Review Article

Factors Influencing the Implementation of Evidence-Based Falls Prevention Interventions for Older Persons Living in Residential long-term care settings – An Umbrella Review of Systematic Reviews

Anthony Scerri¹, Stephen Lungaro-Mifsud²¹Department of Nursing, Faculty of Health Sciences, Mater Dei Hospital, B'Kara, Malta²Department of Physiotherapy, Faculty of Health Sciences, University of Malta, Malta**Abstract**

Falls among older adults in residential long-term care (RLTC) remain a significant concern, with prevention efforts often yielding inconsistent results due to the complexity of implementation. This umbrella review synthesised evidence from ten systematic reviews to explore the factors influencing the implementation of falls prevention interventions in RLTC, using the i-PARIHS framework. Six EBSCO databases and Scopus were searched without date or language limiters. Risk of bias was assessed using the AMSTAR-2 checklist. The review was conducted in accordance with the PRIOR guideline for overviews of reviews. Seventy-three specific factors were identified. Interventions that are simple, engaging, tailored, and supported by leadership were more effectively adopted. Staff knowledge, clarity of roles, and multidisciplinary collaboration and co-design further facilitated implementation, while organisational constraints such as limited resources, rigid routines, and under-resourcing posed substantial barriers. External contextual influences, including funding mandates and policy frameworks. Moreover, this review identified four factors that did not fall under any of the key characteristics of the i-PARIHS framework: *the technological fit of innovations, the health status of residents, changes within the RLTC population, and facilitators' skills in navigating complexity*. This review underscores the importance of contextually sensitive, system-wide strategies that consider the evolving realities of RLTC.

Keywords: Falls prevention, Implementation, Older adults, Residential long-term care, Umbrella review

Introduction

Falls among older adults in residential long-term care (LTC) settings are a major concern, with an estimated rate of 1.6 falls per person-year. Falls are a leading cause of injury, illness, and death in this population, making their prevention a vital focus in healthcare within these facilities¹. Falls prevention interventions, such as 'exercise', 'multifactorial' and 'Vitamin D supplementation' are the interventions mostly used in the community and residential long-term care although their effectiveness in falls reduction seems to vary considerably between the two settings². The World guidelines on falls prevention for older adults³, strongly recommends the use of a multifactorial interventions in care homes, such as staff training, systematic use of a multidomain decision support

tools and implementation of falls prevention interventions. A multifactorial falls prevention intervention has been defined as 'an intervention with multiple components that aims to address the risk factors for falling that are identified in a person's multifactorial assessment'⁴. Evidence

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Corresponding author: Dr Anthony Scerri, Room 38, Department of Nursing, Faculty of Health Sciences, Mater Dei Hospital, B'Kara, MSD2090, Malta

E-mail: anthony.t.scerri@um.edu.mt

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on the effectiveness of multifactorial falls prevention interventions in reducing falls in the community based older adults seems inconsistent. For example, whilst Pillay et al.⁵ concluded that there is evidence on the short-term benefits of individual and multicomponent falls prevention interventions in lowering fall risk for older adults living in the community. A recent Cochrane review⁶ of population-based interventions, concluded that the evidence is still inconclusive. The latter review suggested that there is a need for a better understanding of the mechanisms of how interventions work. Moreover, the implementation of these interventions in community dwelling older persons, has been found to be complex and context specific⁷. There is also lack of clear description of effective strategies and how these strategies could target the factors influencing the implementation of falls prevention interventions⁸.

Like in community settings, falls prevention programs in residential long-term care settings produce variable results. Residential long-term care settings for older adults can be defined as establishments primarily engaged in providing residential long-term care for older persons that combine nursing, supervisory or other types of care as required by the older residents⁹. Meulenbroeks et al.² carried out an umbrella review of falls prevention interventions in these settings and concluded that whilst some falls prevention interventions led to a reduction in falls, other reported an increase. Similarly, a process evaluation of the one of the few successful trial of multicomponent falls prevention programmes in residential long-term care setting^{10,11}, have indicated that impact of falls prevention programs varied considerably across care homes, and this was influenced by the local situation and organisational culture of the institutions in which the program was introduced, as well as how the program was implemented⁹. Similarly, Meulenbroeks et al.² concluded that it difficult to propose one intervention or specific components of multifactorial interventions across different settings, as their effectiveness will depend on the individual and environmental factors influencing their implementation. Therefore, successful implementation of these interventions depends on understanding the factors influencing their implementation.

Recent studies have sought to identify the most important factors influencing falls prevention interventions in residential long-term care settings. Suen et al.¹², carried and intervention component analysis of multifactorial interventions in long term care settings. The authors concluded that whilst effective and ineffective programs include an assessment of extrinsic and intrinsic risk factors, effective programs that resulted in a reduction in falls, were associated with staff engagement and tailored interventions. To facilitate the implementation of these interventions and gain insights into the mechanisms that promote successful outcomes, Suen et al.¹² suggest the utilization of translational frameworks. Determinant frameworks

guide the tailored, multifaceted implementation of complex interventions by addressing barriers and facilitators. One such framework, the i-PARIHS (Integrated-Promoting Action on Research Implementation in Health Services), identified key elements that influence the adoption of evidence-based practices in healthcare¹³. It expands on the original PARIHS model by integrating four key elements:

- Innovation – The intervention's credibility, relevance, and usability.
- Recipients – The individuals affected, including patients, providers, and stakeholders, considering their attitudes and skills.
- Context – The environment at local, organizational, and system levels influencing implementation.
- Facilitation – Active support through dedicated roles or strategies to overcome barriers and leverage facilitators.

Unlike the previous PARIHS framework, the i-PARIHS framework, provided a stronger focus on the role of the recipients as critical components of implementation success¹³. This is in line with the Suen et al.¹¹ systematic review that identified the critical role of residential care staff and management engagement for effective falls reduction in residential age care homes. Further intervention component analysis in systematic reviews of effective exercise programs in residential aged care homes^{14,15} have highlighted other factors related to 'innovation' and the 'contextual' components of the i-PARIHS framework, such as tailoring the exercise to the needs of the residents and ensuring sufficient resources from the organisation. Moreover, the World Guidelines for Falls prevention and management for older adults³, identifies contextual factors such as favourable organisational context as a as important prerequisite of implementation success of the guideline recommendations. The i-PARIHS framework considers many of the factors highlighted in these studies. Consequently, it can be a useful conceptual model when categorising the factors influencing the implementation of fall prevention interventions.

The reviews highlighted above^{12,14,15}, focused on specific falls prevention interventions and provide an interesting, yet incomplete perspective of the factors influencing the successful implementation of falls prevention interventions in residential long-term care (RLTC) settings. Moreover, whilst several systematic reviews have been written with a focus on identifying the most important factors, these have not yet been comprehensively synthesised in an umbrella review to support policy makers, clinicians and researchers. Consequently, using the i-PARIHS framework as conceptual model, the aim of this umbrella review was to summarise the current evidence as obtained from published systematic reviews and provide a general overview of the factors influencing the implementation of falls prevention interventions for older persons residing in long-term care settings.

Methods

The reporting guideline for overviews of reviews of healthcare interventions: the PRIOR statement was used to guide this umbrella review¹⁶.

Search Strategy

A search strategy was done independently by both authors during the months of March/April 2025 to identify relevant systematic reviews on the implementation of falls prevention interventions for older adults in LTC settings. The same search string and Boolean operators (falls prevention OR preventing falls OR prevent falls OR reduce falls AND older adults OR elderly OR seniors OR geriatrics AND implementation AND systematic review AND residential long-term care OR nursing home OR residential care) were used for all the searchers with no filters or limiters included. The initial search consisted of combined search of six EBSCO databases -AgeLine, Academic Search Ultimate, CINAHL Complete, Cochrane Database of Systematic Reviews, PubMed, and APA PsycInfo). A second search using the Scopus database was carried out using the same search string with no filters or limiters. The following databases were selected since they include articles of health and medical science research journals with high impact factors.

Inclusion/Exclusion criteria

The following inclusion/exclusion criteria were considered to identify eligible systematic reviews:

Inclusion Criteria

- Peer-reviewed systematic reviews in English that examined the implementation of single and multi-component or multifactorial falls prevention interventions for older adults in residential long-term care settings.
- Older adults were defined as persons who is over the age of 60 years¹⁷.
- Falls prevention interventions consisted of any intervention (e.g. physical exercise, technologies, medications) or set of interventions (e.g. multicomponent or multifactorial) aimed at preventing falls in residential long-term care settings.
- Systematic reviews had to fall within the Cochrane definition of systematic reviews¹⁸.

Exclusion Criteria

- Non-research reports, guidelines, scoping reviews, narrative reviews, and rapid reviews.
- Primary studies and reviews focusing on community-based interventions.
- Studies focusing solely on older adults with delirium or dementia, or reviews on interventions that are specifically focused on medication management or delirium prevention.
- Reviews related to studies that focused on interventions

(e.g., hip protectors, shock absorbing flooring) to reduce injury following a fall.

- Reviews related to studies that focus exclusively of falls risk assessment tools

Assessment of Risk of Bias

The quality and risk of bias of the selected systematic reviews were assessed using the AMSTAR-2 (A Measurement Tool to Assess Systematic Reviews) tool¹⁹. The two authors individually assessed the methodology adopted of each selected review using the AMSTAR checklist as a guide. Each question was could provide four response options: namely Yes (Y), No (N), N/A (Not applicable) or PY (Partial Yes). Discrepancies between the authors was resolved through a discussion meeting.

Data Extraction and Synthesis

Data from the included systematic reviews were extracted and coded using NVivo data management software. The articles were first read by ** to familiarise oneself with the selected articles. The framework synthesis method described by Carroll et al.²⁰ was utilized to guide the data extraction process. An *a priori* framework was used consisting of the i-PARIHS domains and the key characteristics of each domain as extracted from the article by Harvey & Kitson¹³. The key characteristics from each domain were 'best fit' with the factors influencing falls related interventions as identified from the systematic reviews. A node was created for each characteristic on NVivo and extracts from the selected reviews were uploaded under the most relevant characteristics and themed according to the influencing factors. Moreover, influencing factors that did not fit under any of the key characteristics of the i-PARIHS framework were sought. These were categorised under the most relevant domain of the i-PARIHS framework and named as a distinct key characteristic. The two reviewers cross-verified the categorization and coding of data to ensure accuracy and reliability. Discrepancies were discussed, and alternative categorizations were considered critically.

Results

Risk of Bias

Table 1 shows the risk of bias of the selected studies. The risk of bias assessment using the AMSTAR tool revealed variability in the quality of the included reviews. High-quality reviews, such as those by Albasha et al.²¹ and Vlaeyen et al.²², adhered well to key AMSTAR-2 criteria. These reviews registered protocols in advance, used duplicate screening and extraction, assessed risk of bias in included studies, and disclosed conflicts of interest. In contrast, reviews like those by Mileski et al.²³ and Benjamin et al.²⁴ displayed several methodological weaknesses, including the absence of bias assessment and lack of justification for excluded

Table 1. Quality appraisal of the selected studies (Y: Yes; N: No; N/A: Not applicable; PY: Partial Yes).

Authors	Did the research questions and inclusion criteria for the review include the components of PICO?	Did the report of the review contain an explicit statement that the review methods were established prior to the conduct of the review and did the report justify any significant deviations from the protocol?	Did the review authors explain their selection of the study designs for inclusion in the review?	Did the review authors use a comprehensive literature search strategy?	Did the review authors perform study selection in duplicate?	Did the review authors perform data extraction in duplicate?	Did the review authors provide a list of excluded studies and justify the exclusions?	Did the review authors describe the included studies in adequate detail?	Did the review authors use a satisfactory technique for assessing the risk of bias (RoB) in individual studies that were included in the review?	Did the review authors report on the sources of funding for the studies included in the review?	If meta-analysis was performed did the review authors use appropriate methods for statistical combination of results?	If meta-analysis was performed, did the review authors assess the potential impact of RoB in individual studies on the results of the meta-analysis or other evidence synthesis?	Did the review authors account for RoB in individual studies when interpreting/ discussing the results of the review?	Did the review authors provide a satisfactory explanation for, and discussion of, any heterogeneity observed in the results of the review?	If they performed quantitative synthesis did the review authors carry out an adequate investigation of publication bias (small study bias) and discuss its likely impact on the results of the review?	Did the review authors report any potential sources of conflict of interest, including any funding they received for conducting the review?
Mileski et al. (2019) ²³	Y	N	N	PY	Y	N	N	N	N	N	N/A	N/A	N	N	N/A	Y
Neyens et al. (2011) ²⁵	Y	N	N	Y	Y	Y	N	Y	N	N	N/A	N/A	Y	Y	N/A	N
Diener et al. (2022) ²⁷	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N/A	N/A	Y	Y	N/A	Y
Shakeel et al. (2015) ²⁶	Y	N	Y	PY	Y	Y	N	Y	Y	N	N/A	N/A	Y	N	N/A	N
Vlaeyen et al. (2017) ²²	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N/A	N/A	Y	N	N/A	Y
Albasha et al. (2023) ²¹	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N/A	N/A	Y	Y	N/A	Y
Benjamin et al (2014) ²⁴	PY	N	Y	PY	N	N	Y	Y	N	N	N/A	N/A	N	N	N/A	Y
Suen et al (2023) ¹²	Y	N	Y	PY	Y	Y	N	Y	N	N	PY	Y	Y	Y	Y	Y
Dawson et al (2024) ¹⁴	Y	N	Y	Y	N	Y	Y	Y	Y	N	N/A	N/A	N	Y	N/A	Y
Suen et al (2024) ¹⁵	Y	N	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y

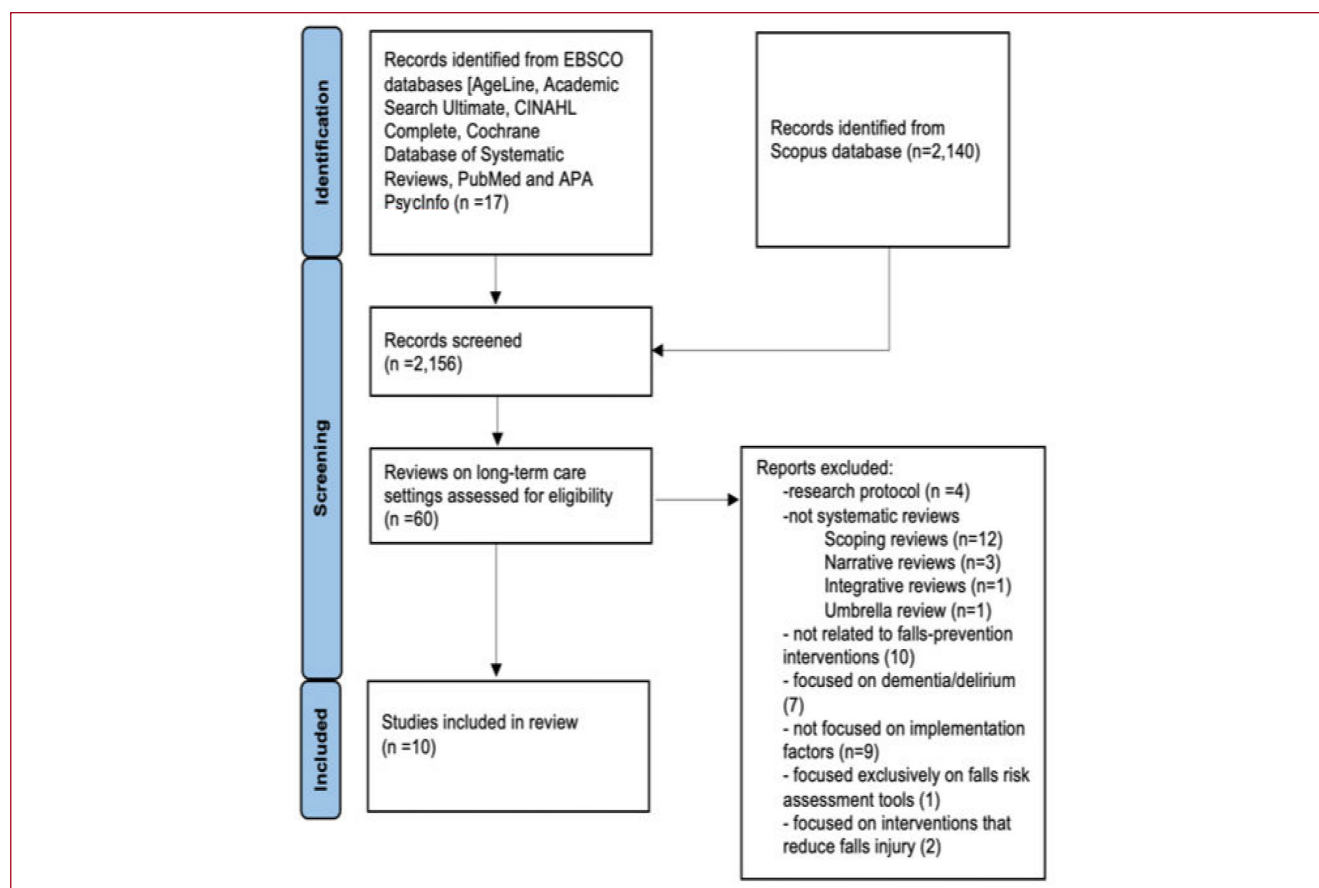


Figure 1. PRISMA flowchart.

studies. As a result of this variability in the methodological quality, whilst all selected reviews were included for data extraction in view of their potential relevance, the findings from higher-quality reviews (e.g., Albasha, Vlaeyen) was given greater interpretive weight, while results from lower-quality reviews (e.g., Mileski, Benjamin) were treated more cautiously.

Selection strategy

Seventeen individual records were initially identified from the EBSCO databases using the keywords. All these seventeen records were eligible for further screening. Since the EBSCO databases were searched collectively it was not possible to identify the number of hits of each database. For the Scopus search, 2140 articles were identified. Following the removing of nine duplicates, the title of the remaining 2131 articles was initially screened. 1,673 articles were excluded since they were primary studies. Using the eligibility criteria both authors searched the articles independently and uploaded potential studies

in a shared spreadsheet. A meeting between the two authors was held, to go through the abstracts of sixty reviews that were assessed for eligibility. After reading these abstracts, 10 systematic reviews were agreed upon by both authors as falling within the eligibility criteria and were selected. Figure 1 maps out the number of records identified, included and excluded, and the reasons for exclusions.

Characteristics of the selected reviews

Ten systematic reviews were selected for inclusion in this umbrella review. These reviews covered a range of topics related to falls prevention interventions in LTC settings, including the effectiveness of alarming devices, e-health technologies, physical activity programs, and multifactorial and multicomponent interventions. Figure 2 provides a matrix and heat map of the primary studies' overlap in the selected reviews. The greatest overlap of primary studies was observed between Suen et al.¹⁵ and Dawson et al.¹⁴, which share 18 studies. Although the

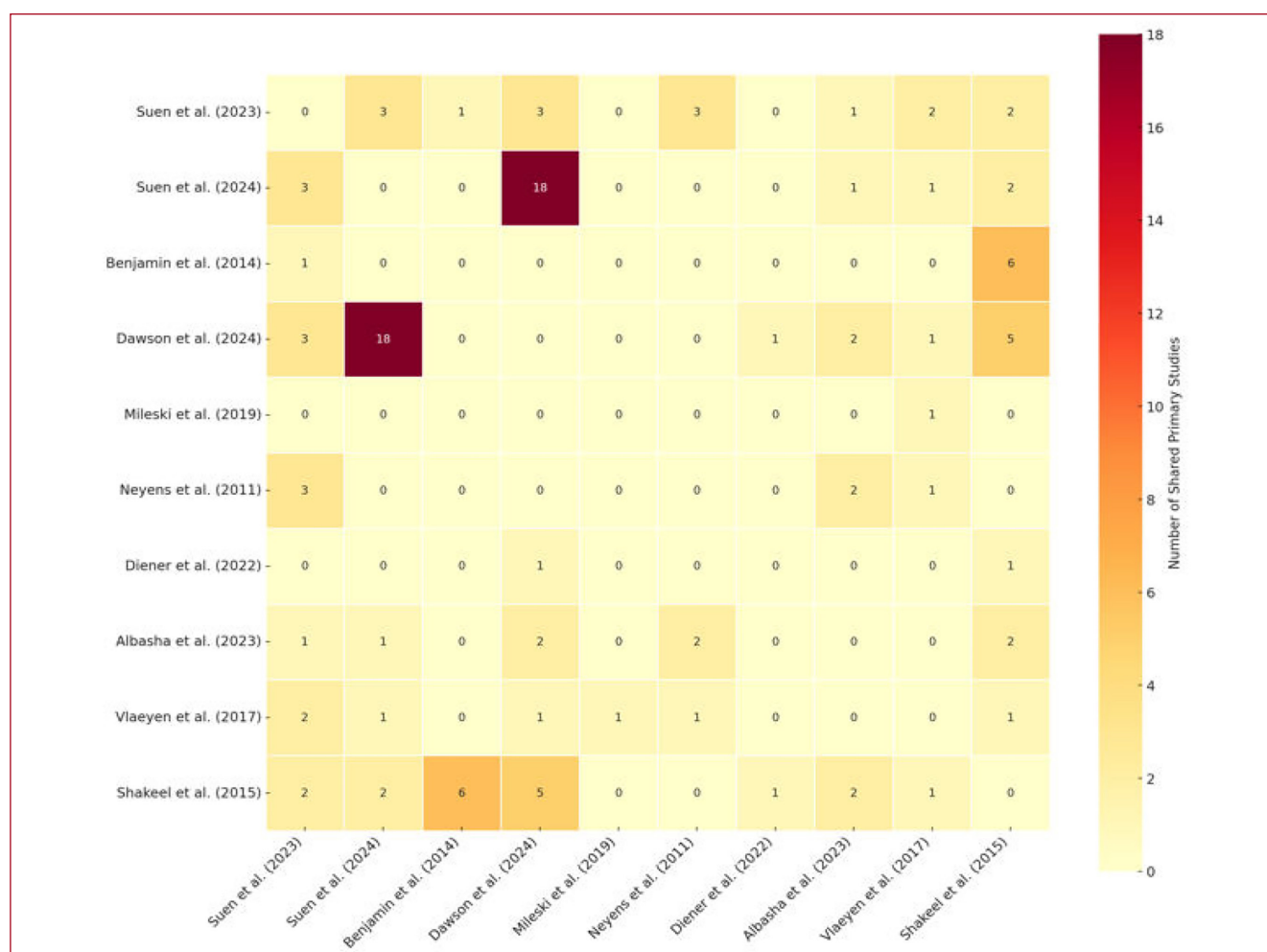


Figure 2. Overlap matrix and heatmap of primary studies in the selected reviews.

same primary studies used by Dawson et al were also used in Suen's study¹⁵, relevant findings and conclusions drawn from Suen's study, complemented Dawson's study. Consequently, they were both retained. Suen et al.¹² showed moderate overlap, sharing 3 studies each with Suen et al.¹⁵, Dawson et al.¹⁴, and Neyens et al.²⁵. Shakeel et al.²⁶ also demonstrated moderate overlap, sharing 6 studies with Benjamin et al.²⁴, 5 with Dawson et al.¹⁴, and 2 studies each with Suen et al.¹² and Suen et al.¹⁵. Reviews such as Mileski et al.²³ and Diener et al.²⁷ showed minimal overlap. Albasha et al.²¹ exhibited modest overlap with several reviews but did not share more than two studies with any single one. Table 2 shows the characteristics of the selected studies with a focus on the review aim, type of falls prevention intervention/s, databases used, records identified, papers selected, type of long-term care institution, key findings and conclusions.

Factors influencing falls related interventions according to the key characteristics of the i-PARIHS framework

Table 3 summarises the factors influencing falls related interventions according to the key characteristics of the i-PARIHS framework. The influencing factors according to each domain will be discussed in turn.

Factors Related to the Innovation - Fall Prevention Interventions

The implementation of falls prevention interventions in residential long-term care (LTC) settings is shaped by several factors related to the interventions themselves. Fall prevention interventions were perceived as credible and evidence-based when grounded in robust guidelines, as highlighted by Vlaeyen et al.²². The attractiveness and feasibility of these interventions were essential in facilitating

Table 2. Characteristics of the selected studies.

Authors	Review aim	Type of falls prevention intervention/s	Databases used	Papers selected	Type of long-term care institution	Targeted population under review	Key findings	Key conclusions
Mileski et al. (2019) ²³	To review literature on the effectiveness of alarming and/or alerting devices in reducing falls in long-term care (LTC) settings and to assess staff perceptions and implementation issues.	Alarming and alerting devices, including bed/chair alarms, pressure sensors, infrared sensors, wearable alarms, and integrated alarm systems.	CINAHL, Academic Search Complete, PubMed	976 initial ->561 (time limit) -> 482 (English & peer-reviewed) -> 28 articles included	Long-Term Care Facilities (nursing homes, skilled nursing, residential care settings)	Older LTCF residents, assumed high fall-risk population	Alarms may reduce falls when properly implemented, especially for residents with cognitive impairment. They can increase staff-resident interaction and resident safety. Newer tech improves effectiveness. However, concerns include alarm fatigue, cost, implementation difficulty, and false alarms.	Alarms are not effective as a standalone intervention. When integrated into a comprehensive care plan, alarms can enhance fall prevention. Education, staff training, appropriate resident selection, and new technology improve utility. Mixed perceptions and need for better integration and evaluation remain.
Neyens et al. (2011) ²⁵	To assess the effectiveness and implementation aspects of interventions aimed at reducing falls in elderly residents of long-term care facilities.	Multifactorial and mono-factorial interventions including safety assessments, medication reviews, balance and strength exercises, staff education, environmental modifications, vitamin D supplementation, and clinical medication reviews.	MEDLINE, EMBASE, CINAHL, plus hand-searching of reference lists	62 trials screened from previous Cochrane review + 2056 new abstracts -> 21 RCTs included	Long-term care facilities and nursing homes for elderly residents	Elderly residents in long-term care facilities; interventions aimed at reducing falls among this population.	7 RCTs (4 multifactorial and 3 mono-factorial) showed significant reductions in falls or fall-related injuries. Positive effects were associated with tailored, comprehensive, and multidisciplinary programs. Poor implementation limited outcomes in some studies.	Evidence for fall prevention effectiveness is mixed. Multifactorial, well-tailored, and resourced programs are more promising. Implementation barriers (low compliance, insufficient resources, staff burden) must be addressed to improve outcomes. Process evaluations are essential.
Diener et al. (2022) ²⁷	To provide an overview of the effectiveness, acceptability, and feasibility of e- and m-health interventions aimed at promoting physical activity (PA) and preventing falls in nursing homes.	e- and m-health interventions including Digital exergaming (Nintendo Wii, Xbox Kinect, VR) -Video-based rehabilitation Cyber-cycling -Mobile and telehealth platforms (no m-health specific studies identified)	PubMed, Scopus, SPORTDiscus, Web of Science Core Collection, Google Scholar, backward and forward citation tracking	1,358 initial -> 830 screened -> 42 full-text reviewed ->28 studies included	Nursing homes, long-term care facilities, residential aged care across multiple countries	Nursing home residents with mild-moderate impairments; often excluded severe cognitive/physical limitations	Exergaming interventions showed potential for improving balance and reducing falls. Most interventions were rated as acceptable and feasible. However, findings were mixed and limited for advanced cognitive/physical impairment populations.	Digital interventions may reduce fall risk and promote PA, but evidence is limited. More studies needed beyond exergaming to explore broader e-/m-health applications. Feasibility is high for those with adequate function. Need for better inclusion of cognitively impaired populations
Shakeel et al. (2015) ²⁶	To assess the feasibility of implementing exercise and falls prevention programs in Ontario long-term care homes (LTCHs), considering recent funding reforms.	Multi-component physical activity and exercise interventions with a focus on low-cost, group-based, minimal equipment programs carried out by LTCH staff or volunteers.	MEDLINE, Embase, PsycINFO, CINAHL, AgeLine, Allied and Complementary Medicine (searched up to March 2014)	1751 identified -> 269 abstracts screened ->69 full-text RCTs -> 39 studies included	Long-Term Care Homes (Ontario, Canada)	Residents in LTCH including frail older adults, those with dementia or incontinence, low- and high-mobility individuals	Most effective and feasible programs used minimal resources, were group-based, and led by in-situ staff or trained non-specialists. Interventions using simple equipment achieved comparable outcomes to those using complex, expensive tools.	Exercise programs can be feasibly implemented in Ontario LTCHs using trained staff and volunteers, simple equipment, and existing infrastructure. These interventions improve physical, psychological, and social health outcomes and are cost-effective under the new funding system.

Table 2. (Cont. from previous page).

Authors	Review aim	Type of falls prevention intervention/s	Databases used	Papers selected	Type of long-term care institution	Targeted population under review	Key findings	Key conclusions
Vlaeyen et al. (2017) ²²	To identify barriers and facilitators for implementing fall prevention interventions in residential care facilities.	Multifactorial interventions tailored to residents' fall risk profiles; the review focused on implementation strategies	MEDLINE, EMBASE, CINAHL, PsycINFO, and Web of Science	2,219 records screened -> 19 full-text reviewed -> 8 studies included	Residential Care Facilities (nursing homes, LTCFs) in the USA and Canada	Staff (nurses, administrators); context focused on residential care facility residents but were not the primary target	44 influencing factors identified: 27 barriers and 17 facilitators across 6 healthcare levels (innovation, individual, resident, social, organizational, political). Most cited barriers: staff feeling overwhelmed, staffing shortages, lack of knowledge/skills, poor communication.	Successful fall prevention requires addressing modifiable factors (communication, knowledge, skills). Implementation should use a tailored, multifaceted approach that aligns with context-specific barriers and facilitators. A whole system strategy is essential for sustained success.
Albasha et al. (2023) ²¹	To synthesise evidence on the implementation strategies and outcomes used in fall prevention intervention studies in long-term care facilities, and to describe clinical outcomes where reported.	Multi-component and multifactorial fall prevention interventions that incorporated implementation strategies such as staff education, audit & feedback, environmental modifications, post-fall assessments, and medication reviews.	PubMed, CINAHL, EMBASE, PsycINFO, SCOPUS, Web of Science; grey literature: OPEN GREY, OATD, ProQuest, British Library EThOS, EBSCO, RIAN, LENSUS, CORA	4,397 identified -> 195 screened in full -> 27 studies included	Long-term care facilities, including nursing homes, skilled nursing facilities, and residential care settings across the US, Europe, Japan, Australia, and New Zealand	LTC residents aged 65+ with a history of falls; staff in facilities with ≥30 residents	39 implementation strategies identified; most common were staff education (n=26), evaluative strategies (n=20), and stakeholder relationship building (n=20). Limited reporting on implementation outcomes and clinical outcomes.	Education is the most widely used strategy. However, implementation strategies were poorly reported and inconsistently applied. A clearer, structured reporting of strategies and outcomes is essential to improve real-world effectiveness.
Benjamin et al. (2014) ²⁴	To review the literature on the barriers to physical activity and restorative care in long-term care (LTC) settings, using a socioecological lens.	Physical activity and restorative care programs.	MEDLINE, CINAHL, AgeLine, SPORTDiscus	110 articles screened -> 7 barrier studies (9 articles) + 11 RCTs (13 articles) = 18 studies (22 articles)	Nursing homes, homes for the aged, assisted-living, and residential care facilities	Residents in skilled nursing/LTC homes, especially those at risk of falls	Barriers to physical activity and restorative care exist at multiple levels: resident-related (e.g., poor health, fear of falling), organizational (e.g., staffing and funding issues, structured routines), environmental (e.g., lack of space, poor infrastructure), and intersecting barriers (e.g., organizational + environmental interactions). Many programs are not tailored to the resident needs and preferences.	Barriers are multi-level and often intersect. Effective interventions must consider these multiple system levels using a socioecological framework and involve multiple strategies. Embedding physical activity into daily care and improving interdisciplinary collaboration is critical for success. Need for better documentation of barriers, especially environmental ones, in future studies.

Table 2. (Cont. from previous page).

Authors	Review aim	Type of falls prevention intervention/s	Databases used	Papers selected	Type of long-term care institution	Targeted population under review	Key findings	Key conclusions
Suen et al. (2024) ¹²	To identify the conditions of RCTs that are associated with reducing falls in residential aged care facilities (RACFs) and to test whether these conditions explain the variability in intervention success.	Exercise interventions compared to usual care, including: - Supervised group exercise - Moderate or low intensity - Tailored interventions - Progressive strength and balance training - Minimum of 1 hour/week	Cochrane review database (2018) and updated literature search to December 2021	18 RCTs (from 11 countries, 2,287 residents)	Residential Aged Care Facilities (RACFs)	Residents in aged care with mobility and cognitive impairments; interventions involved tailored physical activity	Two key success configurations identified: 1. Group exercise of moderate or low intensity 2. For independent ambulatory residents: 1 hour/week of exercise Both configurations explained all trial successes with consistency and coverage scores of 1.0.	Effective exercise interventions require moderate or low intensity group formats or sufficient weekly dosage for ambulatory residents. Interventions should be tailored to mobility and capacity. Future trials should include less mobile residents.
Dawson et al. (2024) ¹⁴	To develop a theory of successful fall prevention exercise features in residential aged care (RAC) using intervention component analysis (ICA) of RCTs.	Stand-alone exercise interventions targeting strength and balance, delivered at moderate intensity, tailored to residents' needs. Includes supervised group or individual programs.	CENTRAL, MEDLINE, Embase, CINAHL (search to December 2022)	32 RCTs total: 17 RCTs included in the ICA analysis	Residential Aged Care (RAC) facilities for older adults (65+)	Older adults in Residential Age Care Facilities	Effective interventions were structured, supervised, and delivered at moderate intensity with tailoring to resident's needs. The most effective focused on progressive standing balance and strength training.	Delivering the right exercise balance + strength, tailored, and at moderate intensity is critical. Sufficient resourcing (structure, supervision, dosage) is also essential for successful fall prevention in RAC. Larger trials needed to confirm theory.
Suen et al. (2023) ¹⁵	To determine what features of multifactorial fall prevention interventions in residential aged care (RAC) are associated with reduced falls. This was done using intervention component analysis (ICA) and qualitative comparative analysis (QCA).	Multifactorial interventions targeting both environmental and personal risk factors	CENTRAL (Cochrane), MEDLINE, Embase, CINAHL (search update to Dec 2021)	12 RCTs (11 from 2018 Cochrane review + 1 new), involving 5,215 residents	Residential aged care facilities (RACFs)	Residents in aged care facilities, especially those at risk of falls; tailored based on fall profiles, mobility, and cognitive status	Two features consistently linked to success: (1) Facility engagement and (2) Tailoring interventions to resident-specific risk profiles. Trials with both features showed greater reductions in falls	Multifactorial fall prevention is most effective when aged care staff and managers are engaged, and interventions are adapted to the residents' intrinsic risk factors. Co-design and tailored implementation are key to success.

Table 3.

Domain	Key Characteristics from the iPARiHS framework	Factors influencing fall prevention interventions extracted from the reviews related to the key characteristics	Extracts from systematic reviews
Innovation	Underlying knowledge sources	- Credibility of the intervention/guideline	"Attractiveness, credibility, and feasibility of the innovation (i.e., guideline or intervention that is perceived as new)...Good credibility, way to promote evidence based practice, keep up-to-date with progress in a field" (Vlaeyen et al)
	Clarity	- Clarity in the characteristics of the physical activities (groups vs individual, dose of the exercise program)	"Group-based exercise programs have been recommended for LTCH population as they are likely to further enhance the broader effectiveness of such interventions, as compared to the individualized interventions" (Shakeel et al) "Moderate or low intensity group exercise OR exercise for more than 1 h per week in independent ambulatory residents are the critical conditions of successful exercise programs for falls prevention in RACFs" (Suen et al. 2024)
	Degree of fit with existing practice and values	- Tailoring the intervention to the residents' characteristics, needs and abilities	"Tailoring the alarm type to resident characteristics can improve alarm performance and ultimately reduce the risk of falls and related injuries" (Mileski et al) "It is important that residents' disease related symptoms be considered when designing physical activity interventions. Providing exercises that residents can accomplish and tolerate may also act as a motivator" (Benjamin et al). "Trialists' perceived enabling staff to tailor the intervention to individual residents based on intrinsic personal factors, when conducting the risk factor assessment was important to ensure the environmental and personal intrinsic risks targeted, could be modified to improve the resident's ability to safely mobilise" (Suen et al 2023)
	Usability	- Good working order of equipment - Simple and easily integrated interventions/ devices - Does not increase workload	"Alarms must be consistently monitored and kept in working order... malfunctions associated with medical technology can increase workload for nurses" (Mileski et al) "Exergaming is an activity that can be relatively easily integrated into the NH environment... residents were confident in operating the Nintendo Wii at the conclusion of the 5-week intervention." (Diener et al) Barrier to implementation: "Too difficult...Not developed in view of context ...Too long ...Not user-friendly" (Vlaeyen et al) With reference to alarming devices: "False alarms can be burdensome on staff and residents and can contribute to "alarm fatigue" by staff members. (Mileski et al)
	Relative advantage	- Inexpensive and simple-to-use equipment over more complex and expensive equipment - Tailored multifactorial interventions over multicomponent interventions - More technologically sophisticated and interactive devices over traditional fall prevention methods	"Interventions that used inexpensive and simple-to-use equipment and showed gains of comparable magnitude to interventions using relatively expensive and custom designed equipment were identified in the literature" (Shakeel et al) "Effective fall prevention must consist of multifactorial interventions that target each resident's fall risk profile, and should be tailored to overcome context-specific barriers and put into action the identified facilitators" (Vlaeyen et al) "Alarming devices can be a key intervention in the safety of those residents who are prone to falls... New technology is changing the perceptions regarding these types of devices as time passes" (Mileski et al) "Data synthesis indicates that exergaming may be effective in reducing the number of falls and fall risk in NH residents... E-health interventions were mostly reported as feasible and well accepted by NH residents" (Diener et al)
	Trialability	-Pilot testing the interventions/physical activity/device	"Programs were often piloted with small groups and modified based on feedback from residents and staff before wider implementation in the long-term care homes" (Shakeel et al) "To enhance protocol adherence in a definitive study, we suggest that care home managers are asked to agree at the outset when and to whom the training will be provided, that refresher sessions are scheduled in advance and that protocols for inclusion of Guide to Action Care Hime in care home records are agreed" (Suen et al et al, 2023)
	Observable results	- Measurable positive outcomes	Barrier to implementation: " Absence of measurable outcomes" (Vlaeyen et al)
	Technological fit of the innovation in RLTC*	- User acceptance through technological advancements - Tailoring interventions to user through technological advancements	"Many aspects of alarms that were undesirable are beginning to evolve with improvements in alarm technology... Smaller and more comfortable alarm devices also have the capability of sending a direct alert to a specific caregiver. This reduces staff brden and increases the efficacy of the alarm system, which will broaden its application." (Mileski) "With advances in information and communication technology, innovative e- and m-health solutions have been developed to poitively influence PA and to reduce accidental falls. ... E- and m-health technologies offer new opportunities for a more person-centered care that more effectively considers individual abilities and impairments"

Table 3. (Cont. from previous page).

Domain	Key Characteristics from the iPARIHS framework	Factors influencing fall prevention interventions extracted from the reviews related to the key characteristics	Extracts from systematic reviews
Recipients	Staff values and beliefs	- Staff engagement alters their attitudes and fall risk awareness - Negative beliefs and attitudes towards guidelines and perceived self-efficacy	"Staff who were actively adhering to the intervention were perceived as crucial to implementation in situations where often facility staff conducted the risk assessment that initiated components of the multifactorial intervention. Trialists' described staff engagement in the intervention, to be associated with altered attitudes and understanding of falls as well as upskilling staff" (Suen et al, 2023) "Negative beliefs and attitudes (4/8 studies): guidelines perceived as replacing clinical judgement, (Colon-Emeric et al., 2007) falls perceived as inevitable and not preventable" (Vlaeyen et al) "Staff feeling helpless, frustrated, and concerned about ability to control fall management; overwhelmed by excess protocols" (Vlaeyen et al)
	Health status of the residents in RLTC*	- Physical health status of the residents and functional ability (e.g. limited mobility, pain, poor eyesight, poor balance, hearing impairment) - Cognitive and mental health status of the residents (e.g. cognitive impairment of energy, depression, fear of falling)	"Poor health status was a barrier reported by both staff and residents" (Benjamin et al) "Independent ambulatory participants, moderate or low intensity, group exercise and an exercise dose of more than 1 h per week demonstrated that these conditions were able to discriminate between successful and unsuccessful trials" (Suen et al, 2024) "Another barrier to restorative care, reported by nursing assistants, was resident anxiety and agitation" (Benjamin et al) "Residents with cognitive impairments and falls history were perceived to respond to intervention features differently and have a different risk profile than those without and therefore impact intervention effectiveness differently" (Suen et al, 2023) "The higher cognition group benefits more regarding reduction of falls and the lower cognition group benefits more with regard to fracture prevention" (Neyens et al) "Residents who accepted the exergames were significantly less cognitively impaired and were less likely to be hearing impaired" (Diener et al)
	Staff and residents' skills and knowledge	- Staff limited knowledge and skills influences implementation (e.g. unaware of fall prevention protocols and interventions, health illiteracy) - Staff and residents' education improves participation, awareness, interest and adherence to exercise programs	"Limited knowledge and skills (5/8 studies): limited general education or health literacy, knowledge deficit of quality improvement processes, poor falls management and computer skills." (Vlaeyen et al) "Raising awareness and interest...Sense-making to understand underlying fall causes...Staff being motivated to learn and use skills regularly" (Vlaeyen et al) "Educating staff and residents on the potential benefits of progressive resistance training (PRT) and balance training may have resulted in higher participation rate" (Dawson et al) "Two trials also described the importance of ensuring residents were actively participating in the intervention which was encouraged through education. However, only one included trial included resident education as an intervention feature" (Suen et al, 2023)
	Time, resources, support	- Adequate resources are critical to provide effective fall prevention exercises - Staffing issues and time constraints is a major challenge to promote fall prevention interventions	"Sufficiently resourced: 4/8 positive trials sufficiently resourced via funding the trials to deliver structured and supervised balance and strength exercise interventions>30 hours compared with 2/9 trials with neutral to negative findings" (Dawson et al) "Staffing constraints had made it challenging to promote physical activity, noting that residents being admitted to LTC were becoming older and sicker and required more assistance with their activities" (Benjamin et al) With reference to the challenges to implementation: "...lack of support for the intervention among staff, the intervention was time consuming and may have kept staff members from their other duties, and the limited resources of contemporary long-term care" (Neyens et al)
	Residents' values and beliefs	- Previous sedentary lifestyle - Resident's view the intervention as enjoyable	"A past history of a sedentary lifestyle reduced engagement in regular physical activity...For instance, some residents explained that they had never got into the habit of exercising or never thought about physical activity. Other residents felt they did not need to engage in physical activity because they felt "good" or believed that they had worked hard most of their lives and now it was time to rest" (Benjamin et al) "Enjoyment, as a measure of acceptability of exergaming, was reported by six studies.(Diener et al)
	Collaboration and teamwork	- Involvement of the multidisciplinary team and ownership by all members of the team	"Falls prevention should be a matter for all health care professionals working in long-term care settings. Therefore, we advise a multifactorial intervention delivered by a multidisciplinary team whereby good coordination, communication, complementarity, and continuity of the intervention program are essential components to enhance the success rate" (Neyens et al)

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Domain	Key Characteristics from the iPARiHS framework	Factors influencing fall prevention interventions extracted from the reviews related to the key characteristics	Extracts from systematic reviews
	Existing networks	- Co-design networks between facility staff and managers improves implementation effectiveness - Using existing communication channels for information sharing - Developing network bridging using falls champions - External facility networks may be considered by staff as foreign and irrelevant and reduces implementation effectiveness	"Effective trials tended to use co-design to engage facility staff and managers and to implement tailored programs... Facility engagement and co-design were present in 6 out of 7 effective trials." (Suen et al, 2023) "Some facilities had regular falls committees, interdisciplinary meetings, or used shared tools such as communication binders to update fall risk care plans." (Vlaeyen et al) "Eight studies used the identification and preparation of champions for supporting implementation in sites... These champions often worked across shifts or professional roles." (Albasha et al) "In some less effective trials, program staff were external to the facility or did not engage meaningfully with care staff, which limited program uptake and contextual fit" (Dawson et al)
	Power and authority	- Power imbalance and exclusion of lower ranked staff in decision making reduces staff compliance - Distributive and democratic leadership styles improve staff engagement - Punitive feedback reinforces power imbalance	"They put it together, they developed it. Then, they dropped it on us. [...] They said: 'Do what you have to do to make it work.'" — Change user, Etheridge et al... "In the USA, often only registered staff has access to the care plan [...] Consequently, it is harder to communicate changes in care plans to unregistered staff." (Vlaeyen et al) "Leaders who involve staff, clearly explain rationale, and provide support [...] contributed to improved fall prevention implementation." (Vlaeyen et al) "Co-design was described as engaging managers to support staff with necessary training and mutual decision making about the intervention protocol." (Suen et al, 2023) "Leaders made punitive statements when providing staff with feedback concerning falls monitoring data." (Vlaeyen et al)
	Presence of boundaries	- Clear role expectations and role clarity	"Teamwork, a sense of community and staff cohesion was improved if diverse opinions were actively sought out, and the role of each discipline was better understood" (Vaeyen et al) "The work of physiotherapists related to the promotion of daily physical activity in LTC settings, and the factors that influence this work is limited. Future studies using an institutional ethnographic approach would help us better understand what physiotherapists "do," related to the promotion of daily physical activity (Benjamin et al)
Context			
Local level	Formal and informal leadership support	- lack of formal leadership support or inaccessible leaders, undermine implementation - Support from fall champions acting as informal leaders - Including leadership training enhances context readiness	Barriers to implementation: "Leadership lacking quality improvement skills, without listening to and learned from staff or not providing support." (Vlaeyen et al) "Eight studies used the identification and preparation of champions for supporting implementation in sites." (Albasha et al) "Six studies employed leadership recruitment, design and training to support changes in care plans, monitor staff performance and offer intervention recommendations." (Albasha et al)
	Organisational culture	- Inflexible cultures interfering with residents' engagement in physical activities - Blaming cultures discourage open discussion and falls reporting - Empowerment and belonging shifts staff culture - Task centred culture reduces staff involvement in engaging in physical activity - A safety culture in RLTCs increases commitment towards falls prevention interventions	"The presence of pervasive institutional routines was also described as interfering with physical activity (Benjamin et al., 2011; Guerin et al., 2008). For example, bath days were scheduled, and residents would opt out of an exercise class if this meant they would miss their bath" (Benjamin et al) "Leaders lacking quality improvement skills (e.g., made punitive statements when they provide staff with feedback concerning falls monitoring data, and thus supporting the 'shame-and-blame' approach that is often predominant in nursing homes.)" (Vlaeyen et al) "In the beginning... I'm a housekeeper, what do you need me for? [...] But after we got into [the program], it was like, 'Oh, I am a piece of this puzzle. We are!'" (Vlaeyen et al) "The focus of personal support workers' work is often on 'getting their work done' (i.e., activities of daily living) and not on the promotion of physical activity." "Safety culture (1/8 studies)... Quality improvement structures (2/8 studies)... Prioritization and strong interest in fall prevention (3/8 studies)." (Vlaeyen et al)

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Domain	Key Characteristics from the iPARIHS framework	Factors influencing fall prevention interventions extracted from the reviews related to the key characteristics	Extracts from systematic reviews
	Past experience of innovation and change	- Past discontinued initiatives and other priorities lead to staff disengagement towards falls prevention initiatives - Lack of reflection on previous experience of barriers/facilitators when introducing new fall prevention interventions	"Meetings gave way to other topics, like patient-centered care, and the falls program was no longer on the agenda.... Sometimes there's just too much overload. You got guidelines for care plans, [tracheostomy] care, HIPAA, OSHA, dysphagia..." (Vlaeyen et al) "This review identified limited use of evaluation of barriers/facilitators at the level of staff/facilities before conducting the interventions... This may have affected the success of the implementation of the others." (Albasha et al)
	Mechanisms for embedding change	- Embedding falls prevention interventions through quality improvement structures - Embedding fall prevention interventions into existing workflows - Establishing a designated role	"The following quality improvement structures, if incorporated into routine practice, were linked to better fall prevention: fall trends analysis; structure for developing a falls management plan for each resident; guideline-based standing orders; and policy review, procedures, and documentation standards." (Vlaeyen et al) "One possible strategy is to embed physical activity into daily care." (Benjamin et al) "A coordinator to manage the implementation of the multiple components of fall prevention was valuable; preferably supported by a multidisciplinary team." (Vlaeyen et al)
	Evaluation and feedback processes	- Need to include evaluation and feedback processes to inform staff about the implementation outcomes - Documentation audits improve assessment and management of falls risk factors	"Six studies conducted audits and provided feedback by informing staff about the implementation outcomes and progress, and two of them only conducted audits, without feedback." (Albasha et al) "Care process documentation: audits of records concerning 10 residents who had fallen twice or more before/during the 6-month evaluation period... Except for two, all critical areas of documentation concerning the assessment and management of all risk factors improved. Notable advancements likely to directly impact recurrent falls included better assessment of fall risk factors, interventions to reduce the risk of falling and the likelihood of injury, and correction of environmental and equipment hazards (Albasha et al)
	Learning environment	- Creating collaborative learning cultures improves networking and knowledge exchange - Creating learning communities	"One study fostered a collaborative learning environment by creating a specific collaborative learning strategy connecting all staff participating in the intervention with the fall prevention resources and encouraging them to use them through continuous networking meetings." (Albasha et al) "I learned as a group. We would all get together, everybody will come up with their different ideas... A combination of everything that will work by all of us getting together and putting out our ideas." — Certified Nursing Assistant. (Albasha et al)
Organisational level	Organisational priorities	- Organisational policies prioritising safety over mobility - limited organisational priority for staff engagement in fall prevention	"Some personal support workers used mechanical lifts... because this practice was considered safer and faster. However, this practice also reduced opportunities for residents to weight-bear." (Benjamin et al) "Survey participants... stated that the following actions needed improvement: getting nursing assistants to contribute to fall prevention (54%), and getting staff to enact care plan changes quickly (65%)." (Vlaeyen et al)
	Structure and systems	- Adequate information systems and IT access - Dedicated equipment, space and physical resources	"Many facilities had insufficient computers... located in locked offices... or not accessible to all staff (i.e., accessible by registered staff only), which made data entry time-consuming." (Vlaeyen et al) "Limited facility equipment... We don't have any [low] beds in the building." (Vlaeyen et al) "Multipurpose rooms were used for exercise classes... staff had to rearrange furniture before and after classes." (Benjamin et al) "Two studies changed the physical structure and equipment... placement of laundry receptacles, storage of maintenance equipment, location of fall registry." (Albasha et al)
	Absorptive capacity	- Organisational readiness for involvement of staff in implementing multifactorial interventions	"Complex interventions in care homes require readiness for involvement including support from managers, a tailored approach to each home and work to be planned jointly with an emphasis on building relationships between visiting healthcare professionals and care home staff." (Suen et al, 2023)
External health system level	Policy drivers and priorities	- External funding will influence the effectiveness of the implementation - Policies restricting access to care plans to non-registered staff	"A SR found that multifactorial fall prevention interventions were beneficial in reducing the fall rate in LTCF only when combined with external resources and financing." (Albasha et al) "In the USA, often only registered staff has access to the care plan, as mandated by Health Insurance Portability and Accountability Act regulations. Consequently, it is harder to communicate changes in care plans to unregistered staff." (Vlaeyen et al)

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Domain	Key Characteristics from the iPARiHS framework	Factors influencing fall prevention interventions extracted from the reviews related to the key characteristics	Extracts from systematic reviews
	Incentives and mandates	- Funding incentives - Implicit incentives – cost-effectiveness of ‘feasible’ interventions	“Under this new agreement, \$ 10 million will be allocated each year for exercise and falls prevention classes three times a week for all long-term care residents.” (Shakeel et al) “This systematic review has identified ‘feasible’ physical activity and falls prevention programs that required minimal investment in staff and equipment, and demonstrated positive outcomes.” (Shakeel et al)
	Regulatory frameworks	- Regulatory requirements promote the implementation of falls prevention programs	“In Ontario, LTCH are required to have falls prevention and management programs in accordance with section 49 of O.Reg 79/10 under the Long-Term Care Homes Act, 2007. [...] The Ontario government recently changed the funding system for physiotherapy services for seniors.” (Shakeel et al)
	Environmental (in) stability	- Natural disasters can disrupt successful implementation	“Another trial providing moderate intensity group exercise was unsuccessful at preventing falls as it was not able to provide continuous exercise during the intervention period due to COVID-19, which was identified by the trialists and in previous meta-analyses as critical for successful falls prevention in RACFs” (Suen et al, 2024)
	Inter-organisational networks and relationships	- Building networks between internal staff and external facilitators to provide technical assistance	“Eleven studies employed facilitation strategies that provided staff encouragement and support in their responsibilities as implementers of the intervention, in problem-solving processes and in managing interpersonal staff communication problems, using researchers, organisational coaches, external consultants and paid facilitators.” (Albasha et al)
	Changes in RLTC population*	- Changes in the complexity (frailty, lower mobility, age on admission) of residents in RLTC - Multicultural workforce in RLTC	“Admission to RACFs has been associated with a decline in ambulatory ability due to the loss of intrinsic capacity associated with ageing.. This decline is further evidenced by the trend of residents admitted to RACFs with increasing disability and complexity of health conditions over the last two decades.. In Australia, the average age of those admitted to RACFs over 2021 to 2022 were 83 years for men and 85 years for women compared to predominately 70 to 80 years of participants in the included trials.. Consequently, most residents currently living in RACFs are likely to be frailer and older than the residents in many of the included trials (Suen et al, 2024) “The staff members in the studies reviewed were predominantly women and frequently identified as migrant workers, including from the Philippines, Africa, and the Caribbean” (Benjamin et al)
Facilitation	Role of facilitator(s)	- Role of facilitators as key to implementation success - Lack of role clarity acts a barrier	“Facilitation was provided by a dedicated project facilitator, usually a nurse with specialist knowledge in falls prevention, and included regular feedback, coordination of meetings, and clinical support.” (Albasha et al) “One study promoted staff to weave a network by creating a group-to-group and individual-to-individual relationship map to improve staff interaction and communication. Where the facilitator’s leadership role was undefined, this network failed to catalyze implementation.” (Albasha et al)
	Skills in change management	- Supporting change using networking and communication - Supporting change using leadership skills	“Facilitators served as translators between researchers and practice staff, tailoring complex intervention content into digestible steps and assigning tasks to designated team members.” (Albasha et al) “Six studies employed leadership recruitment, design and training to support changes in care plans, monitor staff performance and offer intervention recommendations” (Albasha et al)
	Ability to build trust and relationships	- Active listening and respectful communication to build trust - Creating coalitions and interpersonal networks	“Communication that facilitated fall prevention included: (3) active listening, addressing communication weaknesses, and reporting improvements... and (4) using diverse communication strategies (e.g., feedback, explaining and verifying meaning, open communication, pitching in and respecting ideas of others).” (Vlaeyen et al) “One study promoted staff to weave a network by creating a group-to-group and individual-to-individual relationship map to improve staff interaction and communication.” (Albasha et al)
	Responsiveness to feedback and needs	- Responsiveness through audit and feedback mechanisms	“Six studies conducted audits and provided feedback by informing staff about the implementation outcomes and progress.” (Albasha et al)
	Problem-solving ability	- Direct support in problem-solving processes	“Eleven studies employed facilitation strategies that provided staff encouragement and support in their responsibilities as implementers of the intervention, in problem-solving processes and in managing interpersonal staff communication problems, using researchers, organisational coaches, external consultants and paid facilitators.” (Albasha et al)
	Providing education, coaching, and support	- Dynamic and tailored education strategies	“Some studies focused on enhancing staff skills through hands-on training, whether once-off or ongoing, including different interactive learning and training activities (e.g., problem-solving skills). They showed a mixture of passive (e.g., distribute education material) and active (dynamic education/consultation) education strategies.” (Albasha et al)

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Domain	Key Characteristics from the iPARIHS framework	Factors influencing fall prevention interventions extracted from the reviews related to the key characteristics	Extracts from systematic reviews
	Navigating complexity in RLTC*	- Managing intersecting barriers in RLTC	"Although three sets of authors (Benjamin et al., 2011; Galik et al., 2011; Resnick et al., 2011b), used a socioecological model to frame their studies, only one made explicit reference to intersecting barriers at different system levels (Benjamin et al., 2011). For instance, when inadequate staffing (an organizational-level barrier) was coupled with a lack of sufficient elevators (an environmental-level barrier), transporting residents to planned physical activities was constrained. In a second example, a quality-of-care initiative that aimed to improve safe lifts and transfers involved the purchase of mechanical lifts. However, these lifts had to be stored in previously designated physical activity space (Benjamin et al.)

* Factors that did not fit under any of the key characteristics of the iPARIHS framework

their implementation. Clarity in how interventions were structured also contributed to successful uptake. Studies in the selected reviews emphasized that clearly defining aspects such as whether physical activity was group-based or individual, and specifying intensity and duration, led to more effective programs. For example, group-based, moderate- to low-intensity exercises offered over one hour weekly were often more successful in residential aged care settings^{15,27}.

A critical factor in innovation was how well an intervention aligned with the needs and values of the residents. Tailoring programs to individual health profiles, including comorbidities and cognitive status, improved the relevance and acceptance of interventions^{12,15,23,24}. Usability was another key consideration. Simple and easily integrated programs that did not burden staff were better received. Technological tools like exergaming are gaining popularity due to ease of use and positive reception from residents, although technical failures and false alarms remained problematic in more traditional systems like bed alarms^{23,28}.

Relative advantage played a significant role in decision-making. Interventions using affordable, customized and straightforward equipment such as cuff weights, elastic bands, and balance discs, were often found to be as beneficial as their high-tech counterparts²⁷. Multifactorial and interactive programs were preferred, and newer technologies such as e-health platforms and gamified interventions gained popularity for their engaging nature²⁸. Similarly, group-based exercise programs can foster social engagement and motivation among residents, leading to better participation and outcomes²⁷. Programs that began with pilot testing and were iteratively refined based on resident and staff feedback saw improved adherence and feasibility^{23,27}. However, implementation was sometimes hindered by the absence of observable,

measurable outcomes, which affected staff motivation and long-term engagement²². To summarise, interventions that are credible, feasible, appealing and tailored to the specific needs of residents are more likely to be effectively implemented.

Factors Related to Recipients – Residents/Family Members

The beliefs and attitudes of staff significantly shaped the success of fall prevention programs. Staff who were engaged in implementing the interventions reported increased awareness of fall risks and became more proactive in addressing them¹⁵. However, resistance sometimes emerged due to perceptions that guidelines undermined clinical judgment, or due to feelings of helplessness in managing fall-related issues²². On the other hand, the residents' physical and mental health status also had a profound impact. Cognitive impairments, mobility limitations, and emotional states such as fear of falling or anxiety influenced how well individuals could participate in the interventions^{12,15,24,26,27}. The age and cognitive ability of the residents seemed to be related to the acceptability of certain interventions such as exergaming. For example, Diener et al.²⁷ reviewed studies which found that residents who accepted the exergames were significantly younger and showed less cognitive impairment.

Both staff and resident knowledge about falls and fall risk influenced outcomes. Limited understanding of fall prevention strategies among staff was a notable barrier²², particularly when compounded by low health literacy or unfamiliarity with new technologies. Education emerged as a crucial facilitator; when both staff and residents were informed about the benefits and logistics of the programs, participation and adherence increased^{12,14}. However, this heavily depended on the allocation of time and resources. In fact, programs that were well-funded and adequately

staffed tended to yield better outcomes¹⁴, while facilities with chronic under-resourcing struggled to maintain consistent implementation^{24,26}.

Resident values and past behaviors influence their willingness to participate. For those with a sedentary lifestyle history, engagement was low unless the interventions were seen as enjoyable or meaningful^{24,27}. Moreover, the attitudes and behaviors of residents and their family members significantly influenced the implementation of falls prevention interventions. Besides, differences in the goals and expectations of residents and their families can create barriers to intervention uptake²².

Collaboration within the care team was also essential. Multidisciplinary approaches, where staff across roles and ranks shared responsibility and communicated effectively, were more successful in delivering consistent care²⁵. Such initiatives include utilizing existing communication networks and co-designing programs with facility staff, which led to higher engagement and relevance^{12,22}. Conversely, bringing in external facilitators who lacked integration into the existing team often reduced the effectiveness of the intervention¹⁴. Program imposed from the top down, without input from lower-ranked staff, often led to disengagement. Contrary, democratic leadership and participatory decision-making improved buy-in and morale^{12,22}. Effective role clarity and defined responsibilities was key to teamworking and improved staff cohesion and efficacy^{22,24}. Conversely, vagueness in task delineation led to confusion and fragmented implementation.

Factors Related to Context

Context - Local level

LTC staff need to be empowered and directly engaged in the implementation of these interventions. Implementation becomes more challenging if staff perceive such interventions as too time-consuming, is detracting them from other duties and increase their burden²⁵. Additionally, the staff perceived control over the risk of falls can influence the implementation of these interventions. In fact, when staff feels helpless in managing falls, their motivation to engage with prevention programs diminishes²². Contrary, when staff are actively engaged, their attitudes towards the intervention improves¹². Mileski et al.²³ concluded that in relation to the use of alerting devices, staff willingness to participate in these interventions is reduced when they feel that they are increasing their workload leading to “alarm fatigue”. On the other hand, regular reminders about the risk of falls and motivational strategies can encourage staff to engage with preventive interventions²¹.

Besides, a supportive environment from senior management is required, where staff are motivated and aware of the importance of falls prevention interventions and their effectiveness²² and understand the underlying causes of falls²¹. Management strategies such as new professional tasks and leadership roles may be developed

to include falls prevention responsibilities as part of routine practice⁶. In fact, successful programs had strong support from formal leaders and informal champions, such as falls prevention advocates within the team^{21,22}. Inadequate leadership or disengaged managers undermined motivation and coordination. Training for leadership roles was identified as a helpful tool to strengthen context readiness²¹.

The organizational culture also seem to play a defining role. Inflexible routines and task-focused approaches often got in the way of implementing new interventions²⁴. Blaming cultures discouraged open dialogue and learning from falls. On the other hand, when staff felt empowered and recognized as contributors, a stronger sense of ownership emerged, shifting the culture toward one that prioritized safety and resident wellbeing²². Moreover, past experiences also shaped staff attitudes. For example, programs that competed with other priorities or that had failed in the past contributed to scepticism and disengagement^{21,22}.

Efforts to embed interventions within existing routines and quality improvement processes were more successful^{22,24}. Moreover, feedback loops and documentation audits helped staff track progress and fine-tune strategies²¹. Without these mechanisms, teams lacked the data necessary to adjust their efforts or celebrate improvements. Moreover, fostering a learning environment seems to be highly effective. Programs that promoted collaborative learning—through joint meetings, shared ideas, and continuous improvement efforts—led to stronger networking and problem-solving among staff²¹. Organizational priorities that leaned heavily on safety sometimes inadvertently discouraged mobility, as staff used lifts or avoided activities to minimize perceived risk²⁴. Moreover, limited prioritization of frontline staff contributions often left key team members feeling excluded²².

Context - Organisational level

Lack of access to the necessary equipment and physical resources (e.g. mobility equipment, computer access or physical space), can pose a challenge to the efforts of implementation²². Falls prevention may not be addressed as a priority in the LTC settings, which may reduce the chances of successful implementation of the intervention^{22,24}. Also, the cost of buying equipment such as computers or changing the physical environment of LTC can be a significant challenge^{21,22,24}. Readiness to adopt and adapt complex interventions varied by organization. Those with tailored strategies and strong managerial support were better able to engage their teams and navigate the intricacies of implementation¹².

Context - External health system level

The i-PARIHS framework¹³ refers to the external context as the ‘wider health care system in which the organisation is based’ which can include legal, political and social infrastructure related to the inner context. Vlaeyen et al.²² identified government and corporate policies that could

influence the implementation of these programs. External factors such as policies and regulations significantly influenced the implementation of fall prevention programs. Government mandates, such as Ontario's LTC Act, compelled organizations to prioritize falls management²⁶. However, these policies sometimes clashed with internal constraints, such as restricted access to care plans for non-registered staff²². Funding incentives play a vital role. For example, allocated funds for exercise classes encouraged adherence to specific intervention formats²⁶.

Regulatory frameworks provide important structure and accountability, but they could also inadvertently hinder communication or limit who could act on care plans. Moreover, environmental instability, such as the disruption caused by COVID-19, also played a major role in interrupting exercise continuity—highlighting the need for resilient and adaptable models¹⁵. Finally, inter-organizational networks and relationships supported implementation when they enabled shared learning and technical assistance. Facilitators, consultants, and external coaches who maintained consistent, respectful, and tailored support proved instrumental in building staff capacity and sustaining momentum²¹.

Factors related to the approaches used to facilitation

Facilitators were identified as crucial actors in the success of fall prevention interventions. However, who will take this role is not clearly identified in the selected studies. In fact, Shakeel et al.²⁶ noted that the occupation of facilitators who introduced the exercise programs varied considerably in the selected studies and consisted of different professionals including physiotherapists, exercise instructors, occupational therapists, nursing staff, trained research staff and therapeutic recreational therapists. However, existing LTC staff, non-exercise specialists and trained volunteers were also used in other studies²⁶, with similar positive outcomes when compared to licensed professionals. Alternatively, other studies have used purposively appointed falls prevention coordinators or champions, who can improve the organization's capacity to implement these interventions²¹. Irrespective of who acts as a facilitator, their roles were clearly defined as ambiguity in their responsibilities often led to missed opportunities and disjointed efforts²¹.

Facilitators can utilise different strategies to support implementation. Quality improvement initiatives and structures have been used to support facilitation through ongoing evaluation and refinement of falls prevention programs²². In Albasha et al. systematic review²¹, the authors identified several facilitation strategies (such as active listening and problem solving) that could be adopted including the provision of technical assistance and clinical supervision. Moreover, facilitators could focus on improving communication (e.g. ensuring open communication and feedback mechanisms) between the major stakeholders

especially between staff, residents and family members using strategies such as dynamic interactive training methods and ongoing mentoring for sustained learning²¹.

Discussion

The findings of this umbrella review indicate that the implementation of fall prevention interventions in residential long-term care (RLTC) settings is shaped by a complex interplay of factors related to residents, staff, context, and facilitation. Residents' physical and cognitive status, prior activity levels, and the attitudes of both residents and their families significantly influence participation. Interventions perceived as enjoyable and meaningful, such as exergaming, were more readily accepted, especially when residents had fewer impairments. Staff knowledge, motivation, and role clarity also emerged as key determinants of successful implementation, with multidisciplinary collaboration and inclusive leadership fostering greater engagement. Contextual factors at both the local and organizational levels included time constraints, staff workload, leadership support, and the organizational culture. Empowerment, feedback loops, and integration into daily routines facilitated adoption, while rigid workflows and under-resourcing were major barriers. Externally, regulatory mandates and funding incentives played a pivotal role, although policy constraints and environmental disruptions such as COVID-19 complicated delivery. Finally, facilitators—whether internal staff, trained professionals, or designated champions—were instrumental when they offered structured support, ongoing education, and adapted strategies to local needs. Their success depends on clearly defined roles, communication skills, and responsiveness to feedback. Together, these findings underscore the importance of flexible, system-wide implementation strategies tailored to the realities of RLTC environments. Table 4. summarises a set of recommendations for clinicians, RLTC managers and researchers based on the findings of this umbrella review and in alignment with the i-PARIHS framework.

This umbrella review also identified four factors, one in each domain, that did not fit under any of the key characteristics of the i-PARIHS framework. These factors have been labelled by the authors as – 'technological fit of the innovation in RLTC', 'health status of the residents in RLTC', 'changes in the RLTC population' and 'skills of the facilitators at navigating complexity in RLTC'. These factors could enhance understanding of current and future challenges and opportunities with regards to the implementation of falls prevention interventions in the evolving sector of RLTC. Consequently, the discussion will centre around these factors in relation to the evidence of the findings extracted from the selected reviews and extant literature.

Table 4. Recommendations for clinicians, RLTC managers and researchers obtained from the findings and aligned with the i-PARIHS framework.

Recommendation	Rationale as obtained from the systematic reviews	Alignment to i-PARIHS
Recommendations to clinicians		
Deliver enjoyable, person-centred interventions	Multifactorial interventions that are enjoyable and compatible the resident's needs were more acceptable and effective (Suen et al., Diener et al.).	Innovation – Relative advantage, clarity, usability; Recipients – Values, beliefs
Adapt physical activity to residents' cognitive and physical abilities	Success improved when interventions matched residents' health conditions and functional levels (Benjamin et al., Suen et al.).	Innovation – Degree of fit; Recipients – Health status
Educate residents and families on fall risks and benefits	Lack of education limited participation; resident and family knowledge improved motivation (Vlaeyen et al., Suen et al.).	Recipients – Knowledge, goals; Facilitation – Education and support
Work collaboratively across disciplines in care planning	Collaboration across roles improved coordination and intervention uptake (Neyens et al.).	Recipients – Collaboration and teamwork; Context – Embedded change
Use real-time data and feedback to inform care	Audit and real-time feedback supported learning and adaptation (Albasha et al.).	Context – Evaluation and feedback; Facilitation – Responsiveness
Maintain open communication with residents and colleagues	Trust-building and inclusive dialogue encouraged implementation (Vlaeyen et al.).	Facilitation – Trust and relationships; Recipients – Power dynamics
Recommendations to RLTC managers		
Embed fall prevention into strategic goals and quality structures	Leadership support and prioritisation were critical for sustained efforts (Vlaeyen et al., Albasha et al.).	Context – Leadership, organisational priorities, culture
Ensure sufficient staffing, space, and equipment for activities	Lack of staffing, IT access, and basic resources were major barriers (Benjamin et al., Vlaeyen et al.).	Context – Structure and systems, absorptive capacity
Promote a positive, non-blaming safety culture	Blaming cultures reduced reporting; empowerment improved morale (Vlaeyen et al., Benjamin et al.).	Context – Culture and learning environment
Clarify staff roles in fall prevention routines	Staff performed better when responsibilities were clearly defined (Vlaeyen et al.).	Recipients – Boundaries; Facilitation – Role clarity
Develop internal champions and provide leadership training	Trained champions improved motivation and performance (Albasha et al.).	Facilitation – Role clarity, change management skills
Use audits and data to guide continuous improvement	Feedback mechanisms led to documentation improvements and clearer protocols (Albasha et al.).	Context – Feedback mechanisms; Facilitation – Responsiveness
Co-design interventions with staff for contextual relevance	Co-design improved feasibility and engagement in most successful trials (Suen et al.).	Innovation – Degree of fit; Recipients – Collaboration
Recommendations to researchers		
Clearly define facilitator roles and strategies	Unclear facilitator roles weakened team coordination (Albasha et al.).	Facilitation – Role clarity, support strategies
Tailor interventions to account for resident diversity	Cognitive and physical status influenced acceptability of interventions (Suen et al., Diener et al.).	Innovation – Degree of fit
Investigate staff engagement barriers like low self-efficacy	Negative beliefs and limited knowledge hindered adoption (Vlaeyen et al.).	Recipients – Skills and knowledge; Context – Absorptive capacity
Apply frameworks like i-PARIHS to guide design	Many studies lacked theoretical framing or ignored context-fit (Albasha et al.).	Innovation – Knowledge base; Facilitation – Strategic application
Include marginalised groups in implementation studies	Staff with low rank or residents with impairments often excluded (Vlaeyen et al.).	Recipients – Power and authority; Context – Equity and inclusion
Distinguish between clinical outcomes and implementation success	Success was often attributed to interventions alone, not process (Albasha et al.).	Facilitation – Education and coaching; Innovation – Trialability
Assess long-term sustainability of embedded interventions	Few studies evaluated maintenance over time post-intervention (Albasha et al.).	Context – Embedding change; Facilitation – Sustainability focus

Technological fit of the innovation in RLTC

With the improvement in technology, new and existing technologies can improve falls prevention interventions in residential long-term care (RLTC) settings. Examples include wearable devices such as smart watches and smart insoles that can measure movements and predict falls by measuring gait and balance respectively and sending alerts to the caregivers²⁸. Sensor systems such as bed and chair sensors sit and monitor residents' movements and capacity and alert staff to possible falls, which minimizes response time²⁹. Virtual reality (VR) and augmented reality (AR) provide new and exciting ways of delivering training that can enhance balance, and decrease falls through simulated and more interesting tasks³⁰.

Implementing these technologies for falls prevention in residential long-term care (LTC) settings presents several challenges which are not so different from the more traditional interventions. Technical issues such as ensuring the reliability and accuracy of wearable devices and sensors are critical, as false alarms can lead to alarm fatigue among staff²³. Moreover, financial constraints may also be significant barrier, as the cost of purchasing, installing, and maintaining these technologies can be prohibitive for many RLTC facilities²⁷.

The health status of the residents in RLTC

The selected reviews clearly identified physical health conditions such as limited mobility, pain, poor eyesight, poor balance and hearing impairment as a significant barriers for residents to engagement falls prevention interventions. However, these health conditions are also significant risk factors of falls³¹. Consequently, in line with the World guidelines³, a comprehensive multifactorial assessment and management of these risk factors. Moreover, these interventions (e.g. exercise programs, medication reviews, environment modifications) need to be tailored to the health status of the residents to reduce these risk factors¹².

With respect to older persons with cognitive impairment, there is still limited evidence of how to tailor falls preventions interventions to their needs (Booth et al). However, recent evidence Suen et al.¹² recommends that interventions for persons with cognitive impairment should either be specifically adapted—offering additional supervision, support, and time—or carefully assessed for feasibility in modifying relevant risk factors. If certain risk factors cannot be effectively addressed, efforts should be redirected toward targeting those that are more modifiable and likely to reduce fall risk.

Changes in the RLTC population

There is growing evidence that residents entering residential long-term care (RLTC) in recent years are older and exhibit higher levels of frailty compared to residents from earlier cohorts³². With these changes in the characteristics of residents, Suen et al.¹⁵ points out

that exercise interventions need to to the abilities of the residents who may less mobile than previous cohorts of RLTC residents.

The increase in multicultural workforce in RLTC can influence the implementation of falls prevention interventions. For example, an increase in multicultural workforce may affect the context (e.g. changing the organisational culture, improving staffing levels) and the strategies that the facilitators may need to adapt to manage organisational change. Jang et al.³³ carried out a systematic review and narrative synthesis on the cultural influences on exercise participation and fall prevention of older persons and found that program participation is influenced by cultural values. However, this review focused on older persons from cultural and linguistically diverse backgrounds, not RLTC staff. It seems there is a paucity of literature on how diverse cultural backgrounds of RLTC staff can influence the program delivery and implementation. Further studies are needed on this issue.

The facilitators' skills in managing complexity in RLTC

The 'hidden' complexity of the organisation context in RLTC has been found significantly impact knowledge translation and the utilisation of evidence-based practice³⁴. When referring to the barriers to physical activity in long-term care, Benjamin et al.²⁴, highlight the need to consider the overlapping effect of a multitude of challenges. Consequently, facilitators need to attend to this complexity³⁴ in order to navigate the challenges posed by the organisational context within RLTC. Similarly, Leighton et al.¹¹ acknowledged the complexity of the context in care homes and that falls prevention interventions may impact differently in different care settings. Consequently, these authors concluded that facilitators need to understand the organisational context during the planning phase, before introducing such interventions in practice.

Strength and limitations

This umbrella review provides a conceptually grounded synthesis of factors influencing the implementation of falls prevention interventions in residential long-term care (RLTC), using the i-PARIHS framework. It uses comprehensive search strategy across multiple databases, in adherence to the PRIOR guideline. A key strength is the identification of four additional factors—technological fit of the innovation, resident health status, demographic changes, and facilitators' skills in managing complexity—which extend beyond traditional i-PARIHS domains and reflect the evolving realities of RLTC. The review also provides practical, stakeholder-specific recommendations.

However, this umbrella review has several limitations that should be acknowledged. The quality of the included systematic reviews varied, with some lacking transparency in study selection and data extraction. The ten reviews covered a wide range of interventions and settings,

introducing heterogeneity that complicates the synthesis of findings. Geographical and contextual differences across studies further affect the generalizability of the results. Many reviews provided limited detail on specific implementation strategies, making it difficult to identify best practices. Moreover, some reviews have not sufficiently provided detailed information about the implementation processes and the factors influencing successful implementation, making it difficult to identify best practices. Implementation frameworks other than the i-PARIHS framework, such as Consolidated Framework for Implementation Research (CFIR) have been used in reviews to identify determinants of successful fall prevention implementation³⁵. However, the i-PARIHS framework was chosen in view of its simplicity, applicability to health and social care settings and practical guidance. No registered or published protocol was written prior to the writeup of this umbrella review, which may have limited the transparency of the review process. Finally, the review included only English-language, peer-reviewed articles, which may introduce publication bias.

Conclusion

This umbrella review identified numerous factors that influence the implementation of falls prevention interventions in residential long-term care (RLTC) settings. Applying the i-PARIHS framework, the review highlights how success is shaped not only by the design of the intervention, but also by the attitudes and capabilities of staff and residents, the contextual realities of care facilities, and the presence of skilled facilitation. Moreover, it identifies four additional factors—technological fit, resident health status, changes in the RLTC population, and the facilitator capacity to navigate complexity—that are not fully captured by the current i-PARIHS framework but are highly relevant to contemporary RLTC practice. This suggests that while i-PARIHS provides a valuable foundation, it may benefit from refinement when applied in highly complex settings like RLTC.

Authors' contributions

Both Dr Anthony Scerri and Dr Lungaro Mifsud contributed to the conception and writeup of the manuscript. Both authors carried out the search, selection process and assessment for risk of bias. Dr Anthony Scerri read all the selected articles and initiated the data extraction. Dr Lungaro Mifsud reviewed the themes to check for their coherence and that they covered all the codes. Both authors read and approved the final version of the manuscript.

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