

Reducing falls in residential care

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Background

The Deputy Director of Nursing / Operations – Residential Services, Kingston Centre and Satellites on behalf of a falls prevention task force have requested a review of the literature focusing on the investigation of any falls prevention management strategies that could be implemented to assist Monash Health in reducing the rate of falls and falls with injury across the older aged population.

Question

1. What is the effectiveness of interventions designed to reduce falls by older people in residential care settings?
2. What is the effectiveness of strategies to implement falls prevention programs/initiatives/interventions?

Methods

A systematic search of papers in English from 2012 to present was undertaken in Medline, CINAHL, All EBM databases and Google. Search terms are outlined in Appendix 1. Only evidence-based clinical guidelines and systematic reviews were included due to the large volume of papers identified. Papers were screened for inclusion and appraised by one reviewer in consultation with colleagues, using inclusion criteria established *a priori*. A narrative synthesis of results of included papers was conducted.

Results

Four systematic reviews [1-4] and one clinical practice guideline [5] for interventions designed to reduce falls by older people in the residential care setting were included. One systematic review [6] summarising the barriers and facilitators to the implementation of falls prevention in residential care facilities and one economic evaluation [7] summarising the cost effectiveness of falls prevention strategies were also included. For full details refer to Table 1 in full review.

Effective interventions to reduce rate of falls, number of falls, number of fallers and recurrent fallers

Outcome	Interventions for people ≥60 years in residential care
Reduced rate of falls	Gait, balance and functional training with mechanical device [1]
	Balance and strength training [1]
	Multifactorial interventions including exercise, medication management, changes in environment and activities to improve staff knowledge [3, 4]
Reduced number of falls	Customised interventions to residents included: exercise, medication review, orthostatic hypotension, environmental review, hip protectors, vision, feet and footwear assessment and goal setting reminders and feedback [2]
	Single environmental intervention – Wander garden [4]
	Lavender patches [4]
Reduced number of fallers	Single exercise program [4]
	Single social environmental intervention – increased supervision [4]
	Knowledge based intervention for staff (person centered care, dementia care mapping) [4]
Reduced recurrent fallers	Customised interventions to residents included: exercise, medication review, orthostatic hypotension, environmental review, hip protectors, vision, feet and footwear assessment and goal setting reminders and feedback [1, 2]

Facilitators to implementing falls prevention strategies in residential care facilities

Facilitators: good communication and facility equipment availability [6].

Barriers: staff feeling overwhelmed, helpless, frustrated and concerned about their ability to the most cited barriers [6].

The evidence reported that effective fall prevention should be tailored to overcome context specific barriers and put into action the identified facilitators [6]

Conclusion

In conclusion, evidence from high quality systematic reviews and clinical practice guidelines suggest that a multifactorial, customised interventions are most effective at reducing the rate of falls, number of falls and recurrent falls for people in residential care facilities. Successful implementation of these interventions rely on good communication between staff, residents and families and carers as well as the availability of facility equipment.

Background

The Deputy Director of Nursing / Operations – Residential Services, Kingston Centre and Satellites on behalf of a falls prevention task force have requested a review of the literature focusing on the investigation of any falls prevention management strategies that could be implemented to assist Monash Health in reducing the rate of falls and falls with injury across the older aged population.

Question

1. What is the effectiveness of interventions designed to reduce falls by older people in residential care settings?
2. What is the effectiveness of strategies to implement falls prevention programs/initiatives/interventions?

Inclusion Criteria

Setting	Include: Residential care, nursing homes, rehabilitation facilities, Exclude: hospital settings
Population	Include: Elderly, Aged population as defined by studies, aged with mental health issues or dementia diagnosis. Exclude: Children, young adults, adults
Intervention	<ol style="list-style-type: none"> 1. Any intervention focused on falls prevention, falls reduction 2. Any strategies to implement falls prevention/reduction programs/initiatives/interventions
Outcomes	Falls reduction, improvement in strength and balance, overall wellbeing

*Search terms and study selection presented in Appendix 1

Results

Four systematic reviews [1-4] and one clinical practice guideline [5] for interventions designed to reduce falls by older people in the residential care setting were identified. One systematic review [6] summarising the barriers and facilitators to the implementation of falls prevention in residential care facilities and one economic evaluation [7] summarising the cost effectiveness of falls prevention strategies were also identified.

- A summary of interventions effectiveness is provided in Table 1.
- Detailed results by included papers is provided in Table 2.
- A summary of all barriers and enablers to implementation of falls prevention strategies is provided in Table 3.

Synthesis of Results

Quality assessment of included reviews and guidelines

All systematic reviews, the clinical guideline and economic evaluation were all of high quality documenting robust methodology. The quality of studies included within the systematic reviews and guideline was variable. Heterogeneity of interventions in included studies was noted as a limitation to interpretation of results.

Rate of falls

A significant reduction in the rate of falls was seen for older people in residential care facilities where gait, balance and functional training with a mechanical device [1]; balance and strength training [1]; and a multifactorial intervention including exercise, medication management, changes in environment and activities to improve staff knowledge [3] were implemented. A multifactorial intervention [4] in residents with mental health problems including dementia, depression or psychosis also reduced the rate of falls.

Balance and functional training using one leg [1] and Tai Chi [1] for residents aged ≥65 years and single exercise programs for residents with mental health problems [4] did not find a significant reduction in rate of falls.

Balance strength and walking [1]; goal setting and physical activity [1]; and staff training and education focusing on dissemination of information on falls prevention, fall risk assessment and potential modification of risk factors and post falls management [2] showed a significant increase in the rate of falls for nursing home residents.

Number of falls

Interventions customised to residents in nursing homes including multifactorial components consisting of exercise, medication review, orthostatic hypotension, environmental review, hip protectors, visual assessment, feet and footwear assessment and goal setting reminders and feedback showed significant reductions in the number of falls for residents [2]. For patients with mental health problems, Lavender patches and an environmental intervention (wander garden) significantly reduced the number of falls per resident although a high risk of bias was noted for the wander garden intervention, this result should be interpreted with caution [4].

Number of falls per resident in nursing homes and long term residential care facilities were not significantly reduced when interventions including vitamin D supplementation [2, 3]; incontinence care and low intensity, functional oriented exercise programs [2]; supervised ankle strengthening and walking programs [2]; single exercise interventions [3]; hip protectors [3]; medication review [3]; and nutritional supplements [3] were implemented.

A medication review intervention [2] for nursing home residents found no significant increase in the number of falls per resident.

Number of fallers

Significant reduction in the number of fallers was seen in knowledge based interventions for staff (person centered care, dementia care planning) and single exercise programs and increased supervision and in older adults (≥ 60 years old) with mental health problems including dementia, depression or psychosis; although the latter two interventions were seen to have a high risk of bias [4].

No statistically significant reduction was seen in the number of fallers for residents in nursing homes where incontinence care and a low intensity, functional oriented exercise programs; vitamin D supplementation; supervised ankle strengthening and walking programs; and customised multifactorial interventions specific to residents were implemented [2]. Lavender patches; multisensory stimulation in a Snoezelen room; and single exercise programs for older adults (≥ 60 years old) with mental health problems including dementia, depression or psychosis were also found to provide no significant reduction in the number of fallers [4].

Recurrent fallers

Significant reductions in recurrent fallers were seen where interventions were customised to residents and included multifactorial components consisting of exercise, medication review, orthostatic hypotension, environmental review, hip protectors, visual assessment, feet and footwear assessment and goal setting reminders and feedback [1, 2].

Evidence-based clinical practice guideline recommendations

An evidence-based clinical practice guideline was developed by Jung et al (2014) and has included recommendations to prevent falls for older adults living in long-term care facilities [5].

The guideline provides strong recommendations the following interventions: Comprehensive assessment on causes of fall; Strong encouragement of physical activities and participation in exercise; Provision of nursing to alleviate symptoms; Use of appropriate walking aids; Minimization of drug-related side effects; Provision of interventions related to care facility environment; Encouragement of Vitamin D intake; Provision of assessment and intervention for psychosocial matters; Provision of educational programs related to fall prevention; and organisation of a dedicated fall prevention team [5].

Implementation of falls prevention strategies

One systematic review [6] identified 17 facilitators and 27 barriers that influenced the implementation of fall prevention across different healthcare levels. The social and organizational levels had the greatest number of influencing factors, whereas resident and economical/political levels had the least [6].

Most cited facilitators were good communication and facility equipment availability, while staff feeling overwhelmed, helpless, frustrated and concerned about their ability to control fall management, staffing issues, limited knowledge and skills; and poor communication were the most cited barriers [6].

Effective fall prevention should be tailored to overcome context specific barriers and put into action the identified facilitators [6].

Cost effectiveness of falls prevention strategies

One economic evaluation [7] was identified and included in this review as it was thought to be of interest to the requestors. The objective of the paper was to evaluate the cost effectiveness of interventions designed to prevent falls and fall related injuries among older people living in residential aged care facilities from an Australian health care perspective [7]. The evaluation included effectiveness data from two systematic reviews. Medication review, vitamin D supplementation and a multifactorial intervention with a multidisciplinary team all reduced the rate of falling with the multifactorial intervention also reducing the risk of falling [7]. The economic model suggests that vitamin D supplementation and medication review are cost-effective interventions that reduce falls, provide health benefits and reduce health care costs in older adults living in residential aged care facilities [7].

Conclusion

In conclusion, evidence from high quality systematic reviews and clinical practice guidelines suggest that a multifactorial, customised interventions are most effective at reducing the rate of falls, number of falls and recurrent falls for people in residential care facilities. Successful implementation of these interventions rely on good communication between staff, residents and families and carers as well as the availability of facility equipment.

Table 1: Summary of results

Outcome/Result	Population	Intervention	Ref
Rate of falls			
Significant reduction	Older people ≥65 years living in residential care facilities	Gait, balance and functional training with mechanical device	[1]
		Balance and strength training	[1]
	Older adults ≥60 years in long term care facilities	Multifactorial interventions including exercise, medication management, changes in environment and activities to improve staff knowledge	[3]
	≥60 years with Mental health problem including dementia, depression or psychosis		[4]
Non-significant reduction	Older people ≥65 years living in residential care facilities	Balance and functional training using one leg	[1]
		Tai Chi	[1]
	≥60 years with Mental health problem including dementia, depression or psychosis	Single exercise program	[4]
Significant increase	Older people ≥65 years living in residential care facilities	Balance, strength and walking (as a combination strategy)	[1]
		Goal setting physical activity	[1]
	Nursing home residents	Staff training and education focusing on dissemination of information on falls prevention, fall risk assessment and potential modification of risk factors and post fall management	[2]
Number of falls			
Significant reduction	Nursing home residents	Customised interventions to residents included: exercise, medication review, orthostatic hypotension, environmental review, hip protectors, vision, feet and footwear assessment and goal setting reminders and feedback	[2]
	≥60 years with Mental health problem including dementia, depression or psychosis	Single environmental intervention – Wander garden (High risk of bias)	[4]
		Lavender patches	[4]
Non-significant reduction	Nursing home residents	Vitamin D supplementation	[2]
	Older adults ≥60 years in long term care facilities		[3]
	Nursing home residents	Incontinence care and a low-intensity, functional oriented exercise program	[2]
		Supervised ankle strengthening and walking program	[2]
	Older adults ≥60 years in long term care facilities	Single exercise interventions	[3]
		Hip Protectors	[3]

		Medication review	[3]
		Nutritional supplements	[3]
Non-significant increase	Nursing home residents	Medication interventions	[2]
Number of fallers			
Significant reduction	≥60 years with Mental health problem including dementia, depression or psychosis	Single exercise program (High risk of bias)	[4]
		Single social environmental intervention – increased supervision (High risk of bias)	[4]
		Knowledge based intervention for staff (person centered care, dementia care mapping)	[4]
Non-significant reduction	Nursing home residents	Incontinence care and a low-intensity, functional oriented exercise program	[2]
		Vitamin D supplementation	[2]
		Supervised ankle strengthening and walking program	[2]
		Customised interventions to residents included: exercise, medication review, orthostatic hypotension, environmental review, hip protectors, vision, feet and footwear assessment and goal setting reminders and feedback	[2]
	≥60 years with Mental health problem including dementia, depression or psychosis	Lavender patches	[4]
		Multisensory stimulation in a Snoezelen room	[4]
		Single exercise program	[4]
Recurrent fallers			
Significant reduction	Nursing home residents	Customised interventions to residents including exercise, medication review, orthostatic hypotension, environmental review, hip protectors, vision, feet and footwear assessment and goal setting reminders and feedback	[2]
	Older people ≥65 years living in residential care facilities		[1]

*Comparators and exact results can be found in Table 2

Table 2: Summary of included guidelines, systematic reviews and meta-analyses – Interventions to prevent falls in residential care

Ref	Quality	Study Design	Population/ Setting	Intervention	Outcomes	Results
[1]	High Quality Meta-Analysis Included studies ranged from low to high quality	Meta-Analysis of RCTs 21 studies (5540 participants)	Older people (≥65 years) living in care facilities	<p>Single exercise interventions:</p> <ul style="list-style-type: none"> Gait, balance and functional training with mechanical device (2 studies) Balance and strength (7 studies) Balance and functional training using 1 leg (1 studies) Balance, strength and walking (3 studies) Tai Chi (1 study) Goal setting physical activity (3 studies) <p>Combined interventions</p> <ul style="list-style-type: none"> 6 Studies included interventions where exercise was combined with tailored fall interventions eg staff education, medication review or environmental modification 	<ul style="list-style-type: none"> Rate of falls Number of fallers 	<p><i>Overall Effect of Exercise on Fall Prevention</i></p> <ul style="list-style-type: none"> Significant differences between all exercise interventions and control groups were found in the rate of falls (RR 0.81, 95% CI 0.68–0.97; 18 studies, 5,047 participants). No significant differences were found in the number of fallers between all exercise interventions and control groups (RR 0.93, 95% CI 0.86–1.01; 14 studies, 4,100 participants). Although there were no significant differences between the exercise (single) and control groups in the rate of falls (RR 0.91, 95% CI 0.75–1.10) and the number of fallers (RR 1.04, 95% CI 0.92–1.18), significant differences existed between exercise (combined) and control groups in the rate of falls (RR 0.61, 95% CI 0.52–0.72) and the number of fallers (RR 0.85, 95% CI 0.77–0.95) <p><i>Effect of Exercise Type on Fall Prevention</i></p> <ul style="list-style-type: none"> Exercise involving gait, balance, and functional training with mechanical devices (RR 0.45, 95% CI 0.24–0.85; I2 = 0%, 2 studies, 111 participants) and balance and strength (RR 0.84, 95% CI 0.72–0.96; I2 = 0%, 6 studies, 1,166 participants) reduced the rate of falls. Balance and functional training using one leg (RR 0.82, 95% CI 0.65–1.04; 1 study, 553 participants) and Tai Chi (RR 0.75, 95% CI 0.52–1.08; 1 study, 286 participants) did not significantly differ but tended to reduce the rate of falls. Balance, strength, and walking (RR 1.48, 95% CI 1.10–2.00; I2 = 55%, 3 studies, 448 participants) and goal-setting physical activity (RR 1.11, 95% CI 0.84–1.45; 1 study, 682 participants) increased the rate of falls in care facilities. A small amount of heterogeneity was present in the rate of falls across studies. Meanwhile, there were no significant differences in the

Ref	Quality	Study Design	Population/ Setting	Intervention	Outcomes	Results
						<p>number of individuals experiencing falls among types of exercise interventions.</p> <p><i>Effect of Exercise on Recurrent Fallers</i></p> <ul style="list-style-type: none"> There were significant differences between all exercise intervention and control groups in the number of recurrent fallers (RR 0.71, 95% CI 0.53–0.97; I² = 49%, 6 studies, 1,877 participants)
[2]	<p>High quality systematic review</p> <p>Included studies were of moderate to low quality</p>	<p>Systematic Review and Meta-Analysis of RCTs</p> <p>12 studies included</p>	Nursing home residents	Single, multiple or multifactorial fall prevention programs designed to prevent falls	<ul style="list-style-type: none"> # of falls # of fallers # of recurrent fallers 	<p><i>Overall Effect on Number of falls, Fallers and Recurrent Fallers</i></p> <p>Falls: In nine studies, the intervention and control groups did not differ significantly in number of falls Two multifactorial studies showed a significant decrease in falls of 36% and 45%, respectively, over a 12-month period for the intervention groups. An a priori secondary subgroup analysis of one study showed that the effect was only significant in cognitively impaired residents (relative risk (RR) = 0.49, 95% confidence interval (CI) = 0.35–0.69) and not in cognitively intact residents (hazard rate (HR) = 0.91, 95% CI = 0.68–1.22). Pooled data from 10 studies showed no effect on number of falls (RR = 0.93, 95% CI = 0.76–1.13; I² = 89.8%, P < .001).</p> <p>Fallers: Seven studies assessed the number of fallers as an outcome measure, of which two multifactorial studies showed significantly fewer fallers in the intervention group than in the control group. These two studies reported 25% and 30% fewer fallers, although the pooled risk estimates failed to demonstrate a beneficial effect of the intervention on number of fallers (RR = 0.97, 95% CI = 0.84–1.11; I² = 47.9%, P = .09)</p> <p>Recurrent Fallers: The number of recurrent fallers was assessed in four multifactorial studies. One study described a significant 44% reduction in the number of recurrent fallers for the intervention group. In another study, the mean proportion of recurrent fallers was 19% lower in the intervention facilities than in the control facilities. The pooled estimate showed significantly fewer recurrent fallers in the intervention groups than in the control groups (RR = 0.79, 95% CI = 0.65–0.97; I² = 6.3%, P = .36).</p>

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						<p><i>Characteristics and Effects of Different Types of Interventions</i></p> <p>Single Interventions: Two studies examined the effect of staff training and education that focused on dissemination of information on falls prevention, fall risk assessment and potential modifications of risk factors, and postfall management review. Pooled risk estimates showed that the intervention groups had significantly more falls than the control group (RR = 1.29, 95% CI = 1.23–1.36; I² = 0%, P = .49). Two other studies evaluated medication interventions. One used health information technology to analyze medication use in order to identify residents with a high risk of falling. Consultant pharmacists then reviewed medication and discussed their findings with the nursing staff. Nurse assistants observed and reported symptoms of medication side effects. In contrast, another study evaluated whether trained pharmacists who reviewed clinical and prescribing information and then consulted with general practitioners improved prescribing behavior. This study used an algorithm to evaluate the appropriateness of the residents' prescribed psychoactive medications. The pooled risk estimate of 1.20 (95% CI = 0.89–1.61; I² = 63.0%, P = .10) indicated a nonsignificant effect but with a trend toward more falls in the intervention groups. Another study reported results from a vitamin D supplement intervention. Every 3 months, residents were offered 2.5 mg of ergocalciferol for a median 10 months. Another study examined a supervised ankle strengthening and walking program in which the duration, distance, and gait speed were progressively increased according to the capabilities of each participant. Neither of these two studies led to a significant reduction in the number of falls or fallers.</p> <p>Multiple Interventions:</p> <p>In the only multiple intervention study, intervention group residents received incontinence care and a low-intensity, functionally oriented exercise program. No significant decrease in number of falls or fallers was detected as a result of the intervention.</p> <p>Multifactorial Interventions: One study used a customized intervention, with all intervention components targeted to the</p>

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						<p>individual risk profile of each resident. Five studies examined partially customized interventions (general components given to all residents, some components targeted to individual risk profile of the resident). The studies' interventions focused on exercise; medication; orthostatic hypotension; environment; hip protectors; vision; feet and footwear; and goal setting, reminders, and feedback. In all but one study, a multidisciplinary team implemented the intervention program.</p> <p>For the multifactorial interventions reviewed, the pooled risk estimates showed a significant beneficial effect of the intervention for number of falls (RR = 0.67, 95% CI = 0.55–0.82; I² = 16.7%, P = .31) and recurrent fallers (RR = 0.79, 95% CI = 0.65–0.97; I² = 6.3%, P = .36) but not for number of fallers (RR = 0.83, 95% CI = 0.68–1.01; I² = 20.0%, P = .29).</p>
[3]	<p>High quality systematic review</p> <p>Included studies were of moderate to high quality</p>	<p>Systematic Review of Reviews</p> <p>10 meta-analyses were included reporting 26 pooled analyses</p>	<p>Older Adults (mean age ≥ 60 years) dwelling in long term care facilities or hospitals</p>	<p>Any that sought to prevent falls (including the rate, number, risk or odds of falling)</p>	<p>Effect of interventions on the rate of falls and/ number of fallers</p> <ul style="list-style-type: none"> • Exercise • Vitamin D • Nutritional Supplements • Medication Review • Hip Protectors • Multifactorial interventions 	<p><i>Exercise in LTCF</i></p> <p>Four meta-analyses investigated a range of exercise interventions in LTCF. From these 3 out of 10 pooled analyses from two meta-analyses demonstrated a significant effect on reducing falls (including the odds, rate and risk of falling). Briefly, Guo et al. pooled data from 10 RCTs (n = 1262) investigating a range of exercise interventions and found a significant reduction in the odds of falling in the intervention group (OR 0.79 (0.64–0.98)). However, when two tai chi RCTs were removed the result became non-significant (OR 0.84 (0.63–1.11), N = 8, n = 917). Cameron et al. found that exercise had no significant effect on reducing the rate of falls across four pooled analyses. Sherrington et al. pooled data from 15 RCTs (n = unclear) in LTCF and also found that exercise intervention have a non-significant effect. Lastly, Silva et al. pooled data from 14 RCTs in the most recent meta-analyses and found that exercise significantly reduced the risk of falling (RR 0.77 (0.64–0.92), n = 1292). Silva et al. [26] conducted a subgroup analyses and found that only combined exercises were significantly associated with a reduced in the risk of falls in LTCF (RR 0.71(0.55–0.90), N = 9, n = 885, I² = 72.0%). In summary, inconsistent evidence exists with evidence from 3 meta-analyses or 3 out of 10 pooled results demonstrating that exercise can reduce falls. Therefore, the</p>

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						<p>benefits of exercise on reducing falls in hospitals and LTCF are not consistently evident in the literature to date. This is based primarily on moderate and high quality evidence.</p> <p><i>Vitamin D Supplementation in LTCF</i></p> <p>Five meta-analyses investigated the influence of vitamin D supplementation on falls. This included six pooled analyses and only one of these demonstrated a significant reduction in the rate of falls (RaR 0.63 (0.46–0.86), N = 5, n = 4603). Of the remainder, one other meta-analyses demonstrated a trend towards significance [22] (RR 0.90 (0.80–1.01), N = 5, n = 1428) and two pooling’s from another meta-analysis demonstrated a non-significant reduction in the risk of falling from vitamin D supplementation with and without calcium [28]. Given this, the current evidence does not support vitamin D supplementation to reduce falls in LTCF currently. This is based primarily on moderate and high quality evidence.</p> <p><i>Other Single Interventions in LTCF</i></p> <p>In a large meta-analysis, Santesso et al. found that hip protectors were not effective in reducing the rate of falls among older adults dwelling in LTCF (RaR 1.02 (0.90–1.16), N = 16, n = 11,275, I²= 92%). Guo et al. investigated the influence of nutritional supplements on the odds of falling and found it has no significant effect (OR 0.93 (0.77–1.13), N = 6, n = 4934). Finally, Cameron et al. found no evidence to suggest that implementing a medication review reduces the rate of falls in older adults dwelling in LTCF (RR1.00 (0.91–1.10), N = 4, n = 4857, I²= 47%).</p> <p><i>Multifactorial interventions in LTCF</i></p> <p>Two meta-analyses investigated the influence of multifactorial interventions on falls, which involves individually tailoring two or more interventions to an individual following a risk assessment. Both meta-analyses produced one result demonstrating that multifactorial interventions reduce falls and overall two from four pooled analyses demonstrated a significant effect on reducing falls. Specifically, Choi and Hector pooled data from three RCTs and found a large significant reduction in the risk of falls (RR0.45 (0.38–0.53), n =</p>

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						1291, Cochran Q p < 0.001). Cameron et al. investigated multifactorial interventions in greater depth and in their subgroup analyses demonstrated that these were only effective when conducted in intermediate LTCF settings (RaR 0.64(0.50–0.83), N = 3, n = 670, I2= 33%). Both of these meta-analyses were classified as high quality according to the AMSTAR. In summary, although sparse, there is evidence to suggest that multifactorial interventions are effective in reducing falls in LTCF.
[4]	High quality systematic review Included studies ranged from low to high quality	Systematic Review	≥ 60 years with any mental health problem including dementia, depression or psychosis	Single focus interventions Multifactorial interventions <ul style="list-style-type: none"> • Environmental • Exercise • Technological • Psychological • Educational • Health related components 	Number of participants sustaining at least one fall (fallers) and data relating to the rate or number of falls	<p><i>Nursing/residential care: single interventions</i></p> <p>Two studies looked at exercise programmes in nursing or residential care. One (high risk of bias) found a significant reduction in numbers of fallers and the other (low risk of bias) no difference in number of fallers but a non-significant reduction in rate of falls and hip fractures.</p> <p>Four studies looked at some form of environmental intervention. One, a study of a wander garden found a significant reduction in the mean number of falls but this was an uncontrolled study and at high risk of bias. Of the other social environmental interventions two studies involving increased supervision reported a significant reduction in number of fallers, but both were at high risk of bias.</p> <p>A study comparing dementia care mapping (DCM), person-centred care (PCC) and usual care found a reduction in falls in the DCM group compared to control but an increase in the PCC group compared to control. One study which involved a knowledge based intervention for staff reported a significant reduction in fallers but no difference in the rate of falls. Two studies evaluated a sensory intervention. One study of lavender patches (low risk of bias) found a non-significant reduction in number of fallers and a significant reduction in incidence of falls and a study of multisensory stimulation in a Snoezelen room found no difference in the number of falls in the intervention group compared to control.</p> <p><i>Nursing/residential care: multifactorial interventions</i></p> <p>Five studies looked at multifactorial interventions in nursing</p>

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						homes or residential care. Common components of these interventions were exercise, medication management, changes to the environment and activities to improve staff knowledge. Two studies report a significant reduction in the rate of falls in participants with cognitive impairment. However, in the latter there was a non-significant increase in the number of hip fractures in the intervention group compared to control. One low risk of bias study found a slight (non-significant) reduction in fallers but a non-significant increase in fall related A&E admissions, and one a non-significant reduction in injurious falls and number of recurrent fallers. One study which undertook subgroup analyses for participants with cognitive impairment found that the intervention significantly reduced the number of fallers in those with no cognitive impairment but not in the group with cognitive impairment.
[5]	High quality Guideline Majority of included studies were of high quality with two considered moderate and four considered low quality	Guideline – following SIGN methodology	Older adults over 65 years of age in long term care facilities	<i>Recommendations</i> <ul style="list-style-type: none"> • Comprehensive assessment on causes of fall • Strong encouragement of physical activities and participation in exercise among older adults at care facilities • Provision of nursing to alleviate symptoms • Use of appropriate walking aids • Minimization of drug-related side effects • Provision of intervention related to care facility environment • Encouragement of Vitamin D intake • Provision of assessment and intervention for psychosocial matters • Provision of educational programs related to fall prevention • Organisation of a dedicated fall prevention team 		

Table 3: Summary of Implementation of falls prevention strategies

Ref	Quality	Study overview	
[6]	High quality Systematic Review Quality of included studies was low to fair.	Objective: To identify the barriers and facilitators for fall prevention implementation in residential care facilities. Design: Systematic Review of qualitative and quantitative studies of low to fair methodological quality	
Healthcare levels	Barriers	Facilitators	
The innovation	<ul style="list-style-type: none"> • The innovation being too difficult • Not developed in view of the context • Too long • Not user friendly • Missing measureable process 	<ul style="list-style-type: none"> • Seeing an intervention as a way to promote evidence-based practice, and to keep up-to-date with progress in a field • Timely provision of stepwise guideline implementation tools 	
The individual professional	<ul style="list-style-type: none"> • Staff feel helpless, frustrated and concerned about their ability to control fall management, causing stress and anxiety • Staff feel overwhelmed by excessive protocols on top of related information and extra training requirements • Knowledge and skills barriers: limited general education or health literacy among staff having a low level educational background; knowledge deficit of quality improvement processes; poor falls management skills; lack of computer skills to analyze falls data • Negative beliefs and attitudes toward guidelines, in general, or falls and fall prevention, hindered implementation • Staff believed that guidelines led to “cookbook medicine: replacing clinical judgment, and therefore are not compatible with resident-centered care • Falls often considered as being inevitable and thus were perceived as not being preventable 	<ul style="list-style-type: none"> • Awareness of falls prevention among resident care staff influences implementation. Raising fall prevention awareness leads to a strong interest of the staff playing an active role. • Seeking to understand underlying causes for falls by means of “sense-making” and staff being motivated to learn and use skills regularly were perceived as facilitators 	
The resident	<ul style="list-style-type: none"> • Noncompliance to recommendations or conflicts with expectations and goals, of either the resident or their families complicated implementation • Resident boredom led to residents trying to leave their chair and fall 	Not reported	
The social context	<ul style="list-style-type: none"> • Communication barriers: poor information transfer among care providers 	<ul style="list-style-type: none"> • Communication that facilitated fall prevention: staff sharing information 	

	<p>across shifts, as well as between staff and family; lack of care plan communication; failure to communicate falls; no carryover of training information; tension and hostility between licensed and unlicensed staff</p> <ul style="list-style-type: none"> • Absence of staff buy-in or accountability – most common when staff involvement was not sought in advance is problematic • Leaders lacking quality improvement skills, who did not listen to or learned from staff, provide support, or supervised implementation. • Clinical leaders were frequently asked to assume other leadership roles adding to their already high workload 	<p>across shifts and disciplines and between staff and family; a fast and proper care plan communicating strategy to all staff to increase adherence; active listening, addressing communication weakness, and reporting improvements; using diverse communication strategies</p> <ul style="list-style-type: none"> • Staff involvement and empowerment improved implementation. • Collaboration and teamwork: staff recognise the importance of including various disciplines with their diverse perspectives and sharing responsibility for fall prevention • 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 • The presence of clinical leaders was seen as an advantage for implementation and leaders who involved staff in the implementation process, who clearly explained the rationale for implementation and thus provided better support facilitated implementation
<p>The organisational context</p>	<ul style="list-style-type: none"> • Too few staffing resources and lack of time make it harder to supervise, monitor and assist residents; systematically organise prevention meetings; complete assigned fall prevention tasks • Facilities often have a high turnover in staff with clinical administrative functions and made use of floating pool staff which led to interruptions in carrying out fall prevention efforts • Lack of physical and occupational therapists • Lack of equipment, education and training eg insufficient computers, computers locked in offices, not accessible to all staff made data entry time-consuming • No automated falls monitoring program, proactive fall prevention structures or falls meetings • Workload related to fall prevention, struggling to sustain interventions and the related burden of documentation and paperwork 	<ul style="list-style-type: none"> • Facilities with a strong interest in falls prevention and who made it a priority, who focused solely on the implementation of one guideline at a time or who had sufficient equipment available were more likely to succeed. • Educational structures increased training and knowledge standardization across facilities. • The following quality improvement structures, if incorporated into routine practice, were linked to better fall prevention: fall trend analysis; structure for developing a falls management plan for each resident; guideline based standing orders; and policy review, procedures and documentation standards
<p>The economic and political context</p>	<ul style="list-style-type: none"> • 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. • Government reimbursement policies, resulting in meager involvement of in key disciplines (e.g., physiotherapists) in fall prevention 	<ul style="list-style-type: none"> • Corporate or state mandates positively influenced implementation, especially when state surveys were conducted

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Appendix 1

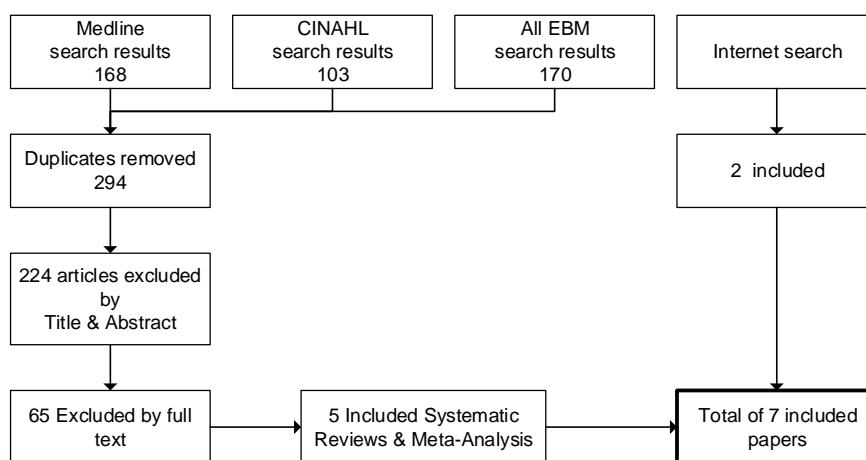
Search Strategy

Setting	Include: Residential care, nursing homes, rehabilitation facilities, Exclude: hospital settings
Population	Include: Elderly, Aged population as defined by studies, aged with mental health issues or dementia diagnosis. Exclude: Children, young adults, adults
Intervention	1. Any intervention focused on falls prevention, falls reduction 2. Any strategies to implement falls prevention/reduction programs/initiatives/interventions
Outcomes	Falls reduction, improvement in strength and balance, overall wellbeing
Publication details	Include: Systematic Reviews, Meta-Analysis, Evidence-Based Clinical Guidelines Exclude: All other study designs, editorials, opinion papers, conference abstracts
Limitations	2012-2017; English, Humans
Databases	Ovid MEDLINE(R) Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily, Ovid MEDLINE and Versions(R);CINAHL Plus; All EBM; Google

Study Selection

Titles and abstracts identified were exported to EndNote X7 (Thompson, Reuters, Carlsbad, California, USA). Papers identified were screened using inclusion and exclusion criteria established *a priori*. Searches of Medline, CINAHL, All EBM and the internet were screened by one reviewer in consultation with colleagues as necessary. Literature was included based on the above criteria.

This diagram indicates the flow of identified and included articles from the different sources searched.



Search terms

Ovid Medline 1946 to Present with Daily Update*			
1	exp Accidental Falls/	16	8 or 9 or 10 or 11 or 12 or 13 or 14 or 15
2	(falls or fallers\$.tw.	17	7 and 16
3	1 OR 2	18	limit 17 to (english language and humans and yr="2012 - Current") [Limit not valid in CCTR,CDSR,CLCMR,ACP Journal Club,DARE; records were retained]
4	exp Aged/	19	(((comprehensive* or integrative or systematic*) adj3 (bibliographic* or review* or literature)) or (meta-analy* or metaanaly* or "research synthesis" or ((information or data) adj3 synthesis) or (data adj2 extract*))).ti,ab. or (cinahl or (cochrane adj3 trial*) or embase or medline or psyclit or (psycinfo not "psycinfo database") or pubmed or scopus or "sociological abstracts" or "web of science").ab. or ("cochrane database of systematic reviews" or evidence report technology

			assessment or evidence report technology assessment summary).jn. or Evidence Report: Technology Assessment*.jn. or ((review adj5 (rationale or evidence)).ti.ab. and review.pt.) or meta-analysis as topic/ or Meta-Analysis.pt.
5	(older or senior\$ or elderly).tw.	20	randomized controlled trial.pt.
6	4 OR 5	21	controlled clinical trial.pt.
7	3 AND 6	22	randomized.ab.
8	exp Residential Facilities/	23	placebo.ab.
9	exp Long-Term Care/	24	Clinical Trials as Topic/
10	exp Institutionalization/	25	randomly.ab.
11	exp Hospices/ or exp Subacute Care/ or exp Nursing Homes/	26	trial.ab.
12	exp Rehabilitation Centers/	27	20 OR 21 OR 22 OR 23 OR 24 OR 25 OR 26
13	((long stay or sub-acute or subacute or residential) adj3 care).tw.	28	18 OR 27
14	((rehabilitation or geriatric) adj (ward\$1 or hospital\$1 or unit\$1)).tw.	29	7 AND 18 AND 28
15	(hostel\$1 or nursing home\$).tw.		

*Search terms were adapted for All EBM, CINAHL and Google.