



**Reducing harm from falls:
Recommended evidence-based resources 2019**

*Includes systematic reviews,
clinical guidelines and toolkits*

April 2019

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For additional resources for consumers on reducing harm from falls, visit the [Live Stronger for Longer website](#).

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Introduction

This document includes:

- a collection of high-level evidence on reducing falls and harm from falls
- evidence about, and an overview of, the Health Quality & Safety Commission's [10 Topics in reducing harm from falls](#). Each topic contains more detailed information, which will be updated approximately every three years and is intended to contribute to professional development exercises
- recent literature of interest and relevance to anyone working to reduce falls and harm from falls, which will be updated annually.

This page will be updated annually. Please [contact us](#) if you know of a readily available resource that you'd like us to consider including.

High-level recommendations

Most falls happen in the community. The information on this page supports a population health approach to reducing harm from falls that starts in the community with strength and balance exercise programmes, home safety modifications and guideline-based screening and treatment for osteoporosis.

Assessing individuals for falls risk factors is also important. Interventions are then tailored to the needs of the individual older person, and guideline-based care is provided after a fall. Evidence supports the following high-level recommendations.

- Ask all older people (generally those aged 65 years and over) about slips, trips and falls to identify those at risk.
- Appropriately supervised and supported balance, strength and gait training is an effective population health prevention measure for falls. It may be the only measure that some older people need ([find a local class](#)).
- Perform a multifactorial assessment for an older person's risk of falling, ideally including assessment for:
 - [frailty](#)
 - [cognitive impairment](#).
- Implement an individualised and collaborative care plan to address the risk factors identified (including safe environment and appropriate referrals).
- Consider bone mineral density screening for women over 65 years, and other individuals at high risk for osteoporosis. The results may lead to prescription of bone preserving medications (treatment can be started without bone mineral density screening in those over 75 years who have had a minimal trauma fracture).
- Consider a medication optimisation review and appropriate deprescribing for older individuals.
- Combine planned, evidence-based falls prevention programmes with fracture liaison services using partnerships of key providers.
- Perform an early orthogeriatrician assessment and physiotherapy assessment for patients who have fractured their hip (see the Australian and New Zealand Hip Fracture Registry [Guideline for Hip Fracture Care and Hip Fracture Clinical Care Standard](#)).
- Ensure that the older person, their carers and/or family and whānau understand the reasons why falls need to be avoided, why the interventions are important and what the evidence base means.

Cochrane Reviews

A number of Cochrane Reviews have evaluated the evidence for interventions to prevent falls and reduce harm from falls. Pooled study results will include some varying definitions of 'older people'. Across all these reviews, the effective interventions can be summarised as follows.

Setting	Interventions that appear effective according to Cochrane Review (where more than one trial was assessed)
Community (all older people)	<ul style="list-style-type: none"> • Strength and balance exercise (reduces the risk of falling and rate of falling, no matter what the level of individual risk) • Home safety assessment and modification (reduces the risk of falling and rate of falling, especially in those at high risk) • Multicomponent interventions, which commonly include exercise, education and home safety interventions (may reduce the rate of falls and risk of falling)
Community (older people who have fallen)	<ul style="list-style-type: none"> • Multifactorial interventions, which include individual risk assessment (may reduce the rate of falls, potentially by hundreds of falls per 1,000 people per year)
Long-term care	<ul style="list-style-type: none"> • Hip protectors (reduce the risk of hip fractures in care settings) • Vitamin D (reduces the rate of falls for those deficient in vitamin D)
Hospital	<ul style="list-style-type: none"> • Multifactorial interventions (based on assessment of the particular risks of each individual, may reduce the rate of falls in sub-acute care) • Comprehensive geriatric assessment (reduces the likelihood of discharge to an increased level of care for those who have fractured their hip)

Important Cochrane Reviews

Strength and balance exercise reduces the risk of falling and rate of falling for those living in the community (**NEW**):

- Sherrington C, Fairhall NJ, Wallbank GK, et al. [Exercise for preventing falls in older people living in the community](#). *Cochrane Database Syst Rev* 2019, Issue 1, Art. No. CD012424.

Vitamin D for those deficient (in long-term care) and multifactorial interventions (in sub-acute hospital care) can prevent falls in older people (**NEW**):

- Cameron ID, Dyer SM, Panagoda CE, et al. [Interventions for preventing falls in older people in care facilities and hospitals](#). *Cochrane Database Syst Rev* 2018, Issue 9, Art. No. CD005465.

Multifactorial interventions may reduce the rate of falls and risk of fractures for those living in the community (**NEW**):

- Hopewell S, Adedire O, Copsey BJ, et al. [Multifactorial and multiple component interventions for preventing falls in older people living in the community](#). *Cochrane Database Syst Rev* 2018, Issue 7, Art. No. CD012221.

Comprehensive geriatric assessment for older people admitted to a surgical service (eg, for hip fracture) improves outcomes (2018):

- Eamer G, Taheri A, Chen S, et al. [Comprehensive geriatric assessment for older people admitted to a surgical service](#). *Cochrane Database Syst Rev* 2018, Issue 1, Art. No. CD012485.

Exercise probably reduces fear of falling in older people living in the community (2014):

- Kendrick D, Kumar A, Carpenter H, et al. [Exercise for reducing fear of falling in older people living in the community](#). *Cochrane Database Syst Rev* 2014, Issue 11, Art. No. CD009848.

Hip protectors can prevent hip fractures in older people living in care (2014):

- Santesso N, Carrasco-Labra A, Brignardello-Petersen R. [Hip protectors for preventing hip fractures in older people](#). *Cochrane Database Syst Rev* 2014, Issue 3, Art. No. CD001255.

Group and home-based exercise programmes, home safety interventions, and multifactorial interventions reduce falls in the community (2012):

- Gillespie LD, Robertson MC, Gillespie WJ, et al. [Interventions for preventing falls in older people living in the community](#). *Cochrane Database Syst Rev* 2012, Issue 9, Art. No. CD007146.

10 Topics in reducing harm from falls

The [10 Topics resources](#) (overview below) were updated in August 2017 (peer-reviewed by a panel of experts). They will be updated approximately every three years (or more often if major new evidence is published).

[Go to the original suite of archived 2013–15 resources.](#)

Topic 1	<p>The impact of falls on the health of older people is substantial. It needs to be addressed through a systematic and integrated approach (see Topic 1).</p> <ul style="list-style-type: none"> • Jones S, Blake S, Hamblin R, et al. 2016. Reducing harm from falls. <i>New Zealand Medical Journal</i> 129(1446): 89–103. • Ehlers MM, Nielsen CV, Bjerrum MB. 2018. Experiences of older adults after hip fracture: an integrative review. <i>Rehabilitation Nursing</i> 43(5): 255–66. doi: 10.1097/rnj.0000000000000096
Topic 2	<p>All older people should be asked about falls to identify those at risk and those identified then need a multifactorial risk assessment (see Topic 2).</p>
Topic 3	<p>All older people screening positive when asked about falls should have a multifactorial risk assessment (see Topic 3).</p> <ul style="list-style-type: none"> • Sousa L, Marques-Vieira C, de Caldevilla M, et al. 2016. Risk for falls among community-dwelling older people: systematic literature review. <i>Revista Gaucha de Enfermagem</i> 37(4): e55030. doi: 10.1590/1983-1447.2016.04.55030. • Fernando E, Fraser M, Hendriksen J, et al. 2017. Risk factors associated with falls in older adults with dementia: a systematic review. <i>Physiotherapy Canada</i> 69(2):161–70. doi: 10.3138/ptc.2016-14.
Topic 4	<p>An individualised care plan addressing identified risk factors should be implemented for any older person at risk of falling (see Topic 4).</p> <p>In the community</p> <ul style="list-style-type: none"> • Hopewell S, Adedire O, Copsey BJ, et al. Multifactorial and multiple component interventions for preventing falls in older people living in the community. <i>Cochrane Database Syst Rev</i> 2018, Issue 7, Art. No. CD012221. • Stubbs B, Brefka S, Denkinger MD. 2015. What works to prevent falls in community-dwelling older adults? Umbrella review of meta-analyses of randomized controlled trials. <i>Physical Therapy</i> 95(8): 1095–110. • Stevens JA, Burns ER. 2015. A CDC Compendium of Effective Fall Interventions: What works for community-dwelling older adults (3rd edn). Atlanta, GA: National Center for Injury Prevention and Control, Centers for Disease Control and Prevention.

	<ul style="list-style-type: none"> Centre for Reviews and Dissemination, University of York. 2014. Preventing falls in the community. York: Centre for Reviews and Dissemination, University of York. <p>In hospitals and long-term care facilities</p> <ul style="list-style-type: none"> Cameron ID, Dyer SM, Panagoda CE, et al. Interventions for preventing falls in older people in care facilities and hospitals. <i>Cochrane Database Syst Rev</i> 2018, Issue 9, Art. No. CD005465. Centre for Reviews and Dissemination, University of York. 2014. Preventing falls in hospitals. York: Centre for Reviews and Dissemination, University of York. Miake-Lye IM, Hempel S, Ganz DA, et al. 2013. Inpatient fall prevention programs as a patient safety strategy: a systematic review. <i>Annals of Internal Medicine</i> 158(5–P2): 390–7. Oliver D, Healey F, Haines TP. 2010. Preventing falls and fall-related injuries in hospitals. <i>Clinics in Geriatric Medicine</i> 26(4): 645–92. Hill AM, McPhail SM, Waldron N, et al. 2015. Fall rates in hospital rehabilitation units after individualised patient and staff education programmes: a pragmatic, stepped-wedge, cluster-randomised controlled trial. <i>Lancet</i> 385(9987): 2592–9.
Topic 5	<p>Falls can be prevented by making the environment safer – whether the older person is in care, at home, or out and about (see Topic 5).</p> <ul style="list-style-type: none"> Keall MD, Pierse N, Howden-Chapman P, et al. 2015. Home modifications to reduce injuries from falls in the Home Injury Prevention Intervention (HIPI) study: a cluster-randomised controlled trial. <i>The Lancet</i> 385(9964): 231–8. <p>Ensure that the tool used to assess the older person’s home environment identifies the relevant hazards and act to mitigate them:</p> <ul style="list-style-type: none"> Romli MH, Mackenzie L, Lovarini M, et al. 2018. The clinimetric properties of instruments measuring home hazards for older people at risk of falling: a systematic review. <i>Evaluation & the Health Professions</i> 41(1): 82–128.
Topic 6	<p>Every fall is an opportunity for assessment, individualised care planning and system improvement to prevent further falls (see Topic 6).</p> <ul style="list-style-type: none"> Healey F, Darowski A, Lamont T, et al. 2011. Essential care after an inpatient fall: summary of a safety report from the National Patient Safety Agency. <i>British Medical Journal</i> 342(d329): 342–3.

Topic 7	<p>Osteoporosis risk assessment and management are important, along with guideline-based care for older people with hip fractures (see Topic 7).</p> <p>Prevent minimal trauma fracture with bone preserving medication:</p> <ul style="list-style-type: none"> • Osteoporosis New Zealand. 2017. Guidance on the Diagnosis and Management of Osteoporosis in New Zealand. Wellington: Osteoporosis New Zealand. • US Preventive Services Taskforce. 2018. Osteoporosis to prevent fractures: screening. Rockville, MD: USPSTF. • bpac^{NZ}. 2018. Bisphosphonates: Addressing the duration conundrum. Dunedin: Best Practice Advocacy Centre. <p>Comprehensive care for consumers who have had a fracture:</p> <ul style="list-style-type: none"> • Eamer G, Taheri A, Chen S, et al. Comprehensive geriatric assessment for older people admitted to a surgical service. <i>Cochrane Database Syst Rev</i> 2018, Issue 1, Art. No. CD012485. • ANZHFR Steering Group. 2014. Australian and New Zealand Guideline for Hip Fracture Care: Improving outcomes in hip fracture management of adults. Sydney: Australian and New Zealand Hip Fracture Registry Steering Group. • Australian and New Zealand Bone and Mineral Society. 2015. Position paper on secondary fracture prevention programs: a call to action. Sydney: Australian and New Zealand Bone and Mineral Society.
Topic 8	<p>A medicine optimisation review is recommended, including review for inappropriate polypharmacy and drugs that increase falls risk (see Topic 8).</p> <ul style="list-style-type: none"> • bpac^{NZ}. 2018. Stopping medicines in older people: the flip side of the prescribing equation. Dunedin: Best Practice Advocacy Centre.
Topic 9	<p>Strength and balance exercises prevent falls (see Topic 9).</p> <ul style="list-style-type: none"> • Sherrington C, Fairhall NJ, Wallbank GK, et al. Exercise for preventing falls in older people living in the community. <i>Cochrane Database Syst Rev</i> 2019, Issue 1, Art. No. CD012424. • US Preventive Services Taskforce. 2018. Falls prevention in community-dwelling older adults: interventions. Rockville, MD: USPSTF. • Lewis M, Peiris C, Shields N. 2017. Long-term home and community-based exercise programs improve function in community-dwelling older people with cognitive impairment: a systematic review. <i>Journal of Physiotherapy</i> 63(1): 23–29.
Topic 10	<p>Falls prevention requires an integrated multidisciplinary system-wide approach (see Topic 10).</p> <ul style="list-style-type: none"> • Jones S, Blake S, Hamblin R, et al. 2016. Reducing harm from falls. <i>New Zealand Medical Journal</i> 129(1446): 89–103.

- Appleton-Dyer S, Edirisuriya N, Boswell A. 2016. [Reducing Harm from Falls Programme Evaluation: A report for the Health Quality & Safety Commission.](#) Auckland: Synergia.
- Bunn F, Dickinson A, Barnett-Page E, et al. 2008. [A systematic review of older people's perceptions of facilitators and barriers to participation in falls-prevention interventions.](#) *Ageing and Society* (28): 449–72.

Clinical guidelines and standards

- National Institute for Health and Care Excellence (NICE). 2013 (reviewed 2016). [Falls in Older People: Assessing risk and prevention](#). Clinical Guideline CG161.
- Australian Commission on Safety and Quality in Health Care. 2010 (web page updated 2015). [Falls prevention resources](#). (Guidelines and guidebooks [for hospitals, residential aged care facilities and community care](#).)
- Australian Commission on Safety and Quality in Health Care. 2016. [Hip Fracture Care Clinical Care Standard](#). Sydney: Australian Commission on Safety and Quality in Health Care.
- Rimland J, Abraha I, Dell'Aquila D, et al. 2017. [Non-pharmacological interventions to prevent falls in older patients: clinical practice recommendations – the SENATOR ONTOP series](#). *European Geriatric Medicine* 8(5-6): 413–8.
- Australian and New Zealand Hip Fracture Registry Steering Group. 2014. [Australian and New Zealand Guideline for Hip Fracture Care: Improving outcomes in hip fracture management of adults](#). Sydney: Australian and New Zealand Hip Fracture Registry Steering Group.
- Osteoporosis New Zealand. 2016. [Clinical Standards for Fracture Liaison Services in New Zealand](#). Wellington: Osteoporosis New Zealand.
- Osteoporosis New Zealand. 2017. [Guidance on the Diagnosis and Management of Osteoporosis in New Zealand](#). Wellington: Osteoporosis New Zealand.
- Crandall M, Duncan T, Mallat A, et al. 2016. [Prevention of fall-related injuries in the elderly: an Eastern Association for the Surgery of Trauma practice management guideline](#). *Journal of Trauma and Acute Care Surgery* 81(1): 196–206.
- Avin KG, Hanke TA, Kirk-Sanchez N, et al. 2015. [Management of falls in community-dwelling older adults: clinical guidance statement from the Academy of Geriatric Physical Therapy of the American Physical Therapy Association](#). *Physical Therapy* 95(6): 815–34.
- Australian New Zealand Society for Geriatric Medicine. 2014. [Position Statement--Exercise guidelines for older adults](#). *Australasian Journal on Ageing* 33(4): 287–94.
- US Preventive Services Task Force. 2018. [Osteoporosis to prevent fractures: screening](#). Rockville, MD: USPSTF. **[NEW]**
- US Preventive Services Task Force. 2018. [Falls prevention in community-dwelling older adults: interventions](#). Rockville, MD: USPSTF. **[NEW]**

Toolkits and guides

For clinicians

- [Stay Independent: Falls prevention toolkit for clinicians](#): Health Quality & Safety Commission, Accident Compensation Corporation, bpac^{NZ}.
- [Preventing Falls in Hospitals: eLearning modules](#): Royal College of Physicians in partnership with NHS England, accredited by NICE.
- [Queensland Stay On Your Feet Toolkit](#): a toolkit developed by Queensland Health, based on a community good-practice model designed for anyone working with older people.
- [Preventing falls-related injury](#): 2017 Goodfellow webinar.
- [Osteoporosis resources for health professionals](#): includes Osteoporosis New Zealand clinical guidance.
- [Fracture risk calculators](#): collated by Osteoporosis New Zealand.
- [Decision support tool for clinicians and patients to discuss bisphosphonate options](#): National Institute for Health and Care Excellence
- [MedSafe guides on medications for osteoporosis](#): collated by Osteoporosis New Zealand.
- Bay of Plenty District Health Board: [Care Companion Programme workbook](#) – practical guidance for close observation care with dignity.

For health consumers

- Accident Compensation Corporation (ACC):
 - [Live Stronger for Longer – ACC’s fall prevention programme for older adults](#)
 - [Find a strength and balance class near you](#)
 - [Online resources for over 65s: bone health, exercise, nutrition and home safety](#)
 - [I care for someone 65 and over](#)
- Osteoporosis New Zealand:
 - [Resources for the public](#)
 - [MedSafe guides on medications for osteoporosis – for patients and members of the public](#)

For organisations

- Health Quality & Safety Commission. 2016 [Releasing Time to Care: Falls Prevention New Zealand module](#). Wellington: Health Quality & Safety Commission.
- Ganz DA, Huang C, Saliba D, et al. 2013. [Preventing Falls in Hospitals: A toolkit for improving quality of care](#). Rockville, MD: Agency for Healthcare Research and Quality.
- Osteoporosis New Zealand. nd. [Fracture Liaison Services Resource Pack](#). Wellington: Osteoporosis New Zealand.

- ANZHFR. 2018. [Annual Report 2018](#). Australian and New Zealand Hip Fracture Registry. [NEW]
- Osteoporosis New Zealand. [Orthogeriatrics services](#). Wellington: Osteoporosis New Zealand.
- Van Grootven B, McNicoll L, Mendelson D, et al. 2018. [Quality indicators for in-hospital geriatric co-management programmes: a systematic literature review and international Delphi study](#). *BMJ Open* 8: e020617. doi:10.1136/bmjopen-2017-020617. [NEW]
- ACC. 2019. [Falls and fractures outcomes framework – dashboard](#). Wellington: Accident Compensation Corporation. [NEW]
- Public Health England. 2017. [Falls and Fracture Consensus Statement: Supporting commissioning for prevention](#). London: Public Health England. [NEW]
- Public Health England. 2017. [Falls and Fracture Consensus Statement: Resource pack](#). London: Public Health England. [NEW]
- National Center for Injury Prevention and Control of the Centers for Disease Control and Prevention. [Preventing Falls: A guide to implementing effective community-based fall prevention programs](#). Atlanta, GA: Centers for Disease Control and Prevention.

Recent literature of interest (February 2018–February 2019)

The links above provide evidence for the key messages in the [10 Topics](#) based on systematic reviews, guidelines, meta-analyses, umbrella reviews or health technology assessments.

Below we outline evidence published in the last 12 months. New findings are summarised in the **information box**:

- Community strength and balance exercise programmes, community multicomponent interventions and individualised community multifactorial interventions all continue to be supported by evidence and reduce the risk and/or rate of falls.
- In-hospital cognitive assessment, involving geriatricians early and using bisphosphonate treatment more systematically are ongoing care gaps for those who have fractured their hip.
- Deprescribing interventions may be effective although blood pressure medications no longer appear to be associated with falls in the long term (without changing dose or adding new medication).
- Fracture liaison services improve outcomes. Services led by orthopaedic surgeons may result in higher rates of bone mineral density assessment than those led by other disciplines.
- Using more than one functional measure (eg, [TUG](#), Berg Balance Test) is optimal for assessing falls risk.
- Given the lack of high-quality evidence for various falls prevention strategies in hospitals and long-term care facilities, clinical judgement and consumer preferences remain important.
- Because the falls prevention strategies that consumers and carers use are not always in line with clinical evidence-based strategies, we should focus on shared decision-making processes involving consumers and carers. This should include discussing why falls prevention is important and what the evidence base means.

New high-level evidence explained

The Cochrane Collaboration has published four new reviews relevant to preventing falls and reducing harm from falls since the Health Quality & Safety Commission's 2018 [Recent literature of interest](#) update. These new reviews evaluate interventions in care facilities and hospitals ([Cameron et al 2018](#)), multifactorial and multicomponent interventions in the community ([Hopewell et al 2018](#)), exercise in the community ([Sherrington et al 2019](#)) and exercise for those with cancer ([Williams et al 2018](#)).

- The only high-certainty guidance we can draw from these four reviews is that **exercise programmes in the community** (primarily involving balance and functional components) are effective for reducing the rate of falls and number of fallers in older populations – both those identified as at high risk and those not identified as at high risk. The overall reduction in falls is 23 percent.
- Moderate-quality evidence indicates that **multiple component interventions in the community** (exercise and another component, commonly education or home-hazard assessment) reduce the rate (by 26 percent) and risk (by 18 percent) of falls.
- Low-quality evidence appears to support assessment of an individual's risk profile and appropriate **multifactorial and multicomponent interventions in the community** (eg, exercise, environment or assistive technologies, medication review and psychological interventions). However, this approach appears most effective in reducing an individual's number of falls, rather than the risk of them having a fall, and so seems to be best targeted at those who have fallen.
- Low-quality evidence suggests that multifactorial interventions in hospitals (tailored to individual patients) may reduce the rate of falls.
- Vitamin D supplementation reduces the rate of falls in care facilities for those who are vitamin D deficient.

These findings need to be put in the context of other studies. A further systematic review ([Francis-Coad et al 2018](#)) concluded that complex interventions in residential aged care may be effective but **only when delivered with additional staffing, expertise or resources across multiple levels of the organisation**. A keynote talk at the Biennial Australian and New Zealand Falls Prevention Society Conference in November 2018 made a similar point ([Haines 2018](#)). This may go some way to explaining why the Cochrane review ([Cameron et al 2018](#)) and other reviews (eg, [Cao et al 2018](#)) have found a range of interventions to be ineffective in long-term care facilities when study data is pooled.

When resources are limited, we want to understand the effectiveness of one intervention compared with another. A recent network meta-analysis of community interventions (comparing multiple interventions simultaneously by including studies of different comparisons) suggested that multifactorial interventions showed the greatest efficacy. Next most effective were interventions that include exercise and education, followed by those combining exercise and home hazard assessment and modification ([Cheng et al 2018](#)).

When evidence quality is very low, low or insufficient, as it is in several of the Cochrane analyses, then clinical judgement and consumer preferences must have greater priority. Also, the opportunity cost of intensive in-hospital programmes needs to be closely considered. This suggests that we need more cost-utility analyses in this area.

Overall evidence is stronger for community interventions than for interventions in hospitals and care facilities. Programmes to reduce harm from falls need to extend beyond institutional boundaries and into primary and secondary community prevention. It is quite possible that balance and functional exercise in the community may reduce falls rates in hospitals; research is needed in this area.

The US Preventive Services Task Force (USPSTF) has published three falls-related evidence reviews in the last 12 months. These cover screening for osteoporosis to prevent fractures ([Viswanathan et al 2018](#)), interventions for reducing harm from falls for those living in the community ([Guirguis-Blake et al 2018](#)) and vitamin D for preventing falls ([Kahwati et al 2018](#)). The new USPSTF evidence reviews led the USPSTF to make recommendations for:

- **screening all women 65 years and over** and post-menopausal women at increased risk of osteoporosis with bone mineral density scanning (but note the [New Zealand guidance](#))
- **community strength and balance exercise programmes** for all adults aged over 65 years who are at increased risk for falls
- **multifactorial interventions for selected adults living in the community** who are aged over 65 years and at increased risk of falls after considering the circumstances of prior falls, presence of comorbid medical conditions, and the consumer's values and preferences.

Fracture Liaison Services (FLS) can improve outcomes following osteoporotic fractures. A systematic review and meta-analysis of controlled trials aimed to clarify the factors leading to successful FLS ([Wu et al 2018](#)). Results indicate that multidisciplinary involvement, a dedicated case manager, regular assessment and follow-up, multifaceted interventions and consumer education all enhance the success of FLS. See also recent '[Capture the Fracture](#)' guidance from the International Osteoporosis Foundation.

FLS programmes led by orthopaedic surgeons had higher rates of bone mineral density testing. Further analysis indicated that FLS is associated with a 27 percent increase in the likelihood of bone mineral density testing and up to 21 percent increase in the likelihood of treatment initiation compared with usual care ([Wu et al 2018](#)).

This is important because the quality of care indicators in the Australian and New Zealand Hip Fracture Registry (ANZHFR) Clinical Care Standard include the proportion of patients with a hip fracture who are receiving bone protection medicine before being separated from the hospital where they underwent hip fracture surgery. Yet only 25 percent of patients are on such medication at discharge. New Zealand osteoporosis clinical guidance ([Osteoporosis New Zealand 2017](#)) indicates that initiation of **bone-preserving medication should not be delayed** in those with a hip fracture.

Comprehensive FLS is likely to increase the proportion of patients receiving guideline-recommended care and so to reduce fracture rates.

New Zealand studies

General practitioners thinking about falls should also think about depression and vice versa, according to the New Zealand LiLACS study of 937 people in their 80s. The study examined the association between falls and depression. Both non-Māori and Māori with depression were more likely to fall than those without depression, and depression was a significant predictor of hospitalisations from falls ([Atlas et al 2017](#)).

Funding private cataract surgery to bypass the public waiting list is cost-effective, taking into account falls reductions. A New Zealand modelling study examined the cost utility of New Zealand district health boards speeding up cataract surgery by purchasing private provision. The study assumed a 34 percent reduction in falls over 12 months following first eye cataract surgery. Private cataract surgery that district health boards funded was cost-effective at \$10,600 per quality adjusted life year (QALY) based on cataract provision in New Zealand in 2011. To put this in context, providing strength and balance exercise programmes in New Zealand costs an estimated \$6,900 per QALY and home safety assessment and modifications an estimated \$9,000 per QALY (Boyd et al under review).

Health professional education courses include one to three hours of lectures on falls, and some courses include more than three additional hours of practical study. A survey of providers in Australia and New Zealand gained data on the falls curriculum from 105 course convenors at 43 tertiary institutions. Most commonly, courses taught risk assessment and falls risk factors, as well as risk management, epidemiology, managing older people at risk of falls and preventing falls in the community. However, the authors conclude that although courses address the issue of falls from a systems perspective (as a threat to consumer safety), they could **do more to address evidence-based population health-related issues** in developing and delivering falls prevention strategies for older people ([Vance et al 2018](#)).

The New Zealand [falls and fractures outcome framework dashboard](#) is updated quarterly. It provides data on the number of fall injuries, serious harm falls, length of hospital stay, bisphosphonate treatment, and consumers enrolled in community or home-based prevention programmes both nationally and by district health board. Users can access the dashboard to **see how the nation and various district health boards are tracking** on key measures of falls harm reduction.

Consumers, carers, families and whānau

An older person's fall affects their mobility, body image, mental health and capacity to participate. A new integrative review summarises data from 11 studies about older people's experiences after a hip fracture ([Ehlers et al 2018](#)). The importance of preventing hip fractures is clear.

Falls prevention strategies that older people and their carers use are not always in line with recommended approaches. An integrative review of 17 studies showed that older people tend to manage falls through self-awareness, while their carers tend to remain vigilant and 'protect'. These themes are important to understand, because key evidence on reducing harm from falls tells us that health professional assessment and individualised interventions, as well as strength and balance exercise, are important and these approaches are at odds with many falls prevention approaches that older people and their carers undertake ([Wilkinson et al 2018](#)).

It is crucial to bring carers under the umbrella of care with shared decision-making among consumers, carers and clinicians about rehabilitation and goals and the reasons for interventions. A review of 21 studies of carers' experiences in caring for people who had fractured their hip identified a key theme of 'engaging in care – struggling through' to

capture the carers' experience. Carers often struggle to engage with complex health care systems and feel their experience is not valued ([Saletti-Cuesta et al 2018](#)). This appears to be particularly important given the findings of the study on carer strategies described above.

Identifying older people at risk of falling

The **timed-up-and-go test (TUG)** is a key tool for screening for older people at increased risk of falls, but is still underused, according to a review of 19 studies. Findings showed the TUG test had fair sensitivity and good specificity and performed better than other clinical measures ([Bassett et al 2018](#)). In contrast, a recent systematic review has found the evidence only weakly supports the Berg Balance Test as a discerning test for falls risk, with fallers scoring very similarly to non-fallers ([Lima et al 2018](#)).

Given these findings, **screening assessment should use more than one functional measure**, as well as [other kinds of assessment](#), because no single test provides sufficient information on risk of falling. Practically, the authors of the first study suggest that sequential tests, such as the TUG followed by the rapid step test, could be performed, but assessment could stop once one test (eg, TUG more than 12 seconds) indicates the older person has screened positive for increased risk for falls. At that point, an appropriate multifactorial assessment of risk factors can be performed.

Bladder problems should be addressed as part of a multifactorial intervention to reduce the risk of falls. The most recent systematic review on the association between overactive bladder and falls shows a clear association between these two issues ([Szabo et al 2018](#)). However, the authors highlight the potential pitfalls of solving one falls risk (overactive bladder) by administering another falls risk (anticholinergic medications). We must be careful that, in addressing risk factors, we are not creating risk factors.

A systematic review and meta-analysis identified that **hyponatraemia (low sodium) is a risk factor for falls**. Even mild hyponatraemia is associated with falls and fractures. This is not surprising given that hyponatraemia can lead to gait, balance and cognitive disturbances. The authors of this analysis suggest that hyponatraemia may be a link between known falls risk factors such as diuretics, antidepressants and hypothyroidism and the resulting falls and fractures. Correction of hyponatraemia is known to improve gait disturbance, so the risk of falls and fractures may be reduced by correcting serum sodium ([Corona et al 2018](#)).

The importance of taking lying and standing blood pressure was again emphasised in a large meta-analysis of 50 studies. Orthostatic hypotension was positively associated with falls, independent of study population, study design, study quality, orthostatic hypotension definition, and blood pressure measurement method. Health professionals must measure lying and standing blood pressure, record the results in the clinical notes and take steps to investigate and address any postural blood pressure drop ([Mol et al 2018](#)).

Keeping active is crucial

High-level evidence continues to support exercise interventions. A large analysis of 46 studies concluded that long-term exercise is associated with a reduction in falls, injurious falls and probably fractures in older adults, including people with cardiometabolic and neurological diseases ([de Souto Barreto et al 2018](#)). The exercise generally included aerobic plus strength plus balance training for a mean of **50 minutes, three times per week**. Also, across 26 studies where the length of exercise intervention was at least four weeks and the length of follow-up was at least six months, the risk reduction was 32 percent for fall events and 22 percent of older adults who fell ([Hamed et al 2018](#)). Posture-challenging exercises were the most effective in reducing the risk of falls.

Tai chi appears to produce good results for older adults at high risk for falls. One recent randomised controlled trial indicates that a therapeutically tailored Tai Ji Quan programme outperformed a conventional balance, aerobic and strength exercise programme for reducing falls by 31 percent ([Li et al 2018](#)).

However, exercise may increase falls in those recently discharged from hospital. A systematic review identified two studies that, when analysed together, indicate home exercise interventions significantly increased the number of fallers in those recently discharged from hospital ([Naseri et al 2018](#)). The authors suggest that it is probably appropriate for those recently discharged from hospital to have more supervision initially and to begin with a lower dose of exercise.

Evidence still does not appear to support exercise for reducing harm from falls in long-term care settings ([Cameron et al 2018](#); [Cao et al 2018](#)). It may be that early prevention of muscle weakness and balance problems in the community is more effective than later-stage exercise.

The older person's environment

A recent review **confirms the importance of a safe environment for reducing falls risks**. It focuses on data on home hazard modification interventions delivered to those recently discharged from hospital, who also have a previous falls history. In these individuals, there is low-grade evidence that **home modifications work** to reduce the number of falls ([Naseri et al 2018](#)).

The Home Falls and Accidents Screening Tool ([HOME FAST](#)) is recommended for screening assessments. Researchers analysed the validity of home-safety assessment checklists and found that nine instruments had satisfactory evidence about their psychometric properties. They concluded that the HOME FAST tool is psychometrically robust, requires minimal training, was designed specifically for older people at risk of falls, has a limited set of items and is freely available. They recommended the Westmead Home Safety Assessment (WeHSA) instrument for a thorough assessment by an occupational therapist, and suggested the Home Safety Self-Assessment Tool (HSSAT) can be used as a self-assessment. The authors conclude that non-standardised instruments should be avoided ([Romli et al 2018](#)).

Medication optimisation

The New Zealand Best Practice Advocacy Centre (bpac^{NZ}) has three new evidence-based publications on medications and falls. These advise on important considerations around stopping medications in older adults ([bpac^{NZ} 2018](#)), length of bisphosphonate treatment for osteoporosis ([bpac^{NZ} 2019a](#)) and risks of proton pump inhibitors ([bpac^{NZ} 2019b](#)).

Bpac^{NZ} notes that the risk of falls is one reason for medication review ([bpac^{NZ} 2018](#)). Another recent systematic review of deprescribing interventions in hospitals supports this approach. It identified three studies that reported on falls, of which one demonstrated a statistically significant reduction in falls in the intervention group ([Thillainadesan et al 2018](#)). The authors of this study conclude that **deprescribing interventions** in hospitals appear feasible and safe.

Bpac^{nz} advises on the length of treatment for bisphosphonates. It suggests an initial three to four years for oral bisphosphonates or a total of three infusions of zoledronic acid at intervals of 18–24 months ([bpac^{nz} 2019a](#)).

A new meta-analysis now links proton pump inhibitors (PPIs) to an increased risk for falls ([Lapumnuaypol et al 2019](#)). Previous research linked PPIs with increased risk of fractures, but the mechanism was unclear. The recent guidance from bpac^{nz} states that PPIs should be used only when there is a specific clinical indication, at the lowest effective dose, for the shortest period of time ([bpac^{nz} 2019b](#)).

A new study has found the risk of injurious falls decreases in those taking beta blockers, ACE inhibitors and calcium channel blockers ([Ang et al 2018](#)). [Topic 8](#) currently describes associations between all classes of antihypertensive medications and falls, but this was based on data from 2008–13. Last year's [recent literature of interest](#) updated this finding to report no association between antihypertensive use and number of falls, apart from in the first 24 hours after a dose change or initiation (21 days for diuretics). The new study, a large meta-analysis of 60 pooled results, indicates that **appropriate long-term use of anti-hypertensives** to maintain blood pressure at guideline-directed levels does not appear to raise the risk of falls, provided that appropriate caution is taken immediately after starting them or adjusting the dosage.

Implementing what works

In some cases, we are not yet implementing simple measures that guidelines recommend. For example, the Australian and New Zealand Hip Fracture Registry Annual Report 2018 notes the following statistics ([ANZHFR 2018](#)).

- Only 20 percent of hip fracture patients in New Zealand had **an assessment of cognitive function** prior to surgery – yet cognitive impairment is a key risk factor for falls ([Topic 3](#)).
- Only 24 percent of hip fracture patients in New Zealand were **assessed by a geriatrician before surgery** – yet orthogeriatrician care improves outcomes for hip fracture patients ([Eamer et al 2018](#)).

- Fewer than one in four hip fracture patients **began active treatment for osteoporosis** when discharged from the operating hospital. This rose to only 38 percent by 120 days – yet New Zealand guidance recommends all patients are offered bone preserving treatment ([Osteoporosis New Zealand 2017](#)).

The Hip Fracture Clinical Care Standard, which the Health Quality & Safety Commission has endorsed, includes seven quality statements. For hip fracture patients, it also recommends assessment of cognition before surgery, an orthogeriatric model of care, and bone health assessment and management. Furthermore, New Zealand guidance for the management of osteoporosis states that ‘although DXA [bone mineral density testing] is recommended after fracture, [bone preserving] treatment must not be delayed’ ([Osteoporosis New Zealand 2017](#)). Finally, international guidelines indicate that a diagnosis of osteoporosis may be assigned to those who have had a hip fracture, no matter whether bone mineral density testing has been performed or not ([Siris et al 2014](#)).

In sum, more systematic cognitive assessments are needed before surgery for those who have fractured their hip and **bisphosphonate treatment** should be offered to all patients who have fractured their hip. The low rates of bisphosphonate treatment by time of discharge from the operating hospital are a ‘**significant and ongoing care gap**’ ([ANZHFR 2018](#)).

Dietary factors continue to appear important in reducing harm from falls. There are some recent indications that increasing protein intake ([Curneen et al 2018](#)) and following a Mediterranean diet ([Malmir et al 2018](#)) may improve bone mineral density or reduce risk of fractures. Additionally, nutritional supplementation for malnourished older adults recently discharged from hospital significantly reduced the proportion of fallers ([Naseri et al 2018](#)).

Multifaceted podiatry interventions and multifactorial interventions involving referral to podiatry significantly reduce the falls rate ([Wylie et al 2018](#)). Many of these interventions include foot and ankle exercise, which may be driving the effect. In one of the studies that Wylie et al discussed, cost-effectiveness analysis indicates that the cost per QALY gained for a multifaceted podiatry intervention is about GBP20,000 (approximately NZ\$38,000). It is important to note that the reduction in incidence of falls was not statistically significant in this particular trial ([Corbacho et al 2018](#)).

Considerations for organisations

A network meta-analysis focused on components of successful quality improvement interventions for reducing falls and injurious falls. Key components it identified were ‘**team changes**’ (including changes to the structure or organisation of the health care team, such as adding a team member, multidisciplinary teams, expansion or revision of professional roles) and ‘**case management**’ ([Tricco et al 2019](#)).

Geriatric co-management is recommended for many falls patients. A Delphi process among 33 clinicians experienced in geriatric co-management, supplemented by a systematic review, has produced a set of quality indicators for in-hospital geriatric co-care programmes ([van Grootven et al 2018](#)). The study found quality was appropriately and feasibly indicated by 31 structure, process and outcome indicators, including: co-management within 24 hours using defined inclusion criteria, a focus on key geriatric

syndromes and complications, and evaluation of outcomes including length of stay, time to surgery and incidence of complications. These indicators could be used to help track progress and also to identify areas for improvement.

Risk prediction tools for falls are not recommended. In the United Kingdom, a summary report from NICE indicates their use dropped from 74 percent of hospital trusts in 2015 to 34 percent in 2017. However, this finding also shows that many hospitals are still using these tools, which might label an older person as not at risk, and so health professionals may be missing opportunities to implement interventions to prevent falls. All older people in hospital should be considered to be at risk for falls ([NICE 2018](#)).

Why don't some programmes work?

It may seem obvious, but **adherence to the interventions is important.** In a randomised controlled study of a multifactorial individualised intervention given to those who had fallen and were attended by paramedics, but not transported to hospital, those who adhered to the interventions had fewer falls. Although the control and intervention groups did not differ in terms of the intention to treat, there was a sizeable statistically significant effect in reducing falls for those who fully adhered to the recommendations. In the intervention group, adherers experienced fewer falls (incidence rate ratio (IRR) 0.53, 95% CI 0.45–0.80) and less fall-related health service use (emergency department presentations IRR 0.37, 95% CI 0.17–0.82) compared with non-adherers ([Mikolaizak et al 2018](#)). This key piece of information may help explain why some trials do not show the expected effect. Implementation in the real world will only be effective where there is adherence.

Adherence cannot be assumed and follow-up is important. A 2016 UK fracture liaison service clinical audit reported that, of those people who required follow-up, only 41 percent had documented follow-up, and 31 percent of these had begun bone protection treatment. However, only 14 percent of people confirmed adherence to their medication at 12 months ([NICE 2018](#)). This finding emphasises the importance of follow-up to support people with the appropriate interventions. Key messages could perhaps be distributed at community strength and balance classes.

Many trial interventions consumed considerable additional resources when they worked. Terry Haines noted this in his keynote address at the Biennial Australian and New Zealand Falls Prevention Society Conference in November 2018. Wherever implementation of interventions is less robust than in trials, or interventions are not the same as trial interventions, we may not expect the same results ([Haines 2018](#)). Supporting this point is a systematic review of complex interventions for falls in residential aged care settings, which found no effect on the incidence of falls or injurious falls, except in the subgroup where additional staffing, expertise or resources are provided across multiple levels of the organisation ([Francis-Coad et al 2018](#)).

Looking to the future

Technological innovation continues to produce devices and applications that may ultimately prove valid, reliable and useful for assessment to identify those at increased risk of falling and to help with prevention strategies. However, most remain insufficiently tested.

At least 10 types of fall detection technology exist, including ambient and wearable technologies, although most have only been evaluated from a technological perspective and validation data from home settings or care units is often lacking ([Lapierre et al 2018](#)). A systematic review catalogues many technological applications related to falls detection and falls management ([Nguyen et al 2018](#)).

One review used a three-tier model for assessment, prevention and intervention and catalogues technology associated with each level. Technologies include accelerometer applications to assist with functional screening (eg, body-worn monitors, phone applications) and other gaming, sensor and exercise technologies for prevention and intervention ([Khanuja et al. 2018](#)). Such technologies also offer the potential to overcome barriers to access for interventions and also issues such as under-reporting of falls events.

Artificial intelligence (AI) techniques are proving revolutionary in addressing many health care problems. One study of deep learning approaches to interpreting sensor data offers some positive indications that such technology can place individuals into faller and non-faller categories just as well as a standard biomechanical model can ([Nait Aicha et al 2018](#)). As sensor technology and data sets improve, it is probable that AI techniques for falls risk assessment will also get better.

Finally, future innovations in falls prevention will need to address the issue of self-motivation. There are excellent reasons why older people should address their risk of falling, although these are not always obvious to older people themselves. There is also good evidence for how falls risk can be addressed. However, further research is needed to discover the best methods for ensuring that, where they need to, older people take up and persist with these falls-reducing strategies.

References

- Ang HT, Lim KK, Kwan YH, et al. 2018. A systematic review and meta-analyses of the association between anti-hypertensive classes and the risk of falls among older adults. *Drugs & Aging* 35(7): 625–35. doi: 10.1007/s40266-018-0561-3.
- ANZHFR. 2018. *2018 Annual Report*. Australian and New Zealand Hip Fracture Registry.
- Atlas A, Kerse N, Rolleston A, et al. 2017. Falls and depression in octogenarians – life and living in advanced age: a cohort study in New Zealand. *Journal of Primary Health Care* 9(4): 311–15. doi: 10.1071/hc17012.
- Bassett AM, Siu KC, Honaker JA. 2018. Functional measures for fall risk in the acute care setting: a review. *Western Journal of Nursing Research* 40(10): 1469–88. doi: 10.1177/0193945917705321.
- Boyd M, Kvizhinadze G, Kho A, et al. (manuscript under review). Cataract surgery for falls prevention and improving vision: modelling the health gain, health system costs and cost-effectiveness in a high-income country. *Injury Prevention*.
- bpac^{nz}. 2018. Stopping medicines in older people: the flip side of the prescribing equation. Dunedin: Best Practice Advocacy Centre.
- bpac^{nz}. 2019a. Bisphosphonates: addressing the duration conundrum. Dunedin: Best Practice Advocacy Centre.
- bpac^{nz}. 2019b. Stopping proton pump inhibitors in older people. Dunedin: Best Practice Advocacy Centre.
- Cameron ID, Dyer SM, Panagoda CE, et al. Interventions for preventing falls in older people in care facilities and hospitals. *Cochrane Database Syst Rev* 2018, Issue 9, Art. No. CD005465.
- Cao PY, Zhao QH, Xiao MZ, et al. 2018. The effectiveness of exercise for fall prevention in nursing home residents: a systematic review meta-analysis. *Journal of Advanced Nursing* 74(11): 2511–22. doi: 10.1111/jan.13814.
- Cheng P, Tan L, Ning P, et al. 2018. Comparative effectiveness of published interventions for elderly fall prevention: a systematic review and network meta-analysis. *International Journal of Environmental Research and Public Health* 15(3) doi: 10.3390/ijerph15030498.
- Corbacho B, Cockayne S, Fairhurst C, et al. 2018. Cost-effectiveness of a multifaceted podiatry intervention for the prevention of falls in older people: the REducing Falls with Orthoses and a Multifaceted Podiatry Intervention trial findings. *Gerontology* 64(5): 503–12. doi: 10.1159/000489171.
- Corona G, Norello D, Parenti G, et al. 2018. Hyponatremia, falls and bone fractures: a systematic review and meta-analysis. *Clinical Endocrinology* 89(4): 505–13. doi: 10.1111/cen.13790.
- Curneen JMG, Casey M, Laird E. 2018. The relationship between protein quantity, BMD and fractures in older adults. *Irish Journal of Medical Science* 187(1): 111–21. doi: 10.1007/s11845-017-1642-8.

de Souto Barreto P, Rolland Y, Vellas B, et al. 2018. Association of long-term exercise training with risk of falls, fractures, hospitalizations, and mortality in older adults: a systematic review and meta-analysis. *JAMA Internal Medicine* 28 December [Epub ahead of print]. doi: 10.1001/jamainternmed.2018.5406.

Eamer G, Taheri A, Chen S, et al. Comprehensive geriatric assessment for older people admitted to a surgical service. *Cochrane Database Syst Rev* 2018, Issue 1, Art. No. CD012485.

Ehlers MM, Nielsen CV, Bjerrum MB. 2018. Experiences of older adults after hip fracture: an integrative review. *Rehabilitation* 43(5): 255–66. doi: 10.1097/rnj.000000000000096.

Francis-Coad J, Etherton-Beer C, Burton E, et al. 2018. Effectiveness of complex falls prevention interventions in residential aged care settings: a systematic review. *JBIR Database of Systematic Reviews and Implementation Reports* 16(4): 973–1002. doi: 10.11124/jbisrir-2017-003485.

Guirguis-Blake JM, Michael YL, Perdue LA, et al. 2018. Interventions to prevent falls in older adults: updated evidence report and systematic review for the US Preventive Services Task Force. *Journal of the American Medical Association* 319(16): 1705–16. doi: 10.1001/jama.2017.21962.

Haines T. 2018. Preventing falls in hospitals and aged care facilities: innovation, policy, practice and negative trials. 8th Biennial Australian and New Zealand Falls Prevention Society Conference, 18–20 November; Hobart, Tasmania.

Hamed A, Bohm S, Mersmann F, et al. 2018. Follow-up efficacy of physical exercise interventions on fall incidence and fall risk in healthy older adults: a systematic review and meta-analysis. *Sports Medicine – Open* 4(1): 56. doi: 10.1186/s40798-018-0170-z.

Hopewell S, Adedire O, Copsey BJ, et al. Multifactorial and multiple component interventions for preventing falls in older people living in the community. *Cochrane Database Syst Rev* 2018, Issue 7, Art. No. CD012221. doi: 10.1002/14651858.CD012221.pub2.

Kahwati LC, Weber RP, Pan H, et al. 2018. Vitamin D, calcium, or combined supplementation for the primary prevention of fractures in community-dwelling adults: evidence report and systematic review for the US Preventive Services Task Force. *Journal of the American Medical Association* 319(15): 1600–12. doi: 10.1001/jama.2017.21640.

Khanuja K, Joki J, Bachmann G, et al. 2018. Gait and balance in the aging population: fall prevention using innovation and technology. *Maturitas* 110: 51–56. doi: 10.1016/j.maturitas.2018.01.021.

Lapierre N, Neubauer N, Miguel-Cruz A, et al. 2018. The state of knowledge on technologies and their use for fall detection: a scoping review. *International Journal of Medical Informatics* 111: 58–71. doi: 10.1016/j.ijmedinf.2017.12.015.

Lapumnuaypol K, Thongprayoon C, Wijarnpreecha K, et al. 2019. Risk of fall in patients taking proton pump inhibitors: a meta-analysis. *QJM: Monthly Journal of the Association of Physicians* 112(2): 115–21. doi: 10.1093/qjmed/hcy245.

- Li F, Harmer P, Fitzgerald K, et al. 2018. Effectiveness of a therapeutic Tai Ji Quan intervention vs a multimodal exercise intervention to prevent falls among older adults at high risk of falling: a randomized clinical trial. *JAMA Internal Medicine* 178(10): 1301–10. doi: 10.1001/jamainternmed.2018.3915.
- Lima CA, Ricci NA, Nogueira EC, et al. 2018. The Berg Balance Scale as a clinical screening tool to predict fall risk in older adults: a systematic review. *Physiotherapy* 104(4): 383–94. doi: 10.1016/j.physio.2018.02.002.
- Malmir H, Saneei P, Larijani B, et al. 2018. Adherence to Mediterranean diet in relation to bone mineral density and risk of fracture: a systematic review and meta-analysis of observational studies. *European Journal of Nutrition* 57(6): 2147–60. doi: 10.1007/s00394-017-1490-3.
- Mikolaizak AS, Lord SR, Tiedemann A, et al. 2018. Adherence to a multifactorial fall prevention program following paramedic care: predictors and impact on falls and health service use. Results from an RCT a priori subgroup analysis. *Australasian Journal on Ageing* 37(1): 54–61. doi: 10.1111/ajag.12465.
- Mol A, Bui Hoang PTS, Sharmin S, et al. 2018. Orthostatic hypotension and falls in older adults: a systematic review and meta-analysis. *Journal of the American Medical Directors Association* 21 December [Epub ahead of print]. doi: 10.1016/j.jamda.2018.11.003.
- Nait Aicha A, Englebienne G, van Schooten KS, et al. 2018. Deep learning to predict falls in older adults based on daily-life trunk accelerometry. *Sensors* 18(5). doi: 10.3390/s18051654.
- Naseri C, Haines TP, Etherton-Beer C, et al. 2018. Reducing falls in older adults recently discharged from hospital: a systematic review and meta-analysis. *Age and Ageing* 23 March [Epub ahead of print]. doi: 10.1093/ageing/afy043.
- Nguyen H, Mirza F, Naeem MA, et al. 2018. Falls management framework for supporting an independent lifestyle for older adults: a systematic review. *Aging Clinical and Experimental Research* 30(11): 1275–86. doi: 10.1007/s40520-018-1026-6.
- NICE. 2018. *NICE Impact: Falls and fragility fractures*. London: National Institute for Health and Care Excellence.
- Osteoporosis New Zealand. 2017. *Guidance on the Diagnosis and Management of Osteoporosis in New Zealand*. Wellington: Osteoporosis New Zealand.
- Romli MH, Mackenzie L, Lovarini M, et al. 2018. The clinimetric properties of instruments measuring home hazards for older people at risk of falling: a systematic review. *Evaluation & the Health Professions* 41(1): 82–128. doi: 10.1177/0163278716684166.
- Saletti-Cuesta L, Tutton E, Langstaff D, et al. 2018. Understanding informal carers' experiences of caring for older people with a hip fracture: a systematic review of qualitative studies. *Disability and Rehabilitation* 40(7): 740–50. doi: 10.1080/09638288.2016.1262467.
- Sherrington C, Fairhall NJ, Wallbank GK, et al. Exercise for preventing falls in older people living in the community. *Cochrane Database Syst Rev* 2019, Issue 1, Art. No. CD012424. doi: 10.1002/14651858.CD012424.pub2.

- Siris ES, Adler R, Bilezikian J, et al. 2014. The clinical diagnosis of osteoporosis: a position statement from the National Bone Health Alliance Working Group. *Osteoporosis International* 25(5): 1439–43. doi: 10.1007/s00198-014-2655-z.
- Szabo SM, Gooch KL, Walker DR, et al. 2018. The association between overactive bladder and falls and fractures: a systematic review. *Advances in Therapy* 35(11): 1831–41. doi: 10.1007/s12325-018-0796-8.
- Thillainadesan J, Gnjjidic D, Green S, et al. 2018. Impact of deprescribing interventions in older hospitalised patients on prescribing and clinical outcomes: a systematic review of randomised trials. *Drugs & Aging* 35(4): 303–19. doi: 10.1007/s40266-018-0536-4.
- Tricco AC, Thomas SM, Veroniki AA, et al. 2019. Quality improvement strategies to prevent falls in older adults: a systematic review and network meta-analysis. *Age and Ageing* 5 February. doi: 10.1093/ageing/afy219. [Epub ahead of print].
- Van Grootven B, McNicoll L, Mendelson DA, et al. 2018. Quality indicators for in-hospital geriatric co-management programmes: a systematic literature review and international Delphi study. *BMJ Open* 8(3): e020617. doi: 10.1136/bmjopen-2017-020617.
- Vance E, Farlie MK, Kool B, et al. 2018. Health professional student education related to the prevention of falls in older people: a survey of universities in Australia and New Zealand. *Australasian Journal on Ageing* 37(3): e116–19. doi: 10.1111/ajag.12543.
- Viswanathan M, Reddy S, Berkman N, et al. 2018. Screening to prevent osteoporotic fractures: updated evidence report and systematic review for the US Preventive Services Task Force. *Journal of the American Medical Association* 319(24): 2532–51. doi: 10.1001/jama.2018.6537.
- Wilkinson A, Meikle N, Law P, et al. 2018. How older adults and their informal carers prevent falls: an integrative review of the literature. *International Journal of Nursing Studies* 82: 13–19. doi: 10.1016/j.ijnurstu.2018.03.002.
- Williams AD, Bird ML, Hardcastle SG, et al. Exercise for reducing falls in people living with and beyond cancer. *Cochrane Database Syst Rev* 2018, Issue 10, Art. No. CD011687. doi: 10.1002/14651858.CD011687.pub2.
- Wu CH, Chen CH, Chen PH, et al. 2018. Identifying characteristics of an effective fracture liaison service: systematic literature review. *Osteoporosis International* 29(5): 1023–47. doi: 10.1007/s00198-017-4370-z.
- Wylie G, Torrens C, Campbell P, et al. 2019. Podiatry interventions to prevent falls in older people: a systematic review and meta-analysis. *Age and Ageing* 7 January [Epub ahead of print]. doi: 10.1093/ageing/afy189.