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CASE FOR ACTION- PROPOSAL TO NHMRC

Falls and fracture prevention

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**Submitted by the Research Translation Faculty Arthritis and
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ARTHRITIS AND INJURY

The National Health and Medical Research Council (NHMRC) Research Translation Faculty (the Faculty) was established as a key advisory forum in 2012. The primary work of the Faculty for the 2013-15 Triennium has been to help NHMRC accelerate the translation of research by identifying the most significant gaps between research evidence and health policy and practice in each of the major health areas in the NHMRC Strategic Plan, and to propose to NHMRC possible action it could consider taking to address that gap – these are called Cases for Action. In April and May 2013, fourteen Faculty steering groups were established as NHMRC working committees to each oversee the development of a Case for Action.

The Faculty's Arthritis and Musculoskeletal Conditions Steering Group and Injury Prevention and Control Steering Group are comprised of a range of experts and include primary (1°) and secondary (2°) representatives of NHMRC Health Care Committee (HCC) and Prevention and Community Health Committee (PCHC). Further information is available at: www.nhmrc.gov.au/research/research-translation/research-translation-faculty/research-translation-faculty-steering-groups.

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Declaration of interests

The declarations of interests of Steering Group members, authors and contributors are available at Appendix 1.

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Case for Action: Falls and Fracture Prevention

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Case for Action: Falls and Fracture Prevention

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Part 1: Rationale

The burden of falls and minimal trauma fractures in Australia

Falls in older people are a major concern in terms of frequency, disability, institutionalisation and mortality with an ever-growing socioeconomic burden.¹ An Australian study found 8% of women in their forties, 14% in their fifties, 25% in their sixties and 40% in their seventies had experienced a fall in the previous 12 months.² In older adults up to 30% of falls can result in moderate to severe injuries, including head trauma, hip fractures and dislocations, resulting in an increased risk of early death.³ In Australia, falls are the leading cause of hospitalised injury, accounting for over one-third of all community injury cases. The estimated number of hospitalised injury cases due to falls in people aged 65 and over in 2009-10 was 83,000 – more than 5,100 extra cases than in 2008-09 (a 6% increase).⁴ One in every 10 days spent in hospital by a person aged 65 and older is directly attributable to an injurious fall.⁴ Age-standardised rates of hospitalised fall-related injury cases in Australians aged 65 years are steadily increasing.⁵ A forecast of future costs attributable to falls published in 2005 predicted that by 2051, the Australian total annual health costs from fall-related injury would be \$1.4 billion.⁶ However, this figure is likely to be an underestimate as there were ~1.3 million patient days spent in hospital due to a fall in the 2009-10 financial year,⁴ and the average cost of treating hip fractures while in hospital is over \$1,000 per day.⁷

According to data from the most recent Global Burden of Disease study, around one third of falls-related deaths could be attributable to low bone mineral density and osteoporotic fracture.⁸ In 2012, 140,822 minimal trauma fractures occurred in Australia including 21,284 hip fractures.⁹ By 2022 it is projected that there will be a 30% increase in the annual number

of fractures (~183,105 fractures annually). In 2012, the total cost of minimal trauma fracture in Australians over 50 years of age was \$2.75 billion. It is predicted that in 2022 the total annual cost will be \$3.84 billion. Osteoporosis is a key contributing factor to fracture among those who have fallen with 1.2 million Australians defined as having osteoporosis by having had a minimal trauma fracture or low bone density and this will increase to 3 million by 2021.¹⁰

Osteoporotic fractures are also costly to repair – \$1.62 billion in total direct fracture cost alone in 2012.⁹ Hip fractures remain the most costly type of fracture, in terms of inpatient care and post-surgical care – rehabilitation and nursing home care for the two years following a fracture account for 29% of the cost of a femoral neck fracture. However, all types of minimal trauma fracture (hip, wrist, spinal and other) will continue to rise as the Australian population ages. In addition to economic costs, there is a large personal cost in terms of reduced quality of life after all minimal trauma fractures, which continue in the long-term for spinal and hip fractures.

Men and women who have had a first osteoporotic fracture are at significant risk of sustaining future fractures. Half of those with a hip fracture have presented to their general practitioner and/or hospital with a prior fragility fracture and their risk of a subsequent hip fracture is double that of their age-matched peers. Despite osteoporosis being part of the Arthritis and Musculoskeletal disease National Priority Area,¹¹ the vast majority of patients with falls and minimal trauma fractures are not appropriately investigated or treated for the underlying cause. Therefore urgent action is required to reduce the burden related to falls and minimal trauma fractures in Australia.

This case for action is in recognition of the huge and growing burden of falls and minimal trauma fractures in Australia, and the fact that, proven interventions do exist to substantially reduce this burden.

Interventions proven to prevent falls and reduce risk of minimal trauma fractures

1. Strength and balance exercise and Tai Chi prevents falls and promotes health and well-being more generally

Falls are putatively recognised as being multifactorial in aetiology. Consequently, a wide range of interventions have been investigated for their efficacy and effectiveness in the prevention of falls. It is beyond the scope of this Case For Action to examine the evidence for each of these. However, readers are referred to the most recent Cochrane reviews of interventions for the prevention of falls amongst community-dwelling older adults,¹² and interventions for the prevention of falls amongst institutionalised (hospitals and aged care facilities) older adults.¹³ In this Case For Action, we focus upon providing strength and balance exercise or Tai Chi as they have the greatest amount of evidence that they are effective approaches for preventing falls. Further, meta-analyses have indicated that targeted single intervention approaches are likely to be as effective as multifactorial intervention strategies which often require completion of risk assessment tools, may be more acceptable and more cost effective.¹⁴

A recent Cochrane review based upon 59 randomized trials (13,264 participants) investigating the effect of exercise among community-dwelling older adults found that group

exercise programs reduced the rate of falls (falls per person-time) by 29% (95%CI: 18% - 37%) – 16 trials, 3622 participants.¹² It also found there was no difference in the magnitude of benefit for high- versus low-risk participants indicating that this may be an effective population-level strategy. This review also found that home-based exercise for prevention of falls reduced the rate of falls by 32% (95%CI: 20% - 42%) based upon seven trials (951 participants). Systematic reviews have also identified that Tai Chi can reduce falls by 37%¹⁵ and the New Zealand developed 'Otago exercise programme' by 32%.¹⁶ A 2009 investigation of the cost-effectiveness of preventing falls using a Tai Chi group exercise program found that only \$1079 was required to prevent one fall,¹⁷ while a separate study found that the Otago exercise program was cost-saving in people ≥ 80 years.¹⁸ There are also other benefits from participating in these forms of exercise beyond the prevention of falls, including lower risk of mortality,¹⁹ enhanced capacity to participate in activities of daily living,²⁰ improved bone density,²¹ and improved mobility, strength and reduced fear of falling.²²

Four systematic reviews and a number of more recent trials have demonstrated that well designed exercise can reduce falls in older community-dwelling people.^{15, 16, 23-25} However not all types of exercise reduce falls. A trial of a brisk walking program in post-menopausal women found the program increased the rate of falls.²⁶ The largest and most recent review by Sherrington et al²⁷ makes eight best practice recommendations for falls prevention exercise:

1. Exercise must provide a moderate or high challenge to balance;
2. Exercise must be of a sufficient dose to have an effect (at least 2 hours per week);
3. Ongoing exercise is necessary;

4. Falls prevention exercise should be targeted at the general community as well as those at high risk for falls;
5. Falls prevention exercise may be undertaken in a group or home-based setting;
6. Walking training may be included in addition to balance training but high-risk individuals should not be prescribed brisk walking programs;
7. Strength training may be included in addition to balance training; and
8. Exercise providers should make referrals for other risk factors to be addressed.

This review also highlighted that both group and individual home exercise programs can be effective and selection should be based on patient preference and need for supervision. Not surprisingly, the benefits of exercise are lost when exercise is ceased highlighting the importance of ongoing exercise.²⁵

2. Anti-osteoporosis treatments reduce the risk of minimal trauma fracture

Randomised controlled trials of anti-osteoporosis treatments (e.g. oral and intravenous bisphosphonates and subcutaneous injectable denosumab) published over the past two decades have provided consistent evidence that these therapies reduce fracture risk compared with placebo, varying by site of fracture and type of medication. The risk of further fractures can be reduced by up to 70% with appropriate management.²⁸

Almost all trials have been performed in postmenopausal women (mainly < 80 years of age), and the data are more compelling for secondary rather than primary prevention. The greatest benefit appears to be in reducing vertebral fracture risk (absolute risk reductions range between 4.9% and 11.9% depending upon medication)(Table 1). While absolute risk reductions are lower for hip and other non-vertebral fractures, on a population level this still

represents a significant benefit.

Table 1: Absolute risk reduction (number needed to treat) for secondary fracture prevention from systematic reviews or randomised controlled trials of osteoporosis treatments in postmenopausal women with osteoporosis and prior minimal-trauma fracture

Medication	Vertebral	Non-vertebral	Hip
Alendronate ²⁹	6.0% (17)	2.0% (50)	1% (100)
Risedronate ³⁰	5.0% (20)	2.0% (50)	1% (100)
Zoledronic acid ³¹	7.6% (13)	2.7% (37)	1.1% (91)
Denosumab ³²	4.9% (20)	1.5% (67)	0.5% (200)
Teriparatide ³³	9.0% (11)	3.0% (33)	NS
Strontium ranelate ^{34, 35}	11.9% (8)	2.2% (45)	NS

One systematic review that synthesised efficacy data from randomised controlled trials of oral bisphosphonates (alendronate: 11,893 participants; etidronate: 679 participants; risedronate: 13,163 participants) at any dose, versus placebo or no bisphosphonate in postmenopausal women reported that in trials with mostly secondary prevention women (8 trials, 6,753 participants, mean age 72 years) bisphosphonates reduced hip fracture risk: RR 0.60 (95% CI 0.43 to 0.83), ARR 1.0%, NNT 100 for 2.9 years, and also reduced wrist fracture (RR 0.63 (0.45, 0.89), ARR 1.3%, NNT 77 for three years).³⁶ There were also consistent data, based upon two trials (9,892 participants) that IV zoledronic acid also reduces hip fracture risk (RR 0.62 (95% CI 95% CI 0.46 to 0.82). In addition, one trial demonstrated that zoledronic acid reduced subsequent mortality from any cause by 28%.³⁷

Based upon randomised placebo-controlled trials performed in men, the absolute risk reduction for prevention of secondary fractures with zoledronic acid has been reported to be 3.3% for vertebral fractures,³⁸ and 3.1% for non-vertebral fractures (following a previous hip fracture)³⁷. As yet there are no trial data regarding efficacy of anti-osteoporosis treatment in preventing hip fracture in men although there is no strong reason to suspect that data from postmenopausal women would not be generalisable to men.

In usual care, the effectiveness of anti-osteoporosis medication is hampered by suboptimal long-term adherence to therapy. There are also known harms including atypical femoral fractures and osteonecrosis of the jaw. There are estimated to be 11 atypical femoral fractures and 7 cases of osteonecrosis of the jaw per year among 10,000 users of bisphosphonates,^{39, 40} and similar skeletal complications are associated with other anti-resorptive therapies.⁴¹ Increased cardiovascular risks have been linked with strontium ranelate, as well as with calcium and vitamin D supplementation.^{42, 43}

3. Preventing falls among older adults reduces the number of fractures

While no falls prevention trials to date have used fracture as a primary outcome due to the prohibitive sample size that would be needed, numerous trials have reported that preventing falls among older adults reduces the number of fractures, often substantially.⁴⁴⁻⁵⁰

In addition, a pooled analysis of individual-level data from four trials involving 1016 community dwelling women and men aged 65 to 97 in New Zealand, found that the relative risk of injurious falls (defined as falls resulting in a fracture or hospital admission or injury requiring stitches) could be reduced by the same amount as falls per se (falls per 100 person years 72.2 in the active group compared with 106.1 in the control group, Incidence Rate Ratio (IRR): 0.65 (95% CI 0.57 to 0.75); injurious falls per 100 person years 29.7 in the active group compared with 45.5 in the control group, IRR: 0.65 (95% CI 0.53 to 0.81).⁵¹

Evidence of the gap between research and practice/policy

There are 4 key gaps that this case for action can address:

Gap 1: Older adults do not participate in activities likely to prevent falls.

An analysis of the 2009 NSW Falls Prevention Survey (n=5681) found that only 12% (95%CI: 11%, 13%) of respondents regularly participated in activities likely to have had an effect of improving balance.⁵² Similarly, strength training was undertaken by only 12% (95% CI: 11%, 13%). Fifty-six percent of respondents felt that walking would improve balance.

There are many reasons why the rate of participation in strength and balance exercise may be so low, the first being that older adults may not be aware that strength and balance

exercise can reduce their risk of falls. A survey of 343 older adults in Western Australia being discharged from hospital were asked to name at least one strategy that they thought might reduce their risk of falling. Strength and balance exercise was specifically mentioned by only two participants, and performing more generic forms of exercise (e.g. walking) was nominated by only 16 participants.⁵³ A separate survey of 394 community-dwelling Victorians >70 years found that ~80% of participants agreed or strongly agreed that participation in strength and balance training would reduce the risk of falls among older adults in general. However, ~25% of participants felt that these approaches would be better for other older adults than for themselves personally. Reasons provided included that they did not believe they were at risk of falls, they felt that other forms of activity they participated in, e.g., walking, had the same benefit, and they also stated that they did not think they could participate in strength and balance training.⁵⁴ It was also identified from this survey that the time-limited (e.g., 6 weeks) nature of falls prevention exercise programs frequently offered was found to be a key reason why those who commence an appropriate exercise program cease participating. There may also be particular challenges in running programs outside of major centres. Boehm et al found that barriers to exercise for older adults living in rural and remote areas of Australia, included time factors, motivation, other health reasons, body image, confidence, fatigue, availability of programs, fear, weather, family / household / community commitments, traffic, parking, transportation and costs.⁵⁵

Gap 2: Health professionals are not recommending/referring older adults for appropriate falls prevention exercises

Over 60% of the 394 Victorian survey participants aged >70 years agreed or strongly agreed they would commence a strength and balance program if a health professional encouraged them to do so. Of a sub-group of 245 participants who were followed-up 12 months following the initial survey, 93 fell during this period yet only 53 sought subsequent medical attention, limiting the opportunity for doctors to intervene. Of the total of 245 participants, 55 spoke with their general practitioner about falls yet only 9 reported receiving advice to participate in exercise to prevent falls.⁵⁶ Other qualitative research conducted amongst 16 older hospital patients, 8 care givers and 27 medical practitioners in Victoria found that both patients and medical practitioners were reluctant to discuss the issue of falls unless it was the cause of the presenting complaint (i.e. the patient had already fallen and hurt themselves).⁵⁷ These data indicate that medical professionals rarely recommend exercise that will prevent falls as a preventive strategy to older adults. This is despite the willingness of older adults to commence such a program if a recommendation of this nature were made.

Gap 3: Exercise prescribers and providers are not prescribing the right type of exercise or correct dose.

A previous project sought to characterise the content and delivery of community-based physical activity programs which have falls prevention as one of their objectives and are funded, supported or promoted through a NSW Area Health Service.⁵⁸ Eight NSW Area Health Services identified 714 eligible exercise groups. Thirty-five randomly selected exercise groups were visited and characterised according to a set of predefined objective criteria. Additional information about the groups was provided by 33 of the exercise leaders. Of the

33 visited groups for which all data were available, 18 (55%) included exercise that provided a high challenge to balance. Of these, eight (24%) ongoing groups also involved at least two hours per week of exercise (including the home program). Seven (21%) of the groups with highly challenging balance exercises were ongoing but involved less than two hours per week of exercise including the recommended home exercise program. Three groups (9%) had highly challenging balance exercises in their exercise group and offered more than two hours per week of exercise but were not ongoing (programs ranged from 7 to 16 weeks). In summary, no group met the criteria set out in the most recent review discussed previously.¹⁶

Gap 4: High-risk individuals with minimal trauma fracture remain untreated for their underlying osteoporosis and/or fail to adopt and adhere to treatment recommendations

Minimal trauma fractures are often the first manifestation of osteoporosis.⁵⁹ Up to 56% of women and 33% of men aged over 60 years will have such an osteoporotic fracture in their lifetime. After the initial fracture, the risk for subsequent fracture is more than doubled in the next 6-12 months,⁶⁰⁻⁶² and the increase in fracture risk may persist for as long as 10 years.⁶³ Current Australian guidelines recommend intervening at or around the time of the initial fracture diagnosis to prevent or reduce the risk of subsequent fracture (secondary prevention) in this high-risk group. Yet it appears that most (80 to 90%) high-risk individuals with minimal trauma fractures remain untreated for their underlying osteoporosis.⁵⁹ Large scale studies in both primary,^{64, 65} and secondary care,⁶⁶ from Australia and overseas,⁶⁷ have shown a universal care gap in regards to secondary fracture prevention.

Case-finding studies for osteoporosis show that only a minority of patients presenting with minimal trauma fractures to both hospital and community settings are appropriately

investigated and treated. An audit of secondary preventive care offered to fragility fracture patients presenting to 16 Australian hospitals between 2003 and 2005, showed that of 1,829 patients, of whom 75% were women, less than 13% had appropriate investigation for fracture risk and only 10% were appropriately treated.⁶⁶ In a large primary care survey involving 927 general practitioners and more than 88,000 women aged >60 years performed in 1999 (the Australian 'BoneCare Study'), Eisman et al. reported that among those who reported a fracture after menopause, only 28% were on any specific therapy for osteoporosis and less than half had been specifically told that they had osteoporosis.⁶⁴ More recent studies,^{65, 68} continue to show a persistent evidence-practice gap.

In addition to suboptimal assessment of risk for subsequent fracture, among those who are treated with anti-osteoporosis therapy, long-term adherence to therapy is a significant issue. For example one study found that among women started on oral bisphosphonates, approximately 25% abandoned treatment within 7 months, most commonly due to reported side effects of treatment.⁶⁹ Adherence issues may be less of a problem with the availability of intravenous bisphosphonate (zoledronic acid), which is administered on an annual basis, and denosumab, administered subcutaneously every six months (though it is recognised that oral medications are cheaper to provide).

Description of what is / has already been tried to address the gap

Gap 1: Older adults do not participate in activities likely to prevent falls and may not believe that exercise that can reduce their risk of falls will do so.

Victoria has recently participated in an NHMRC Partnership Project aimed at using evidence to inform policy and practice in community-based falls through the RE-AIM framework.⁷⁰ As a part of this project, health services in two geographic regions of Melbourne were provided with resources from the Victorian Department of Health to enable provision of group and home-based exercise programs for the prevention of falls. While evaluation of the implementation of these programs found that they rated highly on a number of factors associated with diffusion of innovations, the reliance on often insufficient levels of external funding created challenges for implementation and significantly impaired program sustainability. In the survey of 394 older community dwelling Victorians referred to earlier, the lack of public subsidy had a significant negative effect on the intention of community dwelling older people to participate in group and home-based exercise programs.⁷¹

Ongoing funding models are not presently available to support these programs in the long term, while programs provided by publicly funded health services commonly offer time limited (e.g. 6-week) programs. Currently, there is an absence of funding models that would support older adults to participate in falls prevention programs. The Commonwealth Government Chronic Disease Management program (formerly Enhanced Primary Care) offers 5 subsidized allied health services per year and could be used for falls prevention exercise prescription. However, older adults at risk of falls often have other comorbid conditions which may also necessitate use of these five sessions, therefore falls prevention exercises may need separate funding.^{72, 73} It is noted that group exercise programs for

diabetes management have attracted specific additional support within the Commonwealth Government Chronic Disease Management, though such a policy has not been extended to include strength and balance exercise programs for the prevention of falls.

Gap 2: Health professionals are not recommending / referring older adults to participate in suitable exercise that will prevent falls

We are not aware of any activities aimed at improving the rate of referral / recommendation of older adults to participate in strength and balance training in Australia. Previous research in New Zealand has found that physical activity counselling training for general practitioners and use of communication / referral prompts for general practitioners has increased the rate of physical activity and improved the health of adults/ older adults.⁷⁴

Gap 3: Exercise prescribers and providers are not prescribing the right type of exercise or correct dose.

Victoria has funded the development of an online training course in exercise prescription for falls prevention and has subsequently funded the training of over 100 health professionals. The content of this course encourages participants to prescribe exercise consistent with the best-practice recommendations made by Sherrington,²⁷ along with providing training in motivational interviewing, basic anatomy, biomechanics and exercise prescription principles relevant to falls prevention. This online course has been examined for effectiveness in terms of educational outcomes and economic efficiency compared with face-to-face instruction through a randomised trial with concurrent economic evaluation.^{75, 76} It has been run three times since 2012, attracting over 300 participants across Australia (though more than half

from Victoria). Funding from various state-level health departments has been used to subsidise the cost of course participation for certain provider groups.

In NSW, a NHMRC Partnership Project developed and delivered several professional development curricula for Physiotherapists, Exercise Physiologists and Fitness Professionals. These workshops aimed to equip Health Professionals with important information to guide the provision of appropriate falls prevention exercise programs for older people, covering topics including the social and economic issues of falls, risk factors for falls, physiological consequences of ageing, biomechanical and physiological principles of balance, and effective falls prevention strategies. In particular, workshop attendees learn to develop and implement exercise programs to improve balance and reduce fall risk to groups and individuals while tailoring it to individual needs and co-morbidities. These workshops have been accredited by Exercise and Sports Science Australia and Fitness Australia, for continuing education credit points.

A further activity has been the development of the *Active and Healthy* web-based directory of NSW physical activity programs with falls prevention components for older adults. Users are able to search for programs by location and receive program information including description of the program, any specific entry requirements, location, times, contact details and cost. The Sherrington best practice recommendations with regard to specific balance and strength exercises,²⁷ and the proportion of time allocated in physical activity programs are used to determine eligible programs. Program registration for inclusion on the website is completed through the online registration form, or by downloading a registration form. The website also includes a range of falls prevention resources for consumers and health

professionals seeking information on appropriate physical activity programs. A Project Officer manages the registration and process for programs that fulfil the inclusion criteria. There are currently over 1400 programs listed on the directory and the website receives an average 1300 visits and 6000 page views per month.

Gap 4: High-risk individuals with minimal trauma fracture remain untreated for their underlying osteoporosis and/or fail to adopt and adhere to treatment recommendations

There are numerous international activities currently being directed towards addressing the evidence-treatment gap of re-fracture prevention.

The International Osteoporosis Foundation is supporting Capture the Fracture programmes and evaluating their structure, implementation and effects.⁷⁷ In the USA, the National Healthy Bone Alliance, a public-private partnership on bone health, was launched in late 2010 to lobby government to fund re-fracture prevention initiatives.⁷⁸ This alliance is driving awareness of the need for secondary fracture prevention through its innovative 2Million2Many Campaign and facilitating widespread implementation of refracture prevention programs through the Fracture Prevention CENTRAL website. An American Society of Bone and Mineral Task Force report has provided the evidence behind this initiative.⁷⁹ It found that fully coordinated intensive models of care such as fracture liaison services are likely to be the most effective for secondary fracture prevention while certain interventions based upon patient and/or community-focused educational approaches are consistently ineffective.

There are also major national efforts underway in other countries including Canada,⁸⁰ the United Kingdom,⁸¹ and other countries.^{82, 83} In the UK fracture liaison services are being established in hospitals and primary care doctors are being incentivised to undertake long-term management of osteoporosis for fragility fracture sufferers.⁸⁴ Osteoporosis Canada has launched its *Make the FIRST break the LAST with Fracture Liaison Services* initiative, which aims to drive implementation of fracture liaison programs across all Canadian provinces by 2015⁸⁰.

In September 2013, the Australian and New Zealand Hip Fracture Registry Steering Group undertook a facilities audit across both countries in the course of work to establish trans-Tasman guidelines for acute hip fracture care and national hip fracture registries.⁸⁵ This audit evaluated various elements of service provision pertaining to hip fracture patients, including the presence of a Fracture Liaison Service. At that time, less than 20% of Australian hospitals and no hospitals in New Zealand had such a service established. In New Zealand, re-fracture prevention is being built into government performance appraisals of health care systems (district health boards). To demonstrate that positive change is possible, the New Zealand Health Department has mandated that by June 2015, all district health boards will have fully operational fracture liaison services.

The New South Wales (NSW) government is currently attempting to integrate and standardise post-fracture care through the Agency for Clinical Innovation (ACI). The ACI aims to develop fracture liaison programs in all hospitals across NSW to address the gap in osteoporosis care. Ideally, this system would allow integration of all data in a central database to help benchmark performance. The governments of South Australia,⁸⁶ and

Western Australia,⁸⁷ have also published strategy documents calling for implementation of fracture liaison programs. The Victorian government has recently formed a Lead Clinicians' Group in musculoskeletal diseases, who have identified fracture liaison services as one of three key strategies to improve musculoskeletal health.

The Australian and New Zealand Bone and Mineral Society has prepared a Position Paper on secondary fracture prevention programs.⁸⁸ The paper highlights the system-wide failure to prevent secondary fractures in Australia and calls on the Commonwealth and State governments to engage with the society to agree to a process – with commensurate funding – to make fracture liaison programs available for all older Australians. Osteoporosis Australia has received limited Commonwealth government funding to support the development of fracture liaison programs.

What benefits would be gained if the gap were closed?

There is considerable evidence that increasing participation in exercise suitable for prevention of falls would lead to reductions in falls, improvements in balance, mobility, and health more broadly. Economic modelling has identified that enabling 115,000 community-dwelling Australians >65 years to participate in a 15 week Tai Chi program would lead to 1,000 hospital admissions being averted over 12 months.¹⁷ Similarly enabling 60,000 community dwelling Australians >80 years to participate in home-based strength and balance training would lead to 1,000 hospital admissions being averted over 12 months.¹⁷ Again, economic modelling from New Zealand has indicated that home strength and balance exercise programs can be cost saving when the costs of provision are offset against the costs saved by averting injuries and hospitalisations.¹⁸

There is also evidence that various re-fracture prevention interventions would likely lead to significant reductions in minimal trauma fractures in the Australian setting and be cost-effective. Data from single arm and controlled studies performed in Australia have shown that patients with minimal-trauma fracture attending fracture clinics are receptive to clinic-based assessment and education, take up the offer of BMD testing and blood tests to screen for contributory illnesses when offered and then adhere to treatment recommendations.⁸⁹⁻⁹¹ Studies performed elsewhere have also shown a high level of persistence with osteoporosis treatment when initiation was performed in a fracture liaison service.⁹²

Lih et al. compared the rate of re-fracture over four years among patients presenting with non-vertebral minimal trauma fractures who accepted the offer of clinic-based assessment and management of re-fracture risk to those patients who elected to follow up with their

primary care physician without any specific additional intervention.⁹¹ They reported that the risk of re-fracture was significantly higher among those managed in primary care (31 out of 157 patients treated in primary care had a new fracture (19.7%) compared with 10 out of 246 clinic-treated patients (4.1%); Hazard Ratio 5.3 (95% CI 2.8 to 12.2). The median time to re-fracture was also significantly longer compared with those treated in primary care (26 versus 16 months). A second study that also compared fracture outcomes of patients with minimal trauma fracture presenting to an emergency department of a large NSW hospital who agreed to attend a fracture prevention clinic to those who declined reported similar findings.⁹³ Both studies specifically elected not to perform randomised controlled trials to address their research question on the basis that they considered it unethical to randomise patients to community care which they considered to be likely to offer inferior care (i.e. under-treatment of osteoporosis and increased re-fracture rates). However in the absence of randomisation, it is possible that bias, particularly selection bias, may explain the different outcomes observed between groups.

A cost-effectiveness analysis of the fracture liaison service evaluated in the study by Lih et al. reported that the service improved quality-adjusted life years (QALYs) by 0.089 years and led to an increase in costs of \$1,486 per patient versus standard care over a 10-year simulation period yielding an incremental cost-effectiveness ratio of a fracture liaison service compared with usual care of \$17,291 per QALY gained.⁹⁴ These results were robust to varying sensitivity analyses.

Other interventions designed to reduce re-fracture rates that might also be effective and cost-effective in the Australian setting include multifaceted quality improvement

interventions directed towards older patients and their physicians. For example, a multifaceted intervention that included telephone-based education and counseling and tailored printed materials for patients together with notification regarding acute wrist fracture management, patient-specific reminders that their patient had a high likelihood of low bone mass or osteoporosis and provision of single-page evidence-based treatment guidelines endorsed by local opinion leaders to their physician was found to triple rates of osteoporosis treatment within six months of a wrist fracture in Alberta, Canada.⁹⁵ A Markov decision-analytic model that compared this intervention with usual care over the patients' remaining lifetime found that this strategy was dominant: for every 100 patients receiving the intervention, three fractures (one hip fracture) would be prevented, 1.1 quality-adjusted life year gained, and \$26,800 saved by the healthcare system over their remaining lifetime.

A systematic review of clinical systems developed around the world to ensure appropriate management of patients following minimal trauma fracture has found that 65% include dedicated individuals who act as links between the orthopaedic team, osteoporosis and falls services, the patient and the primary care physician.⁹⁶ Another review of fracture liaison programs worldwide has identified key aspects of service design, which, if implemented, would lead to optimal delivery of post-fracture services.⁹⁷ At a minimum, re-fracture programs must identify fracture patients, provide them with direct education on osteoporosis and future fracture risk, alert their primary care provider and undertake investigations to determine future fracture risk, ideally including BMD testing. Programs that also initiate and monitor treatment where appropriate increase the number of patients taking anti-osteoporosis medication.

What groups are particularly affected by the gap?

Gap 1: Older adults do not participate in activities likely to prevent falls and may not believe that exercise that can reduce their risk of falls will do so

Analysis of the 2009 NSW Falls Prevention Survey found that engagement in strength or balance-challenging activities was lower among those who had low education (< high-school), lived in disadvantaged neighbourhoods, were obese, had fair/poor self-rated health, had problems with walking or used a walking aid or had fallen in the past year.

Gap 2: Health professionals are not recommending / referring older adults to participate in suitable exercise that will prevent falls

General practitioners have been found to be less likely to discuss exercise as a means of preventing falls with older adults in Victoria than other health professionals (e.g. physiotherapists).^{56, 57}

Gap 3: Exercise prescribers and providers are not prescribing the right type of exercise or correct dose.

No direct evidence of the characteristics of providers or settings that are prescribing/providing exercises that do not meet the Sherrington guidelines is available.

Gap 4: High-risk individuals with minimal trauma fracture remain untreated for their underlying osteoporosis and/or fail to adopt and adhere to treatment recommendations

Limited high quality evidence exists for the role that both socioeconomic status and education level might play in osteoporotic fracture.⁹⁸ In Australia, hip fracture incidence is related to quintile of SES, indicating that those of greater social disadvantage should be a

specific target population for intervention to reduce the burden of fragility fractures within Australia.⁹⁹ An even wider treatment gap exists in Indigenous Australians. In Western Australia from 1999-2009, the age-standardised hip fracture rate was 273.0 per 100,000 person-years for Indigenous adults and 148.8 per 100,000 person-years for non-Indigenous adults. This was true for both women and men. The standardised morbidity ratio was 2.2. Over this period, age-standardised hip fracture rates increased by an average of 7.2% per year among Indigenous adults, whereas non-Indigenous rates fell by an average of 3.4% per year. The relatively higher rates among Indigenous adults were more evident in the younger age groups.¹⁰⁰

Will addressing these gaps help advance other aspects of the NHMRC strategic plan?

Addressing these evidence-practice gaps would fulfil the major objective of the NHMRC, which is to improve the health of all Australians. It also is strongly aligned with a focus on translational research, another major part of the NHMRC Strategic Plan. In addition, it directly addresses two National Health Priorities: Injury Prevention and Control, and Arthritis and Musculoskeletal Conditions.

Addressing these gaps will impact more broadly than just the prevention of falls and re-fracture. An example of other National Health Priority Areas that may also be impacted by the actions proposed is shown in Table 2.

Table 2: Evidence that Tai Chi and Strength and Balance Training falls prevention exercise may also benefit other NHMRC priority areas

	Tai Chi	Lower limb strength and balance training
Arthritis and Musculoskeletal Conditions	Possible improvements in pain control for people with lower back pain, ¹⁰¹ knee osteoarthritis, ¹⁰² and delay in decline of bone mineral density ¹⁰³	Reduced pain and physical disability in people with osteoarthritis of the knee ¹⁰⁴
Cancer Control		Improved health-related

		quality of life in women following treatment for breast cancer ¹⁰⁵
Cardiovascular Health and Stroke	Reduced high blood pressure ¹⁰⁶	
Dementia		Improved muscle strength and functional performance ¹⁰⁷ Potential benefits on cognitive function ¹⁰⁸
Diabetes Mellitus		Improved glycaemic control and insulin sensitivity ¹⁰⁹
Mental Health (with a focus on depression)	Reduced symptoms of anxiety and depression ¹¹⁰	

In addition to the National Health Priority Areas, the NHMRC has a focus on enhancing primary health care and the care of people with chronic and complex health conditions. As we have presented, much of the work in preventing falls through enhanced participation in strength and balance exercise needs to be focussed on strengthening the capacity of the primary health care sector. Many of the people who have elevated risk of falls are also those with multiple comorbidities impacting on their health and independence. Several of the recommendations we propose will likely have an overflow of benefits for the primary health

care sector and for people with chronic and complex conditions beyond falls prevention (the latter demonstrated by the range of benefits listed in the table above).

Part 2: Proposed action

We propose that the NHMRC should:

1) Endorse recommendations for the prescription of effective exercise programs for falls prevention and facilitate dissemination of these recommendations to health professionals.

The RACGP Clinical Guidelines for Musculoskeletal Diseases (which includes the Clinical guidelines for the prevention and treatment of osteoporosis in post-menopausal women and older men) have already been endorsed by the NHMRC. The Australia New Zealand Falls Prevention Society “Translation of Research Into Practice” subcommittee will be able to assist with refinement of the falls prevention recommendations based on the work of Sherrington et al.

Timeframe: 1 year.

2) Make an NHMRC public statement focusing on the need for health professionals to

- a) Encourage older adults to participate in strength and balance exercise programs that meet recommendations for preventing falls and managing osteoporosis; and
- b) Identify patients with minimal trauma fracture and instigate appropriate management.

Timeframe: 1 year.

3) Advise State, Territory and Commonwealth Ministers for Health to support development of a funding model that will enable primary care health professionals (eg. physiotherapists) and accredited exercise providers to develop sustainable business models offering group-based falls prevention exercise services and home-based services for those aged over 80 years. This will be similar to the existing arrangements for provision of group-based services for people with type 2 diabetes (MBS item numbers 81100 through to 81125). Practice

Incentives Program arrangements may also be required to facilitate development of viable practice models in regional and remote areas.

Timeframe: 3-5 years.

4) Advise State, Territory and Commonwealth Ministers for Health on strategies to reduce second minimal trauma fractures in Australia and support the development of appropriate models of care to ensure coverage for all Australians, irrespective of geographic location or socioeconomic status, and recognising the additional challenges for regional, rural and remote areas, as well as specific population such as Aboriginal and Torres Strait Islanders and people from non-English speaking backgrounds. This would include examination of the feasibility and costs of different models of care such as fracture liaison clinics in public and private hospitals and primary care facilities, fracture liaison coordinators who would link the patient and different health professionals to ensure that appropriate assessment and treatment is being received, and quality improvement strategies aimed at improved primary care physicians and/or patients.

Timeframe: 3-5 years.

5) Work with the Royal Australasian College of General Practice, Australian College of Nursing, and the Handbook of Non-Drug Intervention (HANDI) project team and content experts to develop evidence-based information for general practitioners and patients regarding

a) The use of strength and balance exercise for the prevention of falls in older adults; and

b) The use of strength and balance exercise in the management of osteoporosis and prevention of minimal trauma fractures.

Timeframe: 2-5 years.

6) Endorse and promote courses for health professionals and accredited exercise providers on

- a) Exercise prescription for falls prevention, which may also include physical activity counselling for older adults. This training may be linked to eligibility to provide publicly subsidised group-based services as described in recommendation 3). This may require consultation with existing industry bodies such as the Australian Physiotherapy Association and Fitness Australia to identify and align with existing course accreditation procedures; and
- b) Appropriate assessment and management of patients with minimal trauma fracture. This may require consultation with existing consumer and scientific bodies such as Osteoporosis Australia and the Australian and New Zealand Bone and Mineral Society to identify and align with existing course accreditation procedures and pre-existing exercise programs.

Timeframe: 1-3 years.

7) Encourage expansion of the Active and Healthy website to all states and territories, with co-funding from relevant agencies. This will require consultation with the New South Wales Clinical Excellence Commission who own this website. This could incorporate development of resources for public education of the community to ensure that the elderly and their families understand the risks of ageing on bone strength, the value of adequate dietary calcium, the importance of maintaining fitness by exercise. This information could also be provided in the form of booklet or fact sheets and will require consultation with consumer groups in its development. This could be modelled on the work by Andrology Australia

through their professional and community education program on male reproductive health.¹¹¹

Time frame: 1-3 years.

8) Institute a targeted call for implementation research addressing the translation of research to practice for falls prevention and appropriate management of minimal trauma fractures. This should include

a) Trials to evaluate the effectiveness and cost-effectiveness of service delivery models for management of minimal trauma fractures, particularly fracture liaison clinics or coordinators, and funding structures to support them. Trials would also need to consider the applicability of any models of care developed for regional, rural and remote areas as well as specific population such as Aboriginal and Torres Strait Islanders and people from non-English speaking backgrounds; and

b) Trials to evaluate the effectiveness and cost-effectiveness of innovative approaches to changing health and fitness practitioner behaviour regarding exercise prescription and appropriate osteoporosis management.

Time frame: 1-2 years.

9) Development of training materials that could be incorporated into undergraduate training of medical, allied health, and nursing professionals and postgraduate training for the relevant specialties (such as general practice, endocrinology, orthopaedics, rheumatology). This training should have a focus on enabling effective communication with older adults to facilitate behaviour change for the prevention of falls. This will require further consultation with consumer groups to aid in its development. The Australia New Zealand Falls Prevention

Society has already commenced work mapping falls prevention content in undergraduate health professional curricula around Australia. This work could be extended upon and would require engagement with relevant educational institutions to enable incorporation of materials being developed into their courses. Engagement with consumer groups would also be necessary to assist

Timeframe: 1-3 years

Key barriers and enablers to uptake:

Recommendation 3) The willingness of policy makers and the Australian Government Department of Health to expand the MBS schedule to include group-based exercise interventions for falls prevention may be a significant barrier to implementing this recommendation. Overcoming this barrier may require direct consultation between the Australia New Zealand Falls Prevention Society and representatives from the Australian Government Department of Health to refine a proposed model for use (including reference to the number of subsidized sessions per year, eligibility criteria for older adults, training requirements for providers, mechanisms for referral e.g. whether a Team Care Arrangement will be required). A trial of the model +/- model alternatives that have been proposed may need to be undertaken prior to full-scale roll-out.

Recommendation 4) Lack of electronic medical records limiting opportunity to identify individuals who have had a minimal trauma fracture or who are likely to benefit from secondary fracture prevention strategies; suboptimal communication between hospital and emergency department physicians and general practitioners; and lack of clear lines of responsibility for implementation of secondary prevention of minimal trauma fracture. These issues will all need addressing when developing appropriate models of care.

Recommendation 7) Willingness of state-based agencies to provide co-funding to support the administrative requirements of this web site. This site requires contemporaneous information to be maintained so that health professionals and older adults do not lose faith in the accuracy of information provided. Hence administrative support for this initiative is essential for its success. Conducting an audit of exercise program uptake rates amongst

those visiting the site may be required to convince state-based agencies of the relative merits of this approach.

Process for monitoring the success of these recommendations

An overall evaluation approach for all recommendations to address **gap 1, 2, 3 and 4** is required.

The area of falls suffers from a paucity of system-level data for anything other than deaths and hospital admissions due to falls. Although these existing measures play an important role in understanding the burden of falls in Australia, it is an incomplete picture. We would recommend complementing these data through a ninth recommendation:

9) That the NHMRC encourage the inclusion of standardised data collection items related to falls and minimal trauma fractures on the National Health Survey and state-level population health surveys. This will allow more effective monitoring of the frequency of falls and minimal trauma fractures among older adults in our community, and will improve upon current data available.

Multiple recommendations to address **gaps 1, 2 and 4** could be evaluated by repeating the survey of older adults to find out the proportion taking up strength and balance exercise programs and treatment for osteoporosis and expanding this survey to include states outside of Victoria.⁵⁴

Multiple recommendations to address **gap 3** could be evaluated by repeating the survey of program providers to find out the proportion of programs offering services that meet recommendations proposed by the Sherrington review and expanding this to include states outside NSW.²⁷

Recommendations to address **gap 4** could be evaluated by monitoring osteoporotic medication prescribing trends through the PBS; by monitoring national minimal trauma fracture rates overall and by anatomical site through national hospitalisation data and registries; and monitoring of treatment for minimal trauma fractures by general practitioners could be through the CareTrack study or other similar mechanisms.

Uptake of **recommendation 3)** will be able to be monitored through existing MBS data collection systems.

Uptake of **recommendation 5)** could be monitored through tracking downloads of the HANDI topic papers on the use of strength and balance exercise for the prevention of falls and secondary prevention of minimal trauma fracture.¹¹²

Uptake of **recommendation 6)** could be monitored by making ongoing endorsement of education courses being contingent upon submission of participation statistics.

Uptake of **recommendation 7)** could be monitored by tracking site visits to the Active and Healthy website. This could be monitored by the Clinical Excellence Commission who own this site.

Uptake of **recommendation 9)** could be monitored by examining downloads of relevant materials and their presence/absence in the formal curricula of undergraduate health professional courses.

Ethical issues that may need to be addressed:

Trialling of a model to implement recommendation 3) may require approval from the NHMRC's Australian Health Ethics Committee.

Part 3: Potential impact

Impact on health outcomes:

We have already described that enabling 115,000 community dwelling Australians >65 years to participate in a 15 week Tai Chi program would lead to 1,000 hospital admissions being averted over 12 months, and that enabling 60,000 community dwelling Australians >80 years to participate in home based strength and balance training would lead to 1,000 hospital admissions being averted over 12 months.¹⁷

We have also demonstrated that participation in exercise suitable for the prevention of falls is likely to lead to a range of health benefits across a number of National Health Priority Areas, and improve the quality of life and functional independence of older adults engaged. It is anticipated that the effect of implementing the recommendations will grow and gather momentum resulting in a measureable impact on hospital admissions due to falls within 5 years. Growth in provision of strength and balance exercise programs due to **recommendation 3** is likely to take at least 5 years (and may take longer than this for the full benefit to be realised) as private providers adapt their business models and form relationships with referral sources (e.g. public hospitals) to enable sustainable business models to be formed.

Population affected

Falls and fractures research most commonly includes those over the age of 60-65 years. However falls and fractures most commonly and severely affect the oldest old, those >85 years. Australian Bureau of Statistics projections indicate that the population aged 85 years and over is projected to experience the highest growth rates of all age groups to 2101.

Growth for this group will peak at between 7% and 8% in 2032. This peak is due to the large cohort of people born in 1947 reaching 85 years around this time. At 30 June 2012 there were 420,300 people aged 85 years and over in Australia. When using a high life expectancy at birth assumption, the population of people over the age of 95 years is projected to more than double within 20 years (to 842,500 people in 2031), to double again by 2045 (1.7 million), and to double once more by 2069 (3.5 million). Over the second half of the century the number of people aged 85 and over will continue to grow strongly, reaching 5.5 million people by 2101.¹¹³

Economic impact

We present estimates for the costs per recommendation in Table 2.

Recommendation	Cost inputs and amount
1 – Endorse recommendations	In-kind: Support from NHMRC administrative staff time, time of falls experts to participate in refinement of recommendation. Direct costs: Dissemination expenses \$20,000
2 – Public statement	In-kind: Support from NHMRC communications personnel. Direct costs: Dissemination expenses \$20,000
3 – Establishment of MBS item number for group exercise services to	In-kind: Time of personnel from the Commonwealth Department of Health and Ageing, time of falls experts to participate in refinement of policy. Direct costs:

<p>be provided by private practitioners</p>	<p>Dissemination expenses \$20,000</p> <p>Cost to Commonwealth Department of Health and Ageing of use of MBS item number likely to grow over time with development of business models based upon this and ageing demographic. Costs to be offset from lower general practice costs, residential care costs, hospital admissions and community care packages to manage the injuries arising from falls.</p> <p>Examination of comparable MBS item numbers subsidizing the provision of group exercise for people with type 2 diabetes mellitus reveal that item number 8115 (group exercise program) had 41,441 services in 2013-2014 for a total benefit paid of \$702,807 while the item number 81110 (assessment for group exercise program) had 8,648 services in that year for a total benefit paid of \$587,206.¹¹⁴</p>
<p>4 – Develop HANDI guidelines</p>	<p>Direct costs: Project costs for HANDI staff to develop materials regarding strength and balance exercise for the prevention of falls and management of minimal trauma fracture. \$50,000</p>
<p>5 – Endorsement of courses delivering education on exercise</p>	<p>Direct costs: Project costs for team of researchers and practitioners to develop guidelines for endorsement. \$20,000.</p> <p>Costs of courses to have course subjected to assessment to be borne by course provider.</p>

prescription for falls prevention and physical activity counselling for older adults.	
6 – Expansion of Active and Healthy website to other states and territories	Direct costs: Ongoing cost of \$30,000 per year per state / territory to maintain website administration. One-off cost of \$50,000 for development of additional community education materials linked to this website.
7 – Inclusion of data collection items related to falls on National Health Survey	In-kind: Time of survey managers and researchers to develop and refine survey items. Time of survey administrators to administer these survey items.
9 – Development of materials for incorporation into health professional undergraduate training curricula	One-off cost of \$50,000 to adapt content and formatting of existing materials to meet needs of institutions that provide the targeted training programs.

Economic and broader impacts:

The primary manifestation of economic benefits from the proposed recommendations is that the cost of managing fall-related injuries and minimal trauma fractures (by general practitioners, community health workers, rehabilitation service providers, hospitals, and residential care providers) will be reduced. We have earlier presented data from economic evaluations of falls preventions highlighting the economic benefits of group-based and individual falls prevention exercise programs for the prevention of falls in older adults. We have also presented evidence of the broader health benefits from participation in strength and balance exercise. In addition there is compelling data to show that the incidence of second and subsequent minimal trauma fractures can be substantially reduced, by identifying and managing falls risk and osteoporosis. The deficiencies clearly apparent within our current system need to be urgently addressed before the “tsunami” of the ageing demographic incur the damaging consequences of falls and the burden of managing falls after they have occurred lands upon an already stretched health care system.

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Arthritis and Musculoskeletal Conditions & Injury Prevention and Control Case for Action – Declarations of Interests

The declarations of interests of Steering Group members, authors and contributors to this Case for Action are listed below.

Name and Role(s)	Interests declared
ARTHRITIS AND MUSCULOSKELETAL CONDITIONS STEERING GROUP	
<p>Prof Rachele Buchbinder</p> <ul style="list-style-type: none"> • Steering Group Chair • Author 	<p>Consultancy fees/honorarium</p> <ul style="list-style-type: none"> • Honorarium received for role as an international Mentor and Member, International Steering Committee for the 3e initiatives: Pain management by pharmacotherapy in rheumatic conditions (2010 -2011) and Diagnosis and management of gout (2011-2012); funded by Abbott (now AbbVie), which did not have a role in the scientific components of either project • Cabrini Institute received an honorarium for an invited talk given at the Roche Annual Symposium on Rheumatology (RASoR), Melbourne, March 2011. The presentation entitled 'Rheumatoid arthritis and malignancy' was entirely Prof Buchbinder's own work. • Honorarium received for an invited talk given at the Pfizer AIM Pain Conference, Melbourne, July, 2010. The presentation entitled 'Evidence-based management of painful musculoskeletal disorders' was entirely Prof Buchbinder's own work • Honorarium received for an invited talk given at the Wyeth Progress and Promise: Personalising Therapy, Optimising Outcomes Conference, Melbourne, July, 2010. Invited Plenary Speaker. The presentation entitled 'What have we learned from registries?' was entirely Prof Buchbinder's own work. <p>Grants</p> <ul style="list-style-type: none"> • Institutional funding received to manage the Australian Rheumatology Association Database (ARAD) from the Australian Rheumatology Association (ARA) who in turn received unrestricted grants from Abbott Australia, Pfizer Australia, Janssen Australia, Sanofi Aventis, Amgen, Wyeth, Schering-Plough and Roche to support ARAD • Holds NHMRC and other grants and may apply for NHMRC grants throughout the period of Steering Group membership. <p>Speeches/lectures</p> <ul style="list-style-type: none"> • Has published, spoken and advocated publicly about matters likely to be discussed by the Arthritis and Musculoskeletal Conditions Steering Group for the NHMRC Research Translation Faculty. This includes the need to improve uptake of evidence into clinical management of back pain, shoulder disorders, osteoporotic spinal fractures, osteoarthritis of the knee, etc. Examples include: <ul style="list-style-type: none"> ○ 2011 Keynote Speaker. Conservative care for low back pain: recent research and new developments. UK Society of Back Pain Research (SBPR) Annual Scientific Meeting, Cambridge, November 2011 ○ 2011 Invited Speaker. The evidence for vertebroplasty. Annual scientific meeting of the Spine Society of Australia and Australian Orthopaedic Association Continuing Education Meeting, Melbourne, April 2011 ○ 2011 Keynote Speaker. Debate: Vertebroplasty for vertebral fracture. UK Society of Back Pain Research (SBPR) Annual Scientific Meeting, Cambridge, November 2011. <p>Publications</p> <ul style="list-style-type: none"> • Buchbinder R, Staples M, Jolley D. Doctors with a special interest in back pain have poorer knowledge about how to treat back pain <i>Spine</i> 2009;34(11):1218-26 • Buchbinder R, Harris I. Arthroscopy for osteoarthritis of the knee? [Invited Editorial] <i>Med J Aust</i> 2012; 197(7): 364-5 • Buchbinder R. Real or non-specific effects of meniscectomy? [Invited Editorial] <i>New Eng/J Med</i> 2013; first release 19 Mar 2013. DOI: 10.1056/NEJMe1302696 • Harris I, Buchbinder R. Time to reconsider steroid injections in the spine? <i>Med J Aust</i> • Buchbinder R, Staples MP, Shanahan EM, Roos JF. General practitioner management of shoulder pain in Australia and comparison with rheumatologist expectation of care and best evidence. <i>PLOS One</i> 2013.

Name and Role(s)	Interests declared
<p>Prof David Findlay</p> <ul style="list-style-type: none"> • Steering Group member • Author 	<p>Consultancy fees/honorarium</p> <ul style="list-style-type: none"> • One-off honorarium from AmGen to run meeting. <p>Grants</p> <ul style="list-style-type: none"> • Past/Current NHMRC Project Grants, NHMRC grants: <ul style="list-style-type: none"> ○ Evdokiou A, Findlay DM, Butler L. "Histone Deacetylase Inhibitors (HDIs) with antineoplastic and antiosteolytic properties" NHMRC Project (2008-2010) ○ Evdokiou A, Findlay DM, Zannettino AC. "Novel strategies for the treatment of bone cancer." NHMRC Project grant (2009-2011) ○ Atkins GJ, Findlay DM, Bonewald L, Anderson PH. "Osteocytes and bone health." NHMRC Project grant (2009-2011) ○ Atkins GJ, Findlay DM, Haynes DR. "Sclerostin: a key regulator of bone mineralisation and bone catabolism." NHMRC Project grant (2011-2013) ○ Atkins GJ, Anderson P, Morris H, Davey R, Findlay DM. "Control of bone remodelling by osteoclastic metabolism of vitamin D." NHMRC Project grant (2012-2014) ○ Findlay D, Wluka A, Kuliwaba J, Taylor DJ. "Targeting bone marrow lesions to find interventions in the progression of osteoarthritis." NHMRC Project grant (2013-2015). ○ Findlay D, Atkins G, Haynes D, Howie D. "The role of osteocytes in particle induced osteolysis." NHMRC Project grant (2013-2015). <p>Speeches/Lectures</p> <ul style="list-style-type: none"> • "Cartilage-bone interface" Cartilage and Bone Symposium, Institute of Advanced Studies, The University of Western Australia, Aug 2011 • "Osteocytes and calcium: a little give and take" Combined meeting of the International Bone and Mineral Society and Australian and New Zealand Bone Mineral Society, Gold Coast QLD, Sept 2011 • "Debate: Is Subchondral Bone or Articular Cartilage the Best Target for Disease Modifying Osteoarthritis Drug Development? Bone" Osteoarthritis Research Society International World Congress, San Diego, Sept 2011 • "Subchondral bone in osteoarthritis: victim or villain." National Guest speaker at Australian Rheumatology Association Victorian Branch 2012 ASM, Melbourne, Aug 2012 • "Sclerostin is a target for bone anabolism- how does it work?" Invited speaker at The 7th Int Congress Chinese Orthop Assn, Beijing, China, Nov 2012 • "The role of the osteocyte: an update on bone biology" invited speaker and organiser, Bone Academy, Sydney, Dec 2012. <p>Expert Testimony</p> <ul style="list-style-type: none"> • Invited participant at the Australian Osteoarthritis Summit, Sydney, Nov 2012 • Appointment to Prosthesis List Advisory Committee (Specialist Orthopaedic Clinical Advisory Group - S), Department of Health and Ageing, for the period 29 Sep 2012 to 26 Mar 2016.
<p>Prof Peter R Ebeling AO</p> <ul style="list-style-type: none"> • Steering Group member • Author 	<ul style="list-style-type: none"> • No company shares held. <p>Research funding to Department:</p> <ul style="list-style-type: none"> • Amgen, Novartis, Eli-Lilly, GlaxoSmithKline (GSK), Merck. <p>Honoraria to Department for talks/presentations:</p> <ul style="list-style-type: none"> • Amgen, Merck, GSK. <p>Board membership (unpaid):</p> <ul style="list-style-type: none"> • International Osteoporosis Foundation (Nyon, Switzerland) • Endocrine Society of Australia (Sydney, Australia) • American Society of Bone and Mineral Research (Washington DC, USA). <p>Journal Editorial positions</p> <ul style="list-style-type: none"> • <i>Paid:</i> Editor, Bone (Elsevier, Amsterdam); Editor, Clinical Endocrinology (Oxford, England, UK) • <i>Unpaid:</i> Osteoporosis International – Editorial Board.

Name and Role(s)	Interests declared
<p>Dr Tamara Mackean</p> <ul style="list-style-type: none"> Steering Group member Health Care Committee (HCC) secondary contact 	<p>Employment</p> <ul style="list-style-type: none"> Senior Research Fellow, Poche Centre for Indigenous Health and Wellbeing. <p>Grants</p> <ul style="list-style-type: none"> NHMRC Project Grant - Regional Primary Health Care Organisations: population health planning, participation, equity and the extent to which initiatives are comprehensive. NHMRC CRE Social Determinants and Health Equity (awarded at the end of 2014). <p>Activities</p> <ul style="list-style-type: none"> Chairperson, Royal Australasian College of Physicians Aboriginal and Torres Strait Islander Health Advisory Committee Member, Australian Indigenous Doctors' Association.
<p>Prof Chris Maher</p> <ul style="list-style-type: none"> Steering Group member Author 	<p>Board membership</p> <ul style="list-style-type: none"> Member of the editorial board of three academic journals (Physical Therapy, BMC Musculoskeletal Disorders, Journal of Manual and Manipulative Therapy) Member, Australian Institute of Health and Welfare Musculoskeletal Advisory Group Member, The Royal Australian and New Zealand College of Radiologists working group producing educational modules for appropriate imaging referrals Director of the Centre for Evidence-Based Physiotherapy Member, Advisory Panel, Cochrane Back Review Group. <p>Consultancy fees/honorarium</p> <ul style="list-style-type: none"> Receives honorarium for serving on the Editorial Board of Physical Therapy. <p>Grants</p> <ul style="list-style-type: none"> Holds ARC Fellowship, Honorary NHMRC Fellowship, NHMRC project grants Intends to apply for NHMRC and ARC grants throughout the period of Steering Group membership Has received supplementary funding from industry for investigator-initiated NHMRC funded clinical trials Has received research grant funding from Compulsory Third Party (CTP) and Workers Compensation insurers and government regulators Has received research donations from physiotherapy associations to fund the Centre for Evidence-Based Physiotherapy. <p>Support for travel or accommodation</p> <ul style="list-style-type: none"> Has received financial support for travel and accommodation to attend conferences from my employer, ARC, conference organisers and industry. <p>Meals/beverages</p> <ul style="list-style-type: none"> Has received complimentary tickets to welcome receptions and conference dinners when an invited speaker. <p>Gifts or gratuities</p> <ul style="list-style-type: none"> Has received small gifts such as chocolates or a bottle of wine for talks/lectures delivered to professional groups eg. continuing education lecture for a division of general practice. <p>Publications/Speeches/lectures</p> <ul style="list-style-type: none"> Has published extensively on management of musculoskeletal conditions; provided lectures at professional and scientific conferences, continuing education seminars; provided lectures to university students, and have provided comment in the media on issues related to management of musculoskeletal conditions. <p>Expert testimony</p> <ul style="list-style-type: none"> Has provided expert testimony in legal cases involving accusations of negligence made against physiotherapists. <p>Relationships</p> <ul style="list-style-type: none"> Member, Australian Physiotherapy Association Fellow, Australian College of Physiotherapists. <p>Other</p> <ul style="list-style-type: none"> <i>Paid:</i> Has received speaker fees for presenting at scientific conferences and fees for reviewing clinical practice guidelines and education material produced by CTP/Workers Compensation regulatory agencies and industry

Name and Role(s)	Interests declared
Prof Chris Maher <i>...continued</i>	<ul style="list-style-type: none"> <i>Unpaid:</i> Advisor to the Cochrane Back Review Group, the Centre for Evidence-Based Physiotherapy, the Australian Institute of Health and Welfare Musculoskeletal Advisory Group, The Royal Australian and New Zealand College of Radiologists working group producing educational modules for appropriate imaging referrals.
A/Prof Anne Wilson <ul style="list-style-type: none"> Steering Group Member Prevention and Community Health Committee (PCHC) primary contact 	Consultancy fees – honorarium <ul style="list-style-type: none"> Chief Investigator, NHMRC Project Grant Chief Investigator on Department of Health and Ageing (DOHA) Grants Researcher in new sensor device not funded by NHMRC Investigator on current and past NHMRC Project Grants. Other <ul style="list-style-type: none"> Fellow of the Australian College of Nursing (Ongoing). Employment <ul style="list-style-type: none"> Since May 2012 – Associate Professor Research, Paramedics, School of Medicine, Flinders University.
Prof Samar Aoun <ul style="list-style-type: none"> Steering Group member PCHC secondary contact 	Employment <ul style="list-style-type: none"> Professor of Palliative Care, and Associate Dean of Research, Faculty of Health Sciences, Curtin University. Grants <ul style="list-style-type: none"> Past and current NHMRC and ARC grants and possibly future ones.
Prof Wendy Oddy <ul style="list-style-type: none"> Steering Group member PCHC secondary contact 	Employment <ul style="list-style-type: none"> Appointment as NHMRC Career Development Fellow Level II (2011-2014) in the field of nutritional epidemiology Chief Investigator (CIA) on NHMRC Project Grant (2012-2014) and CIA on NHMRC-EU collaborative project Current, past and likely future application to NHMRC for research and people support.
INJURY PREVENTION AND CONTROL STEERING GROUP	
Prof Russell Gruen <ul style="list-style-type: none"> Steering Group Chair 	Grants <ul style="list-style-type: none"> Holds NHMRC grants. Support for travel/accommodation <ul style="list-style-type: none"> Invited academic meetings only (not industry). Speeches/lectures <ul style="list-style-type: none"> Invited speaker at academic meetings (no industry involvement).
Adj Prof Lesley Day <ul style="list-style-type: none"> Steering Group member Author 	Grants <ul style="list-style-type: none"> Holds NHMRC grant and may apply for further grant(s) in the future. Other <ul style="list-style-type: none"> Publishes regularly in Injury Prevention and has written to the Victorian Health Minister regarding funding for falls prevention research has sat on advisory committees on falls and injury prevention for Victorian Government. Relationships <ul style="list-style-type: none"> Member, Executive Committee of the Victorian Safe Communities Network Member, Australian Injury Prevention Network.
Prof Ann Williamson <ul style="list-style-type: none"> Steering Group member 	Employment <ul style="list-style-type: none"> NHMRC Senior Research Fellow - salary is largely covered by the Fellowship. Board Membership <ul style="list-style-type: none"> Member, Road Safety Remuneration Tribunal (appointed by the Minister for Department of Education, Employment and Workplace Relations). This is a paid, part time position. Consultancy fees/honorarium <ul style="list-style-type: none"> Occasional consultancies undertaken for transport and road safety authorities including the National Heavy Vehicle Regulator, the National Transport Commission and the National Rail Regulator. These are remunerated according to the time spent. Grants <ul style="list-style-type: none"> Holds an NHMRC Project grant, ARC Discovery and ARC Linkage grants and may apply for other grants from these funding sources in the future.

Name and Role(s)	Interests declared
Prof Ann Williamson <i>...continued</i>	<p>Speeches/lectures</p> <ul style="list-style-type: none"> Invited speaker mainly at academic meetings, and occasionally for industry meetings such as transport or trade union organisations. Has been involved in advocacy for research on road and transport safety in Australia. <p>Expert testimony</p> <ul style="list-style-type: none"> Has provided expert testimony on the issue of fatigue and driving in a number of fora including government inquiries and courts. <p>Relationships</p> <ul style="list-style-type: none"> Member, Australian Injury Prevention Network Member, Australian College of Road Safety.
Prof Lynne Bilston <ul style="list-style-type: none"> Steering Group member 	<p>Board membership</p> <ul style="list-style-type: none"> Member, NSW Product Safety Committee (NSW State Cabinet appointment). While not a company board, this committee undertakes enquiries into product safety issues and has an interest in injury prevention. Sitting fees received to attend meetings. <p>Consultancy fees/honorarium</p> <ul style="list-style-type: none"> Contract research undertaken for both government departments with an interest in injury prevention (Transport for NSW, VicRoads) and non-government non-profit organisations (e.g. Royal Automobile Club of Victoria, NRMA in NSW) from time to time in the area of injury prevention. There is no personal financial benefit from these research activities, as funds go exclusively toward funding research activities undertaken in the laboratory Honoraria received occasionally from other universities for examining PhD theses. <p>Grants</p> <ul style="list-style-type: none"> Recipient of an NHMRC senior research fellowship, has held NHMRC grants and will apply for grants throughout the period of Steering Group membership. Has also held and currently participate in research grants from NGOs (NRMA, RACV) and government departments (VicRoads, Centre for Road Safety, Transport for NSW). <p>Support for travel/accommodation</p> <ul style="list-style-type: none"> Occasional travel support received for invited lectures at conferences and workshops. Sponsors are usually scientific professional organisations or government departments and NGOs organising the conferences. Has also acted as an examiner for one recent PhD defence in France (2012) for which travel expenses were paid. <p>Meals/beverages</p> <ul style="list-style-type: none"> Meals/beverages provided at conferences sponsored by commercial and non-commercial entities with an interest in injury prevention policy. <p>Speeches/lectures</p> <ul style="list-style-type: none"> Frequently delivers presentations/lectures about child restraints and child safety standards, and other aspects of her research in biomechanics. <p>Other</p> <ul style="list-style-type: none"> Neuroscience Research Australia interests <p>Advisory Roles</p> <p>Provides advice on road safety and child safety issues to the following organisations (unpaid, except as noted under Consultancy fees above):</p> <ul style="list-style-type: none"> <i>Non-commercial:</i> NRMA motoring (NSW); VicRoads (Vic); RACV (Vic); NSW for Transport; Qld Ambulance; Kidsafe (both national and state organisations); NSW Department of Fair Trading (NSW Product Safety Committee); Standards Australia (through CS-085 Child Restraint Standards Committee); Engineers Australia (through National Panel for Biomechanics of Impact Injury); Safekids (New Zealand government); Australian Automobile Association; Royal Automobile Association (SA); University of Otago (NZ); Plunket Society (NZ) <i>Commercial:</i> Britax Australia (child restraint manufacturer); Infra secure (child restraint manufacturer); Restraint Research (consultant to Infra Secure); Mobility Engineering (manager of NSW government sponsored child restraint fitting station network). <p>Relationships - professional memberships</p> <ul style="list-style-type: none"> Member, World Council of Biomechanics, 2010-present Member, NSW Products Safety Committee, 2007-present Board Member, College of Biomedical Engineers, Engineers Australia, 1998-present

Name and Role(s)	Interests declared
Prof Lynne Bilston <i>...continued</i>	<ul style="list-style-type: none"> • Member, Engineers Australia National Panel on the Biomechanics of Impact Injury, 1995-present (including Chair, 1996-2002) • Member, Engineers Australia, 1995-present • Member, Australian Standards Committee for Child Restraints in Motor Vehicles (CS-085), (including working party responsible for drafting standards) 2005-present • Member, Australasian College of Road Safety, 2007-present • Member, American Society of Biomechanics (ASB), 1991-2004. • Member, International Society of Biomechanics (ISB), 2004-present • Member, Kidsafe, 2004-present • Member, National Association of Research Fellows. <p>Activities</p> <ul style="list-style-type: none"> • Regular media appearances on child road safety related topics, including news, current affairs, science-focussed programs, and in educational materials (for which several NGOs and government departments are advised).
Prof Robyn Norton <ul style="list-style-type: none"> • Steering Group Member • HCC primary contact 	<p>Direct or indirect pecuniary interest</p> <ul style="list-style-type: none"> • Employment: University of Sydney; University of Oxford, The George Institute for Global Health (Principal Director) – As Principal Director, oversee and support teams of researchers in Australia, China, India and the UK who are continuously seeking funds from research bodies (including the NHMRC), governments, commercial entities and philanthropic sources. The George Institute owns an academic clinical trials management organisation that provides for-profit services to commercial organisations – the profits of which underwrite our not-for-profit research organisation. The George Institute is in the process of establishing a number of other social enterprises aimed at providing low-cost effective medicines, technologies and healthcare services for people in resource poor settings – these enterprises aim to provide both social financial dividends to potential investors. The George Institute has a modest endowment fund, with funds invested in a range of predominantly Australian companies.
Ms Meagan Lawson <ul style="list-style-type: none"> • Steering Group member • PCHC primary contact 	<ul style="list-style-type: none"> • Nil interests to declare.
Prof Melanie Wakefield <ul style="list-style-type: none"> • Steering Group member • PCHC secondary contact 	<p>Employment</p> <ul style="list-style-type: none"> • Since 2002 - Director, Centre for Behavioural Research in Cancer at Cancer Council Victoria. <p>Grants</p> <ul style="list-style-type: none"> • Chief Investigator or Associate Investigator on two NHMRC Project grants, three NHMRC Partnership grants, three National Institutes of Health (NIH)/National Cancer Institute (NCI) grants and one Australian National Preventive Health Agency (ANPHA) grant pertaining to tobacco control, skin cancer prevention, obesity prevention or alcohol harm prevention.
A/Prof Anna Barker <ul style="list-style-type: none"> • Author 	<p>Financial interests</p> <p>Has received the following grants for topics that relate to the Case for Action:</p> <ul style="list-style-type: none"> • NHMRC Career Development Fellowship (CIA) 2014-2017 - Addressing missed opportunities: Improving knowledge in the care and outcomes of older people • NHMRC Partnership Project (CIA) 2013-2015 - RESPOND - A patient-centered program to prevent secondary falls in older people presenting to the emergency department: a randomised controlled trial • NHMRC Project grant scheme (CIA) 2014-2017 - The ASPREE-fracture sub-study: Does daily low-dose aspirin reduce fracture risk in healthy older adults?
Prof Terrence Haines <ul style="list-style-type: none"> • Author 	<p>Financial interests</p> <ul style="list-style-type: none"> • Director of Hospital Falls Prevention Solutions Pty Ltd. This company provides training for hospital staff members as to how they can prevent falls using a patient education approach. This is not of direct relevance to the Case for Action (CFA) though as the CFA focuses on exercise for older adults rather than education for older adults • Has provided expert witness testimony for the prevention of falls in the hospital setting for Minter Ellison Law Firm. Again, this is not directly related to the case for action as the case for action focuses on the prevention of falls in the community.

Name and Role(s)	Interests declared
Prof Terrence Haines <i>...continued</i>	Non-financial interests <ul style="list-style-type: none"> • Has published research of relevance to CFA, and research that has been directly cited in the CFA • Member of the Australia New Zealand Falls Prevention Society management committee having served as President from 2012-2014.
Prof Stephen Lord <ul style="list-style-type: none"> • Author 	<ul style="list-style-type: none"> • Nil interests to declare.