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MODELLING THE IMPACT, COSTS AND BENEFITS OF FALLS PREVENTION MEASURES TO SUPPORT POLICY-MAKERS AND PROGRAM PLANNERS

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July, 2009

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REPORT DOCUMENTATION PAGE

Report No.	Date	ISBN	ISSN	Pages
286	May 2009	0 7326 2356 1	1835-4815 (on-line)	198

Title and sub-title:
Modelling the impact, costs and benefits of falls prevention measures to support policy-makers and program planners

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Sponsoring Organisation(s):
This project was funded through the Australian Government Department for Health and Ageing (Falls and Community Injury Grants Program), and the Australian National Health and Medical Research Council (Principal (CF) and Senior (LD)) Research Fellowships.

Abstract:
The ageing of the population is one of the major transformations being experienced in Australia, with falls a significant threat to safety, health and independence. There is now substantial evidence regarding effective interventions for preventing falls among older people living independently in the community. The aim of this project was to develop and apply a framework for epidemiological modelling of the population level impact of proven interventions on future fall rates, providing a powerful policy-setting tool for prevention. We used the Cochrane review to source current best efficacy evidence from randomised controlled trials which have provided evidence of minimising the incidence of falls among older people living in the community. Six interventions defined in that review as most promising for community dwelling older people were modelled. Additionally, one other intervention not in the Cochrane review, expedited cataract removal, was also modelled. Occupational therapy delivered home hazard assessment and modification for those with recent fall history, as modelled here, represents the best falls prevention investment. Cardiac pacing is a good falls prevention investment over the medium term, although is unlikely to have a major impact on population level hospital admission rates. The relative cost-effectiveness of psychotropic medication withdrawal appears high, although some implementation issues would need to be addressed and further costs included. Multi-disciplinary multi-factorial risk management represents good clinical practice for high risk individuals, but is not relatively cost-effective for widespread implementation. Tai chi programs may represent good value for falls prevention resources, if local circumstances allow the cost per participant to be substantially lower than modelled here. Predicted reductions in national fall-related hospital admission rates for people aged 65 years and over ranged from 0.4% to 4.6% for five of the six falls prevention strategies implemented over a one year period. These reductions, however, suggest that substantial investment in falls prevention will be required to have large effects on the fall-related hospitalisation rates. In addition, the cost-effectiveness of a number of the modelled interventions could be improved by variations to the implementation processes such as measures to increase uptake, or decrease the cost per participant. The framework developed provides the potential for the research evidence base to better guide policy and practice with respect to reducing falls and future fall-related hospitalisation rates.

Key Words:
Falls prevention, modelling, community dwelling, tai chi, psychotropic medication, home hazard assessment and modification, muscle strengthening, balance training, psychotropic medication, cardiac pacing, risk factor screening, policy, cost-effectiveness

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Preface

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Acknowledgements

We are grateful to the following researchers who generously provided data and advice in relation to the various falls interventions that were modelled in this project.

Dr Jacqueline Close, Prince of Wales Medical Research Institute, Australia
Dr Rowan Harwood, Nottingham University Hospitals, UK
Associate Professor Clare Robertson, University of Otago, NZ
Professor Glen Salkeld, University of Sydney, Australia
Professor Steve Wolf, Emory University, USA
Mr Alex Voukelatos, Injury Prevention Co-ordinator, Sydney South West Area Health Service, Australia

Dr Duncan Mortimer (Monash University) provided assistance with modelling concepts and software. A/Professor Colin Cryer (University of Otago) provided critical comment on the model concepts and some early drafts of sections in Chapter 2. Professor Keith Hill (Latrobe University), Professor Stephen Lord (Prince of Wales Medical Research Institute), A/Professor Lindy Clemson (University of Sydney), David Fitzgerald (University of Queensland), Lorraine Lovitt (NSW Health), Margaret Thomas (Victorian Department of Human Services) provided useful advice on a range of aspects. Rob Maris (Western Australian Department of Health) provided data from the Western Australia Hospital Morbidity Data System.

The National Injury Prevention Working Group participated in the policy officer consultations, assisting to ensure the work provided output that could directly inform policy decisions. Members include:

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EXECUTIVE SUMMARY

Introduction

There is now substantial evidence regarding effective interventions for preventing falls among older people living independently in the community. However, the potential for the research evidence base to translate into falls reductions has not yet been fully realised. The challenge now is to deliver the most effective interventions efficiently at a population level. The proven falls interventions differ in their type (or mix of types), effectiveness, specific sub-groups targeted, and in the level of resources required. The relative benefit of delivering these falls prevention interventions will vary according to the demographic structure of the population, and the differing cost-benefits likely under different health care systems. Other variables influencing the relative benefits include levels of compliance and intervention uptake. There is, therefore, considerable opportunity for modelling the impact of the different proven falls interventions on future fall rates, which together with cost-effectiveness analyses will provide a powerful tool for determining policy directions.

The aim of this project was to provide a powerful policy priority-setting tool for falls prevention by modelling the population level impact of proven fall prevention interventions on future rates of falls and fall related injury in Australia. The objectives were to:

(1) model, for the five-year period 2009-2013, the population level impact of proven falls prevention programs for community dwelling older people;
(2) incorporate intervention costs into the model, and calculate cost-effectiveness;
(3) design and test formats for conveying model findings to policy officers and practitioners.

Methods

We used the Cochrane review to source current best efficacy evidence from randomised controlled trials which have provided evidence of minimising the incidence of falls among older people living in the community. The six interventions defined in that review as most promising for community dwelling older people were:

- tai chi group exercise intervention for 15 weeks;
- muscle strengthening and balance retraining, individually prescribed at home by a trained health professional;
- home hazard assessment and modification that is professionally prescribed for older people with a history of falling;
- multidisciplinary, multifactorial, health and environmental risk factor screening and intervention;
- withdrawal of psychotropic medication; and
- cardiac pacing for fallers with cardioinhibitory carotid sinus hypersensitivity.

Since the date of the Cochrane review, results trials testing other interventions have been published. Some of this work found that expedited surgery for the first cataract removal substantially reduced falls. As this type of intervention is of particular interest to the health care sector, the project scope was expanded to include modelling for this seventh intervention, at the request of the Department of Health and Aged Care.

The general approach was to incorporate fall rates and falls reductions from the trials into an epidemiological model applied to the eligible Australian population, assuming the same inclusion and exclusion criteria as used in the trials. Where necessary, additional data required for the modelling, and not available in the trial publications were obtained from other published and unpublished sources. We estimated the number of people in Australia who would be eligible for the intervention in 2009, and estimated the number of falls and fall hospitalisations that would be prevented if the interventions were delivered and resulted in the same level of falls reduction as observed in the trial. We also estimated the percentage reduction in the fall-related hospital admission rate that could be expected. Some variations to this general approach were necessary, and are described in the relevant sections of this report. The initial plan was to model the interventions for the period 2009-2013. While most of the interventions might be expected to have some ongoing effect for various periods of time beyond the period of the research trial, there is very limited data regarding the size of the effect and the length of time, except for the home based muscle strengthening and balance retraining program. This intervention was tested over a two-year period, and consequently we produced both one- and two-year models based on the evidence available. In addition, cardiac pacemakers can be expected to function for at least 5 years, and therefore we estimated benefits over a five-year period for this intervention. Further, there are considerable limitations with the projection of the fall-related hospital admissions rate even to 2009, and therefore extending the time period for the projections would be of marginal benefit.

The primary outcome measure from the model was the unit cost per fall prevented. Additional outcomes of interest included the cost per hospitalisation prevented, and the impact on the number of falls and the fall-related hospitalisation rate.

An iterative action research approach was used to consult with, and seek input from, the key stakeholders in falls prevention policy development and implementation in Australia's states and territories.

Results

A comparison in tabular format of six of the interventions modelled is provided. The expedited cataract surgery intervention was not included in this table due to the uncertainties inherent in estimating the eligible population and in estimating the potential benefit of this intervention for shorter reductions in the waiting time than that tested in the trial. The table compares the base case model outputs i.e., those derived using the best available point estimates for the model input parameters. The time period is 12 months for all interventions, plus two and five year estimates for the muscle strengthening and balance re-training exercise program and cardiac pacing interventions, respectively.

Apart from injury, falls among older people result in a multitude of adverse effects including loss of confidence and mobility, a general reduction in activity and independence, subsequent decline in health, decreased quality of life, and may be a precursor to institutional care. The cost per hospital admission averted by the interventions modelled may appear to be relatively large compared with the average cost of a fall-related hospitalisation for an older person. However, if all health related economic savings due to falls reduction are considered, it may be apparent that the current falls prevention interventions are an attractive investment. Furthermore, the falls interventions modelled here are likely to have other health benefits, all of which need to be taken into consideration when estimating the overall benefit and savings that are likely to arise from these interventions. Our model was not intended to include all health related economic savings, but rather to indicate the falls prevention benefits of the selected interventions.
The policy sector consultations resulted in an agreed format in which to provide national, state and territory modelling results. These can be found in Appendices Two and Three.

Summary comparisons of falls interventions: note-impact on hospital admission rates should be interpreted with caution due to data limitations

	Tai chi	**Muscle-strengthening and balance re-training**		**OT home hazard assess and modification**	**Multi-dis. Multi-factor. Risk screening**	**Psychotropic medication withdrawal**	**Cardiac pacing**	
Target group	70+ years, community dwelling, mobile	80+ years, community dwelling, mobile		65+ years, hospital inpatient not receiving OT visit as routine care, fall in previous 12 mths	65+ years, presenting to hospital ED for fall	65+ years, community dwelling, taking psychotropic medication	50+ years, presenting to hospital ED for fall, cardioinhibitory carotid sinus hypersensitivity	
		Year 1	Over 2 years				Year 1	Over 5 years
Uptake (% eligible population)	1.9	39.4		55.4	55.4	18.9	80.0	
Population uptake (n)	31,998	208,386		141,493	39,717	97,406	567	567
Falls reduction (%)	48.9	27.7	27.7	44.2	57.2	65.9	55.9	55.9
Cost per participant ($)	470	1,091	1,310	413	1,244	604 [c]	13,526	13,526
Falls prevented (n)	13,926	54,222	87,297	140,078	59,706	117,208	2,947	14,735
Hospital admissions averted (n)	279	3,521	5,669	2,802	1,194	2344	59	295
Reduction in fall-related hospital admission rate for 65+ years (%)	0.4	4.6[a]	2.7[b]	3.7	1.6	3.1	0.08	Not calculated
Reduction in fall-related hospital admission rate for community dwelling 65+ years (%)	0.5	5.9 [a]	3.5 [b]	4.7	2.0	3.9	0.1	Not calculated
Total cost ($M)	15.03	227.25	255.09	58.37	49.41	58.82[c]	7.67	7.67
Cost/fall prevented ($)	1079	4,191	2,922	417	828	502 [c]	2,601	520
Cost/hospital admission averted ($)	53,974	64,542	44,997	20,834	41,374	25,092 [c]	130,058	25,986

[a] reductions for 80+ yrs and community dwelling 80+ yrs were 7.1% and 10.0% respectively
[b] for second year only, not years 1 and 2 combined
[c] additional implementation costs likely

Implications for falls prevention policy

- Occupational therapy delivered home hazard assessment and modification for older people with a recent fall history, as modelled here, represents the best falls prevention investments among those interventions examined in this study.
- Cardiac pacing for those with cardio-inhibitory carotid sinus hypersensitivity is a good falls prevention investment over the medium term, although unlikely on its own to have a major impact on population level falls-related hospital admission rates.
- The relative cost-effectiveness of the psychotropic medication withdrawal intervention in this model is high, although some issues with implementation would need to be addressed, and further implementation costs included, prior to any major initiative.
- The multi-disciplinary multi-factorial risk management intervention represents good clinical practice for those individuals with a falls history, but was not relatively cost-effective for widespread implementation.
- Tai chi programs may represent good value for falls prevention resources, if local circumstances allow the cost per participant to be reduced substantially compared with the model in this study.
- There appears to be limited potential to impact on falls rates in Australia by expediting cataract surgery, given the current waiting periods. This finding may need confirmation.
- The preliminary results of this work relating to the potential reductions in the fall-related hospitalisation rates associated with these interventions suggest that substantial investment in falls prevention will be required to have large effects on the fall-related hospitalisation rates.
- The total health benefits from the falls interventions modelled in this study have not been included in our models, and this should be considered when using this study to make decisions regarding investment in falls prevention programs.

Recommendations and future directions

- The cost-effectiveness of a number of the modelled interventions could be improved by variations to the implementation processes such as measures to increase uptake, or decrease the cost per participant. These would need to be developed and tested.
- Person linked data would facilitate more accurate estimations of the impact of these interventions on the falls-related hospitalisation rates. The need for person linked hospital data in Australia is apparent and should be given high priority, not just for the purposes of this study, but for all epidemiological and health service research.
- There may be some merit in undertaking more focussed work on modelling the effect on fall-related hospitalisation rates in those states, such as New South Wales and Western Australia, where person linked data are already available.
- Some of the modelling work was limited by the type of data available in the publications of the randomised controlled trials. The definition of a set of data required for epidemiological modelling of falls interventions, including information about the level of intervention uptake, compliance and maintenance, should be developed. Journal editors should be encouraged to require that these datasets be posted on the journal website when falls trials are published.
- The benefits of other health outcomes arising from falls prevention measures should be included in cost benefit analyses of falls programs. Some of the required evidence may already be available for some of the interventions included in this study eg., tai chi.
- Australia will continue to benefit by close collaboration between falls researchers, policy officers and program managers. Opportunities for formal and informal networking should be encouraged.

1 INTRODUCTION

1.1 BACKGROUND

There is now substantial evidence regarding effective interventions for preventing falls among older people living independently in the community. A recent Cochrane review concluded that programs in the community that are likely to be beneficial include: group based Tai Chi, professional prescribed home hazard assessment and modification (especially for those with a history of falling), individually prescribed program of muscle strengthening and balance retraining, withdrawal of psychotropic medication, multidisciplinary/multi factorial health/environmental risk factor screening/intervention programs, and cardiac pacing for fallers with cardio-inhibitory carotid sinus hypersensitivity (Gillespie et al., 2006). Further, the evidence base for effective falls prevention is growing rapidly. The most current edition of the Cochrane review (updated Feb 2005) refers to an additional 14 trials awaiting assessment, and results from additional trials have been recently published.

Commitment to falls prevention in Australia is shown by recent investment in policy development, practice networks and infrastructure both nationally and at the state and territory level. However, the potential for the research evidence base to translate into falls reductions has not yet been fully realised. The challenge now is to deliver the most effective interventions efficiently at a population level. The proven falls interventions noted above differ in their type (or mix of types), effectiveness, specific sub-groups targeted, and in the level of resources required. The relative benefit of delivering these falls prevention interventions will vary according to the demographic structure of the population, and the differing cost-benefits likely under different health care systems. Other variables influencing the relative benefits include levels of compliance and intervention uptake. There is, therefore, considerable opportunity for intervene the impact of the different proven falls interventions on future fall rates, which together with cost-effectiveness analyses, will provide a powerful tool for determining policy directions. Investment decisions regarding falls prevention for older people need to be guided by more than just the evidence from randomised controlled trials (RCTs). Efficient use of resources requires, among other things, careful consideration of the population group to target (e.g. their age, whether they are living independently in the community or in residential care, whether they have a history of falling or have multiple risk factors etc.), the best means of promoting interventions (e.g. using GP/health professional referrals, written invitations or community awareness raising), and consideration of the relative value of different falls prevention strategies.

The limitations of direct use of RCT evidence for policy making are well recognized (Brennan and Akehurst, 2000; Liew et al., 2002). These have been addressed in public health to some extent by epidemiological and health economic intervene, which involves the use of mathematical applications to integrate data from RCTs with those from observational epidemiology, demography, and economics to estimate potential future benefits and costs (Liew et al., 2002). Modelling approaches enable extrapolation of possible health and injury outcomes to the longer term and to a wider population base, generalising between locations and population sub-groups, varying key parameters, and systematic sensitivity analysis. In doing so, they facilitate more uniform understanding among decision makers about the outcomes to expect from different interventions, and the ultimate translation of trials into policy and practice (Brennan and Akehurst, 2000). Cost-effectiveness of a limited number of specific falls interventions has been studied, but has not been particularly useful in the context of epidemiological intervene for the Australian population and health systems to date.

Despite the potential for supporting the current commitment to falls prevention policy implementation, population level epidemiological intervene has not yet been applied to falls prevention in Australia.

1.2 AIM AND OBJECTIVES

The aim of this project was to provide a powerful policy priority-setting tool for falls prevention by modelling the population level impact of proven fall prevention interventions on future rates of falls and fall related injury in Australia. The objectives were to:

1. model, for the five-year period 2009-2013, the population level impact of proven falls prevention programs for community dwelling older people;
2. incorporate intervention costs into the model, and calculate cost-effectiveness;
3. design and test formats for conveying model findings to policy officers and practitioners.

The first objective was modified (as noted in Progress Report Number 3), for a number of reasons, to modelling for 2009 only, for all except one intervention. While most of the interventions might be expected to have some ongoing effects for various periods of time beyond the period of the research trial, there is very limited data regarding the size of such effects and the length of time for which these would be sustained, except for the home based muscle strengthening and balance retraining program. This intervention was tested over a two-year period, and consequently we produced both one- and two-year models based on the evidence available. Further, there are considerable limitations with the projection of the fall-related hospital admissions rate even to 2009, and therefore extending the time period for the projections would be of marginal benefit.

All objectives have been achieved. The six interventions initially targeted, plus an additional intervention included at the subsequent request of the Department of Health and Ageing, were modelled for Australia (at the national, and state and territory level) for 2009. Intervention costs for the six interventions were incorporated and the cost-effectiveness calculated. Costs for the additional intervention, expedited cataract surgery, could not be readily calculated.

At this stage, we have been unable to provide the impact on hospital admission rates for Queensland and the Australian Capital Territory, as approval for release of the hospital data has not been obtained from the relevant authorities. However, we have modelled the number of falls and fall hospital admissions likely to be prevented in these two jurisdictions.

A format for conveying model findings to policy officers was designed and tested during three phases of consultation.

1.3 REPORT OUTLINE

Following this introductory chapter, is a general methodological chapter (Chapter 2) which outlines the approach taken for the epidemiological modelling and describes techniques and data sources common to the modelling for all interventions. Chapter 3 presents the detailed national results for each of the interventions modelled. Deviations from the general methods, or additional data sources, are also noted as necessary. A summary comparison of all interventions is included. The model outputs for each state and territory arranged by intervention has been included in Appendix 2. These summaries also include analysis of specific implementation issues associated with each intervention. A summary table for each state and territory can be found in Appendix 3. Chapter 4 outlines the methods and results of the consultative process used to design and test formats for conveying model findings to policy officers. Chapter 5 provides an overall discussion of this work.

2 METHODOLOGICAL OVERVIEW FOR MODELLING

2.1 GENERAL APPROACH

We used the Cochrane review (Gillespie et al., 2006) to source current best efficacy evidence from randomised controlled trials (RCTs) which have provided evidence of minimising the incidence of falls among older people living in the community. The six interventions defined in that review as most promising for community dwelling older people were:

- Tai Chi group exercise intervention for 15 weeks
- muscle strengthening and balance retraining, individually prescribed at home by a trained health professional
- home hazard assessment and modification that is professionally prescribed for older people with a history of falling
- multidisciplinary, multifactorial, health and environmental risk factor screening and intervention
- withdrawal of psychotropic medication
- cardiac pacing for fallers with cardioinhibitory carotid sinus hypersensitivity.

Since the date of the Cochrane review, results from a number of RCTs testing other interventions have been published. Some of this work has focused on expedited cataract surgery, finding that expedited surgery for the first cataract removal substantially reduced falls (Harwood et al., 2005). As this type of intervention is of particular interest to the health care sector, the project scope was expanded to include modelling for this seventh intervention, at the request of the Department of Health and Aged Care.

The general approach was to incorporate fall rates and falls reductions from the trials into an epidemiological model applied to the eligible Australian population, assuming the same inclusion and exclusion criteria as used in the trials. Where necessary, additional data required for the modelling, and not available in the trial publications were obtained from other published and unpublished sources. Some variations to this general approach were necessary, and are described in the relevant sections of this report. The initial plan was to model the interventions for the period 2009-2013. While most of the interventions might be expected to have some ongoing effect for various periods of time beyond the period of the research trial, there is very limited data regarding the size of the effect and the length of time, except for the home based muscle strengthening and balance retraining program. This intervention was tested over a two-year period, and consequently we produced both one- and two-year models based on the evidence available. In addition, cardiac pacemakers can be expected to function for at least 5 years (www.betterhealth.vic.gov.au) and therefore we estimated benefits over a five-year period for this intervention. Further, there are considerable limitations with the projection of the fall-related hospital admissions rate even to 2009, and therefore extending the time period for the projections would be of marginal benefit.

The primary outcome measure from the model was the unit cost per fall prevented. Additional outcomes of interest included the cost per hospitalisation prevented, and the impact on the number of falls and the fall-related hospitalisation rate.

2.2 DESCRIPTION OF THE MODEL

To measure the potential effectiveness of each intervention in the Australian population in terms of the number of falls prevented we required a model that would enable us to estimate the number of falls both with and without the intervention. This led to the development of the model shown in Figure 1. The model begins with an estimate of the number of eligible people in 2009, and compares two pathways – one in which there is a co-ordinated funded effort to offer the intervention to all members of this population, and one in which there is no such effort. The intervention-offered-arm of the model, splits into those people who take it up and those who do not. Both these groups are further categorised into those who fall and those who do not. In general, the falls rate applicable to those who are not offered the intervention, and those who are offered the intervention but do not take it up, is estimated to be that observed for the control group in the relevant trial. The falls rate applicable to those who do take up the intervention is taken to be the falls rate observed for the intervention group in the trial. The model was extended to calculate the number of hospitalisations prevented as a result of the intervention.

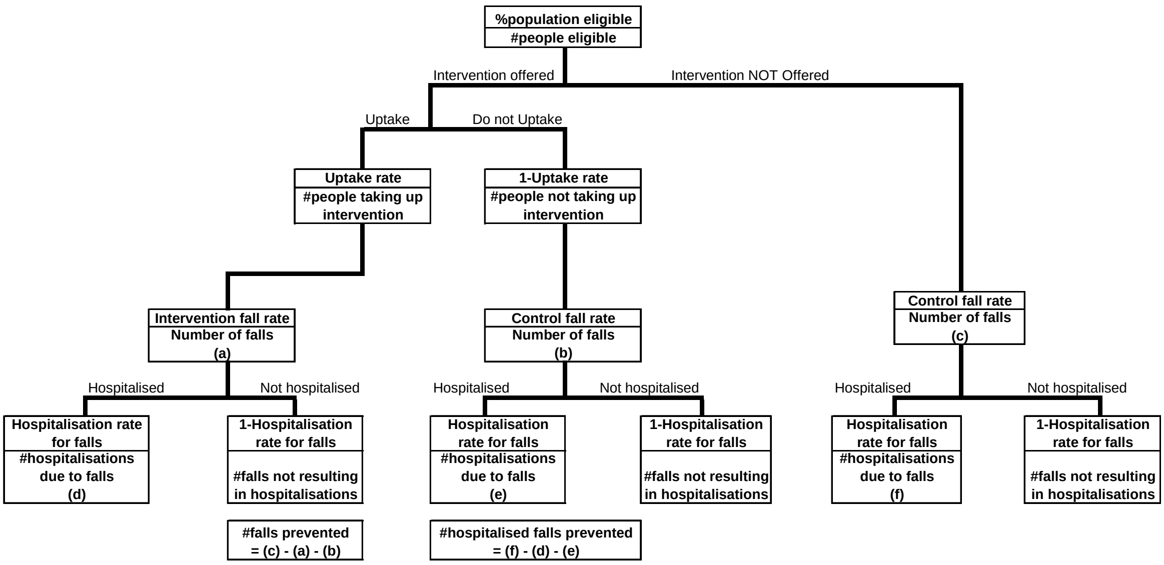

Figure 1
Structure of the epidemiological model for estimating the population-level effectiveness of an intervention

2.3 DATA SOURCES

2.3.1 Population data and factors used to select eligible population

We took the conservative position of only generalising the trial results to those sub-groups in the population of older people that have similar characteristics to the trial participants. The older population for 2009 was enumerated using Australian Bureau of Statistics (ABS) population projections. National disability and health surveys, as well as state population health surveys and other published and unpublished data were then used to determine the eligible population for each intervention (i.e. in terms of the proportion of older people with characteristics similar to those participating in the trial). A summary of two surveys used for a number of the interventions is described below.

Survey of Disability, Ageing and Carers

The Survey of Disability, Ageing and Carers (SDAC) produces detailed disability data and national prevalence estimates, and seeks information on the actual nature and causes of the disabilities and restrictions with which it is concerned (Australian Bureau of Statistics, 2003). The SDAC also records conditions that are more likely to be associated with impairments and activity limitations.

Information in the 2003 SDAC was collected between June to November 2003 from approximately 14,000 private dwellings (houses and flats) and 300 non private dwellings (hotels and motels), while the cared accommodation sample included approximately 550 establishments. The final sample for the household component comprised 36,241 people and 5,145 for the cared-accommodation component. Information was collected via (1) an interviewer-based computer-assisted collection for all usual members of selected households, and (2) mail-back forms completed by a staff member for residents of cared accommodation facilities.

Unpublished data extracted from this survey was provided to us via request by the ABS for use in our study. This included data stratified by state, residential status and disability status for three different age groups. Disability status was further stratified by the level of limitation in a core activity. These data were used in models for the three interventions which targeted community dwelling older people who are independently mobile in their own homes. The SDAC levels of core activity limitation (Box 1) provided a means of estimating the numbers of people who would meet this criterion, by excluding those with a profound level of core-activity limitation.

The publication notes that the sample in the Northern Territory was too small to support reliable estimates for this territory and as a result was not published (Australian Bureau of Statistics, 2003). We have therefore estimated the proportion of community dwelling older people who were profoundly limited in their core activities using the proportional average from the other states. Since estimates for the ACT also could not be provided, we also used this same average to obtain an estimate for the ACT.

Box 1 ABS Survey of Disability, Ageing and Carers: core activity limitation

Four levels of core-activity limitation are determined based on whether a person needs help, has difficulty, or uses aids or equipment with any of the core activities (communication, mobility or self care). A person's overall level of core-activity limitation is determined by their highest level of limitation in these activities.

The four levels of limitation are:
Profound: the person is unable to do, or always needs help with, a core-activity task

Severe: the person
- Sometimes needs help with a core-activity task
- Has difficulty understanding or being understood by family or friends
- Can communicate more easily using sign language or other non-spoken forms or communication.
-

Moderate: the person needs no help but has difficulty with a core-activity task

Mild: the person needs help and has no difficulty with any of the core activity tasks, but
- Uses aids and equipment
- Cannot easily walk 200 metres
- Cannot walk up and down stairs without a handrail
- Cannot easily bend to pick up and object from the floor
- Cannot use public transport
- Can use public transport but needs help or supervision
- Needs no help or supervision but has difficulty using the public transport

Source: ABS 2004:72.

National Health Survey

The national health survey (NHS) is a population based survey conducted by the ABS every three years (Australian Bureau of Statistics, 2006). It is designed to obtain national benchmark information on a range of health related issues and to enable the monitoring of health trends over time. It is a self-report survey conducted in private households throughout Australia.

The information collected in the survey includes the health status of Australians, their use of health services and facilities and health-related aspects of their lifestyle. Information about long term medical conditions experienced by respondents, recent injury events, consultations with health professionals, other actions people had recently taken in regard to their health (e.g. taken days away from work, used medication) is also collected.

Approximately 25,900 people from all states and territories and across all age groups were surveyed between August 2004 and June 2005 for the most recent publication (Australian Bureau of Statistics, 2006). One adult (aged 18 years and over) and one child (where applicable) from each sampled dwelling were included in the survey. This was the source for the estimate on the proportion of community dwelling older people taking psychotropic medication. Furthermore, we obtained approval to use the 2004-05 NHS Confidential Unit Record Files (CURFs) to obtain the proportion of older people who had been admitted to a hospital in a 12-month period. CURF is a file of responses to an ABS survey that has had identifying information about a person or organisation removed.

2.3.2 Intervention uptake and compliance

The uptake rate was defined as the proportion of older people who are likely to respond to an invitation to participate in the intervention. We modelled the same recruitment processes as used in the trials, and based the uptake rate, and its range, on data provided in the trial publications, complemented with other data sources where necessary.

Compliance (i.e., the degree to which participants adhered to the particular intervention), where it applied, was assumed to be equal to that achieved for each trial. Sensitivity analysis was not undertaken on this variable, as there is insufficient published information on the relationship between different compliance levels for the various interventions and falls rates.

In the instance of exercise interventions for example, there may be a dose response relationship between the number of exercise sessions attended (compliance) and the size of the falls reduction. Similarly, for home hazard modification, there may be a dose response relationship for the number, or type, of hazard modifications.

2.3.3 Fall rates and confidence intervals

Fall rates per person year for control and intervention groups were extracted, or calculated from, the trial publications. In some instances, the denominator for these rates was based on average person time, as total person time was not reported in some publications.

Confidence intervals for the falls rates were calculated where these were not published. This required the falls frequency distributions for both the control and intervention groups, which were requested directly from the trial investigators and which were provided in most instances. For some of the interventions, however, the fall frequency distributions were not available, and for these models the most appropriate distribution available was used. The confidence intervals were then estimated by modelling the falls frequency data by a negative binomial distribution.

The negative binomial distribution, which consists of three parameters (the mean, variance and dispersion), has become increasingly popular for modelling count data with over dispersion. Over dispersion occurs when the variance exceeds the mean by a large amount, as is the case for falls data (Bliss and Fisher, 2003; Byers et al., 2003; White and Bennetts, 1996). Calculation of the mean and variance of the falls frequency distributions permitted the estimation of the dispersion parameters. Using these estimated dispersion parameters, the falls rates, and the sample size, we generated 1000 simulations of falls frequency distributions for both the control and intervention groups. These simulations, conducted with the statistical software R (R Development Core Team, 2004) were used to estimate standard errors of the falls rates. A maximum likelihood method was used to fit the falls data by applying a generalised linear model from an underlying negative binomial family (Venables and Ripley 2002). The estimated standard errors were subsequently used to construct the 95% confidence intervals.

2.3.4 Proportion of falls resulting in hospitalisations

Few published prospective falls studies have reported the proportion of all falls among community dwelling older people that result in hospitalisation. This estimate for our model was obtained from two Australian prospective studies (Tiedemann et al, 2008; Day et al., 2002) The participant groups were both relatively healthy community dwelling older people who were not cognitively impaired and who were English speaking – one group comprised 578 people 75+ years selected randomly from a health insurance database; the second group comprised 1090 people 65+ years who were recruited from the electoral roll. Both studies monitored participants over a 12 month period and captured falls using monthly calendars. When falls occurred, these were followed up with telephone contact and the outcomes recorded. The falls data from these two studies were pooled, and the hospitalisation rate and 95% confidence intervals calculated.

2.3.5 Costs of intervention implementation

As the purpose of modelling the seven interventions is to facilitate effective allocation of falls prevention resources, cost-effectiveness was defined as the intervention cost (inclusive of public and private costs) per fall prevented. The items, and quantities of each, required to deliver each intervention (egg., exercise leader or health professional time, equipment) were systematically identified from the trial publications (excluding costs for the research components), and consultation with policy officers. The cost of delivery was estimated by using current hourly salary rates for the relevant professional groups. Non-salary components were costed by reference to schedules and published reports of tabulated cost data where these were relevant. Published economic evaluations undertaken in Australia and New Zealand were available for two of the interventions (home based exercise and home hazard modifications) and were used to inform the cost estimates for modelling of these interventions. All dollar amounts are given in Australian dollars at 2008 values.

2.4 MODEL SCENARIOS

Parameters for a base case scenario were identified using the available data sources. The base case scenario uses the best available point estimates for each input parameter (uptake, fall rates, proportion admitted to hospital) to model the impact on falls and falls hospital admissions. The base case provides the best estimate of the likely impact, and is also the reference point against which the effect of variation in the input parameter values can be judged. One-way sensitivity analyses were undertaken, varying the value of one input parameter at a time, using the lower and upper bounds of the ranges for each input parameter. The more or less effective intervention scenarios were run through the model with the intervention fall rates set at the upper and lower bounds of the confidence intervals, and the control fall rate set at the base case scenario point estimate. National and state and territory specific modelling was undertaken.

2.5 ASSUMPTIONS

The following assumptions were made in establishing the model:

- The reduction in falls risk from the trials is generalisable to sections of the Australian population with comparable characteristics to those who participated in the trials
- Uptake of the intervention within the eligible population would be the same as that observed in the trials
- Compliance with the intervention delivered to the population will be the same as that achieved in the trials, resulting in the same level of falls reduction
- The interventions do not affect the probability of admission to hospital should a fall occur.

- Any control group activities provided in the trials had no impact on falls outcome
- The interventions did not reduce serious falls injury to a greater extent than the reduction in falls
- The frequency (and rate) of falls in people who are offered an intervention, but do not adopt it, is the same as that amongst people who are not offered the intervention (control group)
- The rate of falls hospital admissions in Australia (and the states and territories) will not change significantly from the average rate for the four year period 2002/03 – 2005/06
- The proportion of falls among older people that require admission to hospital will be the same in 2009, as was observed in the time period from which this estimate was calculated (1997-1999 for one study, and 2004 for the other study).

2.6 PREDICTING THE IMPACT OF THE MODELLED INTERVENTIONS ON FALL-RELATED HOSPITALISATION RATES

There is an expectation of reduced fall-related hospitalisation rates resulting from investment in falls prevention programs in Australia. The modelling of proven falls interventions provided an estimate of the numbers of falls and fall-related hospitalisations that would be expected to be prevented in 2009 if these interventions were delivered. We used the model outputs, and national hospital records, to provide an indication of the percentage reduction in the fall-related hospitalisation rate that could be expected. This reduction was calculated for two specific rates: fall-related hospitalisation rates for people 65+ years (directly attributable to injurious falls), and fall-related hospitalisations among community dwelling older people 65+ years. Reductions in these two rates are often used as targets in falls prevention policies.

National Hospital Morbidity Database hospital separation unit records containing codes from the ICD-10-AM Chapter XIX (injury and poisoning) and/or Chapter XX (external causes) were obtained from the Australian Institute of Health and Welfare.

Records involving people aged 65 years and older were selected for analysis if they had:

1. a date of separation from hospital in the range 1st July 1999 to 30th June 2006;
2. a principal diagnosis of S00–T75, T79, R29.81 or Z04.3; and,
3. a first-occurring external cause code in the range W00–W19.

A single case of a person requiring hospital inpatient care due to one or more falls can result in more than one episode in hospital. This occurs when a person is transferred between hospitals (e.g. from a local hospital to which first admission occurred to another hospital with necessary specialist capabilities), and when a person is readmitted for further treatment of the same condition.

For most purposes of this study, we want to count each new instance of a person being hospitalised due to falls exactly once. The available data file (NHMD) has observation units of ‘separations’ not persons or cases. A separation is the event that occurs at the end of an episode of care in hospital, and is either discharge home (or to another place of residence), transfer to another hospital, death or ‘statistical’ discharge. The latter refers to circumstances in which the person remains in hospital, but on a different basis (e.g. change from acute care to rehabilitation). The NHMD is not organised to facilitate analysis in terms of persons or cases, and current permissions do not normally allow attempts to do so. However, techniques are available that can reduce the extent of overestimation of cases due to multiple counting. In this project, we omitted admissions recorded as being from other acute care hospitals, on the basis that the cases that these separation records represent are likely to have been included on the basis of their first episode of inpatient care.

The criteria listed above were thought to capture all episodes of hospital care directly attributable to injurious falls for people aged 65 years and older in the study period. Some hospital separations that contained both a relevant diagnosis code and unintentional falls external cause code within the record were not included in this analysis. The principal diagnosis (i.e. the main reason for the hospital episode) for these cases was generally not an injury and the relationship between the recorded fall and the principal condition is not fully understood (Bradley and Harrison 2007).

Further, a proportion of cases with a principal diagnosis of R29.81 were not included in this analysis. These cases lacked both any injury code (S00–T98) and any external cause code and as such were not available to the National Injury Surveillance Unit at the time of analysis. The R29.81 cases included in the current analysis are most likely represent the minority of all separations with R29.81 as the principal diagnosis.

It is important to note that each record in the National Hospital Morbidity Database relates to an episode of care. There may be more than one episode of care for each fall requiring hospital admission. Estimated case numbers attributable to hospitalised falls were calculated as described in Bradley and Harrison (2007). Rates of hospitalised falls cases per 100,000 were standardised (using the direct method) to the estimated resident population of Australia as at 30th June 2001.

A second set of analyses sought to quantify the number of hospitalised falls sustained by community-dwelling older people. Here, hospital separation unit records fulfilling the above criteria were excluded from the analysis if the first-reported place of occurrence code indicated the fall had been sustained in an aged care facility (Y92.14). As this place of occurrence code has only been available from the third edition of the ICD-10-AM onwards, which was applied to cases separating from hospital on and after 1st July 2002, analyses were restricted to records separating from hospital from 1st July 2002 onwards. Denominator data for the calculation of rates for community-dwelling older people were determined by first estimating the 31st December population resident in aged care facilities (the average of successive 30th June residential aged care census data, obtained from AIHW (2003) and later reports in the series) and then subtracting this estimate from the total Australian population aged 65 years and older as at 31st December in each year. See Bradley and Harrison (2007) for further detail regarding this method.

The fall related hospital separations data were used to determine the expected counts and rates for 2009 in the absence of additional prevention effort. Age specific rates for the four year period 2002–03 to 2005–06 were applied to the matching age groups in 2009 population to obtain 2009 expected counts for each age-sex group, and total expected counts for ages 65 years and older. The number of falls hospitalisations prevented by each intervention was subtracted from the total expected counts, and the resulting percentage reduction in falls hospitalization rates was calculated. The same method was used to estimate the percentage reduction in falls hospitalization rates in 2010, the second year of the home-based exercise programs for people aged 80 years and older intervention.

Two sets of estimates were produced. The first used 2002–06 average rates of all hospitalized falls cases (i.e. including falls in aged care facilities). The second used 2002–

06 average rates excluding falls reported to have occurred in aged care facilities. The community-dwelling older persons population in 2009 and 2010 (the denominators for rates in the second set of estimates) was estimated by applying the average proportion of the 2002–06 population aged 65 years and older thought to be resident in the community to the projected estimates of the equivalent population in 2009 and 2010.

Estimation proceeded differently for one intervention; home-based exercise programs for persons aged 80 years and older. Since this is inherently age-specific, it was necessary to estimate the percentage reduction in rates of falls hospitalisation separately for persons aged 80 and older, since exposure to the intervention would be restricted to this group. Otherwise, any age-specificity of the application and/or efficiency of the interventions have not been accounted for in these analyses.

3 INTERVENTION MODELLING FOR AUSTRALIA

3.1 TAI CHI

3.1.1 Intervention

We used the Cochrane review (Gillespie et al., 2006) to source current best efficacy evidence from randomised controlled trials (RCTs) which have provided evidence of minimising the incidence of falls among older people living in the community. One tai chi-based trial among community dwelling older people, conducted by Wolf et al. (1996) was included in the review. The trial tested a 15-week tai chi program consisting of ten forms providing a gradual reduction in the base of standing support until single leg stance was achieved, and including increased body and trunk rotation and reciprocal arm movements. Classes of 45 minutes duration for 12 participants per group were held twice each week in a community setting, and twice daily practice was encouraged (intervention n = 72). The control group participated in weekly discussion groups focusing on a number of health related issues (n = 64). Participants were required to be 70+ years, live in unsupervised environments and be ambulatory. Exclusion criteria included the presence of debilitating conditions or profound visual deficits. Falls occurrence was monitored prospectively from the time of randomisation to the final follow-up, 4 months post-intervention. Two different falls definitions were used: The Frailty and Injuries: Cooperative Studies of Intervention Techniques (FICSIT) definition, and the Atlanta FICSIT site specific study definition. The FICSIT definition of a fall as "unintentionally coming to rest on the ground, floor or other lower level" (Wolf et al., 1996) is a recognised standard definition of a fall (Lamb et al., 2005). The Atlanta FICSIT study definition was narrower in scope, and excluded minor events such as stumbles, and was based on information about medical problems related to the severity and intensity of a fall (Wolf et al., 1996). The falls outcome variable was time to first fall, and the results were reported as adjusted risk ratios following Cox proportional hazards modelling (FICSIT definition 0.511, 95% CI 0.361-0.725, p=0.017; Atlanta site definition 0.525, 95% CI 0.321-0.860, p=0.010).

3.1.2 Data sources

<u>Population data and factors used to select eligible population</u>
Data used to estimate the eligible population were obtained from the Australian Bureau of Statistics (ABS). An estimate of the proportion of those aged 70+ years who would be eligible was obtained from the most recent Disability, Ageing and Carers Survey (ABS, 2003). This population-based survey provided estimates of the proportion of community dwelling older people stratified according to their level of restriction in core activities. By excluding those who were profoundly limited in their core activities, the proportion that would meet the eligibility criteria of the Wolf et al study (1996) was identified (see Section 2.3.1). This proportion was applied to the 2009 projected population data from the ABS which provided an estimate of 1,684,091 Australians eligible for participation in the tai chi program in 2009.

<u>Intervention uptake</u>
In the Wolf et al. trial (1996), the invitation to participate was delivered via local advertising and direct contact with residents of an independent living facility. The uptake rate was not reported in the published paper, nor was this information readily available in other published tai chi trials. However, unpublished data from a recently completed Australian tai chi trial among older people, using a similar recruitment method, indicated

that on average 1.9% of the eligible population in a region responded to an advertisement in the local paper (A. Voukelatos, unpublished data, 2007). Therefore, we used 1.9% as the uptake level in the base case model for recruitment via newspaper advertising, and calculated the associated 95% confidence intervals which were used for the range (Table 1).

Table 1 Estimated base case parameters for the tai chi model

Parameter	Base case value	Range	Sources for value and range
Uptake – recruitment via newspaper advertising (%)	1.9	0.95 – 2.85	A. Voukelatos, unpublished data, Australian tai chi trial among community dwelling older people
Average falls rate per person year (no intervention)	0.89	0.72 – 1.09	Based on data from Australian studies (Hill et al., 1999; Lord et al., 2005)
Average falls rate per person year (intervention)	0.45	0.38 – 0.55	Derived by applying falls reduction obtained in Wolf et al (1996), to the average falls rate per person year (no intervention- as above)
Hospitalised falls (% of falls)	2.0	1.4 – 2.6	Tiedemann et al (2008), and Day, unpublished data, prospective falls data from Australian trials involving community dwelling older people

Fall rates

The control group fall rate from the Wolf et al trial (2.68 per person year) was somewhat higher than that reported for similar samples of Australian community dwelling older people (0.87-0.92 falls per person year) (Hill et al., 1999; Lord et al., 2005). We therefore deviated from the general methods protocol and calculated the baseline falls rates (i.e., the rate in the absence of the tai chi intervention) by pooling results from these prospective Australian studies of older people with similar inclusion and exclusion criteria to the trial. The Australian studies collected falls data prospectively using similar methods to Wolf et al. (1996) and adopted the standard falls definition (FICSIT definition). The pooled average from these studies was 0.89 falls per person per year. We applied the 48.9% reduction observed using the FICSIT falls definition from the Wolf et al trial to this falls rate, to obtain the expected falls rate among those people who take up the tai chi intervention. Consequently, intervention and control falls rates of 0.45 and 0.89 falls per person per year, respectively, were used in our model.

Confidence intervals for fall rates

To calculate the confidence intervals for the above falls rates we required Australian falls frequency distributions for both the control and intervention groups. The only Australian study which had trialled tai chi as a falls intervention and had published the falls frequency distribution was Voukelatos et al. (2007). Hence, these published falls frequency distributions for the control and intervention groups were used to calculate the 95% confidence intervals as described in Chapter 2.

Costs of tai chi implementation

The predominant cost associated with running tai chi classes is that for the instructor's time, the estimate for which was based on the range paid by Arthritis Victoria, a major provider of tai chi programs ($80-$150 per class; mid range $115). Venue hire cost estimates were obtained directly from a convenience sample of exercise program leaders and co-ordinators across Australia. The costs ranged from $10-$40 per hour, and the average was used. Music licence fee costs were obtained from the web sites of the two relevant organisations (Australasian Performing Rights Association, Phonographic Performance Company of Australia). It was assumed that exercise class leaders and hired venues would carry their own professional indemnity and public liability insurance respectively, and therefore that these costs would be included in the leader and venue rates. Quotes for small advertisements in local newspapers in capital cities and major regional centres were obtained directly from these businesses. We estimated that two advertisements would be required per class group. An allowance was made for 16 hours per class group for co-ordination (arranging venue, leader, and advertising, registering people for the class, follow up of those missing classes).

3.1.3 Assumptions

The following specific assumptions, in addition to those outlined in Chapter 2, were made in establishing this model:

- the falls frequency distribution from Voukelatos et al., (2007) is directly relevant and valid for use in this study and hence appropriate for estimate generation;
- the Wolf et al., (1996) trial results can only be generalised to community dwelling older people over 70+ years with similar levels of fitness and mobility to those in the trial itself;
- the proportion of community dwelling older people with restrictions in their core activities has not changed greatly from 2003 to 2009.

3.1.4 Results

Base case

The numbers of falls prevented and hospital admissions averted in the base case scenario (i.e., using the point estimates for the model input variables (Table 1)), are shown in Table 2. If close to 2% of the eligible population take up the tai chi intervention, 13,926 falls would be prevented, and 279 fall related hospital admissions averted. The projected 2009 fall-related hospital admission rate for older people 65+ years would be reduced by 0.4%, and the rate for community dwelling older people 65+ years would be reduced by 0.5%. Three people need to participate in the tai chi intervention in order to prevent one fall, and 115 people are needed to prevent one hospital admission.

Table 2 Estimated number of falls prevented and hospital admissions averted, tai chi model, eligible Australian population 2009

Option	N falls when no tai chi	N people taking up tai chi	N falls when tai chi offered	N falls prevented	N hosp admissions when no tai chi	N hosp admissions when tai chi offered	N hospital admissions averted
Base case	1,498,841	31,998	1,484,915	13,926	29,977	29,698	279

One way sensitivity analyses

The changes in the base case scenario generated by changing the values of the model input variables one at a time are shown in Table 3. Percentage changes, relative to the base case scenario, are shown. A negative value means that fewer falls and falls hospitalisations would be prevented compared with the base case, eg., the low value for uptake would result in 50% less falls prevented than the base case scenario. However, even with this lower uptake, 6,934 falls would still be prevented. Clearly, the variables influencing the estimate of the number of falls prevented are the uptake rates and the level of intervention effectiveness.

Apart from uptake, the estimate of the proportion of falls resulting in hospital admission has the greatest influence on the number of hospital admissions averted, varying this by 30%. Intervention effectiveness varied the number of hospital admissions averted by approximately 20%.

Table 3 One way sensitivity analysis, tai chi model

Option	Falls when no tai chi	People taking up tai chi	Falls when tai chi offered	Falls prevented		Hosp admissions when no tai chi	Hosp admissions when tai chi offered	Hospital admissions averted	
	n	*n*	*n*	*n*	% [c]	*n*	*n*	*n*	% [c]
Low uptake	1,498,841	15,931	1,491,907	6,934	-50	29,977	29,838	139	-50
High uptake	1,498,841	47,929	1,477,982	20,859	50	29,977	29,560	417	50
Low[a] hospitalisation	1,498,841	31,998	1,484,915	13,926	0	20,984	20,789	195	-30
High[a] hospitalisation	1,498,841	31,998	1,484,915	13,926	0	38,970	38,608	362	30
More effective intervention[b]	1,498,841	31,998	1,482,419	16,422	18	29,977	29,648	328	18
Less effective intervention[b]	1,498,841	31,998	1,487,898	10,942	-21	29,977	29,758	219	-21

[a] Low and high hospitalisation calculations have been made using the uptake rate and intervention effectiveness for base case.

[b] Intervention fall rates set at the upper (less effective) and lower (more effective) bounds of the confidence interval; all other parameters at base case levels

[c] Percentage change from the base case shown in Table 2. While a negative value means that fewer falls would be prevented compared with the base case scenario, some falls would still be prevented.

Table 4 Implementation costs, tai chi model

Item	Cost $AUS
Fixed costs	
Recruitment	428.00
co-ordination	800.00
Fixed costs per participant for 15 week course (12 participants per group)	***102.30***
Recurrent costs	
instructor time per class	115
venue hire per class	30
music licence fee per class	2
Recurrent costs per participant for 15 week course (two classes per week, 12 participants per class)	***367.50***
Total cost per participant for 15 week course	***469.80***

Cost-effectiveness

The unit cost for the tai chi intervention was $470 per participant for the 15 week program (Table 4). This translated to costs of $1,079 and $53,974 per fall prevented and per hospital admission averted respectively, in the base case scenario (Table 5). Two factors influenced the cost per fall prevented: intervention effectiveness and intervention cost (Table 5). The estimated variation in intervention cost, driven by the range of likely rates for the class leaders, had more influence than the estimated variation in intervention effectiveness. With respect to the cost per hospital admission averted, the proportion of fallers admitted to hospital had a large influence, compared to the variation in intervention cost, and the variation in intervention effectiveness.

The largest influences on the total cost were the uptake rate and the variation in the intervention cost (Table 5).

The importance of participant contributions is clear, with even a small contribution of $3 per class resulting in a 19% reduction in the total cost, cost per fall prevented and cost per hospital admission averted, relative to the base case scenario (Table 5).

Table 5 Cost effectiveness, tai chi model, eligible Australian population, 2009

Scenario	People taking up intervention	Total cost	Cost per fall prevented		Cost per hospital admission averted	
	n	$AUS (M)	$	%[d]	$	%[d]
Base case	31,998	15.03	1079		53,974	
Low uptake	15,931	7.48	1079	0	53,974	0
High uptake	47,929	22.52	1079	0	53,974	0
Low hospitalisation[a]	31,998	15.03	1079	0	77,106	43
High hospitalisation[a]	31,998	15.03	1079	0	41,518	-23
More effective intervention[b]	31,998	15.03	915	-15	45,769	-15
Less effective intervention[b]	31,998	15.03	1374	27	68,689	27
More costly intervention	31,998	17.83	1280	19	63,992	19
Less costly intervention	31,998	12.26	880	-18	44,002	-18
Participant contribution of $3 per class[c]	31,998	12.16	873	-19	43,657	-19
Participant contribution of $5 per class[c]	31,998	10.24	735	-32	36,764	-32
Participant contribution of $10 per class[c]	31,998	5.44	391	-64	19,531	-64

[a] Low and high hospitalisation calculations have been made using the uptake rate and intervention effectiveness for base case.

[b] Intervention fall rates set at the upper (less effective) and lower (more effective) bounds of the confidence interval; all other input parameters at base case levels

[c] Input parameters at base case levels

[d] Percentage change from the base case. A negative value means that the cost per health outcome is less than that for the base case scenario

3.2 HOME BASED MUSCLE STRENGTHENING AND BALANCE RETRAINING

3.2.1 Description of the intervention

A home based muscle strengthening and balance retraining program has been tested in four randomised controlled trials involving over 1,000 community dwelling older people in New Zealand (Robertson et al., 2002, Table 6). This intervention comprises an individualised prescribed home based exercise program delivered by a district or general practice-based nurse, trained by a physiotherapist. The program is delivered during five home visits commencing with a one hour visit in week 1, followed by half hour visits at weeks 2, 4 and 8, and a booster visit at 6 months. Participants also receive a monthly telephone call to maintain motivation. The prescribed exercises are carried out at least three times a week and become progressively more difficult. A walking regimen twice a week is also incorporated into this year-long intervention. The control group underwent the same assessments and collected falls occurrence in the same way as the intervention group.

The age groups differed in the trials (65+, 75+, 80+ years) and one trial included only women (80+ years). The only exclusion criteria were not being independently mobile in own home, and receiving physiotherapy at the time of the trial. Falls occurrence was monitored prospectively using monthly calendars from randomisation to the final follow-up at different time points in the trials (44 weeks, 1 year, 2 years). The number of falls per 100 person years was the outcome of interest. In the meta-analysis of these four trials (Robertson et al., 2002), the falls rate for the intervention (n=612) and control groups (n=404) were 72.2 and 106.1 falls per 100 person years respectively, and the incidence rate ratio was 0.65, 95% CI 0.57-0.75.

Modelling of this intervention in this project was undertaken for 80+ year olds based on the trial by Robertson et al. (2001b), as the intervention was found to be most effective among this group. This trial also included an economic evaluation which was useful for determining the implementation costs for this intervention. As there is evidence regarding the impact of this intervention over a two year period (Campbell et al., 1999a), we modelled its impact over both one and two years.

Table 6 Summary of trials of home based muscle strengthening and balance retraining program

Trial	1	2	3	4
Trial participants	Women 80+ years	Women and men 65+ years taking psychotropic medication	Women and men 75+ years	Women and men 80+ years
Exercise instructor	Physiotherapist	Physiotherapist	Community nurse	General practice nurse
Setting	Research	Research	Community health	General practice
Economic evaluation	no	no	yes	yes
Publications	Campbell et al., 1997, 1999a	Campbell et al., 1999b	Robertson et al., 2001a	Robertson et al., 2001b

3.2.2 Data sources

Population data and factors used to select eligible population

An estimate of the proportion of community dwelling people aged 80+ years who would be eligible was obtained from the most recent Disability, Ageing and Carers Survey (ABS, 2003). We excluded those who were profoundly limited in their core activities to satisfy the criterion of mobility. After estimating the percentage this group of eligible people comprised in the 2003 population (63.48%), we applied it to the 2009 ABS projected population to obtain an estimate of the number of eligible people for 2009 (n=529,461). It was not possible to estimate the number of people receiving physiotherapy and hence they are included in the eligible population, which will consequently be slightly over-estimated.

Intervention uptake

The invitation to participate in the New Zealand trials was via a letter from the person's general practitioner if it was thought that the person could benefit. The participation rate was not directly available from the published trial, therefore the uptake rate from a similar trial (Trial 1, Table 6) comprising only women aged 80 years and over (Campbell et al., 1997) was used. The total number of people randomised in this study (n=233) was divided by the total number eligible (n=592) giving an uptake rate of 39.4% (Table 7). We have assumed that this uptake rate derived from a study of women only would be applicable to men. Certainly, in trial 3 (Table 6), which involved both men and women aged 75+ years, the uptake rate was 41% (Robertson et al., 2001a).

Table 7 Estimated base case parameters for the home based muscle strengthening and balance retraining model, 80+ years

Parameter	Base case value	Range	Sources for value and range
Uptake – recruitment via letter from general practitioner (%)	39.4	36.2 – 43.3	Campbell et al 1997
Average falls rate per person year (no exercise)	0.94	0.71 – 1.23	Robertson et al, 2001b
Average falls rate per person year (exercise)	0.68	0.56 – 0.82	Robertson et al, 2001b
Hospitalised falls (% of falls)	6.50	3.74 – 9.25	Robertson et al., 2002 and unpublished data from Robertson.

Fall rates

Person time fall rates for the control and intervention groups for the 80+ years model were obtained directly from Robertson et al. (2001b). In this particular trial, the intervention was delivered in three centres, therefore, the intervention fall rates were derived by pooling the number of falls from the three centres and dividing by the pooled total person time (from the three centres). Rates are shown in Table 7.

Confidence intervals for the fall rates

Unpublished fall frequency distributions were provided by Robertson for both the control and intervention groups. These were used to calculate the 95% confidence intervals as described in Chapter 2, and shown in Table 7.

Proportion of falls resulting in hospitalisation

The standard value for this outcome calculated as described in Chapter 2 is best applied to people 65+ years, given the age groups in the two studies from which it was derived. However, the proportion of falls resulting in hospitalisation is likely to increase with age, due to increased prevalence of osteoporosis and co-morbid conditions. Therefore, we used values obtained from a more age-appropriate group. For the 80+ years model, we used data from the home based exercise trials published in Robertson et al., (2002), in addition to unpublished data provided by Robertson, to calculate the proportion of falls resulting in hospitalisation for this age group (Table 7).

Costs of intervention

Two of the four trials in the meta-analysis presented economic evaluations for two slightly different modes of intervention delivery: one used the district nursing network for delivery of the home based exercise program (Robertson et al., 2001a), and the other used nurses based in general practice to deliver the program (Robertson et al., 2001b). We costed each delivery mechanism separately using the published cost items, and applied current Australian unit cost data (Table 8 and Table 9). Training costs were included in recognition that there is no existing workforce trained to deliver this particular program. We assumed that the different costs per participant were associated with the mode of delivery, and not the different age groups used in these two trials (75+ years and 80+ years). We used the costs associated with the district nurse delivered program as the base cost in our cost effectiveness analysis and the cost associated with the general practice based nurse delivered program as the higher cost option.

Modelling accrued benefits over two-year period

The effectiveness of this intervention was assessed over two years in Campbell et al., (1999) in women aged 80+ years. The results showed that 61% of the intervention participants continued to exercise at least three times per week into the second year and maintained a very similar fall rate as that observed in the first year of the intervention. We therefore modelled the falls prevented and hospital admissions averted in the second year (2010), by applying the same level of falls reduction to 61% of the year one (2009) participating population who would be expected to continue to exercise for a second year. The second year of the intervention was achieved for relatively little additional resources. Participants were telephoned every month to maintain their levels of interest. We assumed 15 mins per phone call, and 12 calls per participant. In costing these items for our study we estimated the total cost per participant for the second year to be $219.

Table 8 Implementation costs, home based muscle strengthening and balance retraining model, based on exercise program delivered by a district nurse

Cost item	Resource use	Unit cost ($AUS)	Total Cost ($AUS)	Comments/Reference
Training course				
Nurse	40 hours	72	2880.00	Primary Health Funding Approach of DHS Victoria http://www.dhs.vic.gov.au/rrhacs/ph_funding/faq.htm#1
Physiotherapist	37.5	81.38	3051.75	Primary Health Funding Approach of DHS Victoria http://www.dhs.vic.gov.au/rrhacs/ph_funding/faq.htm#1
Transport	Visits to 15 clients 10 km	0.69 / km	103.50	0.69 cents per km in Australia www.ato.gov.au
Sub Total Training			6035.25	
Recruitment, programme prescription and follow up				
Nurse	1,239 hours	72	89208.00	Primary Health Funding Approach of DHS Victoria http://www.dhs.vic.gov.au/rrhacs/ph_funding/faq.htm#1
Exercise nurse transport (km)	6250	0.69/km	4312.50	
Doctors' time	30 Doctors, 0.25 hours each	54	1620.00	30 appointments at AMA rates
General practice staff	17 practices, 0.75 hrs each	25	318.75	
Typing lists & letters	51 hours	25	1275.00	
Pager	18 months		n/a	
Postage (stamps)	580	0.5	290.00	
Stationery and photocopying	275 x Paper, envelopes	0.5	137.50	
Telephone calls	1619	0.25	404.75	
Ankle cuff weights	177	49	8673.00	http://www.nordicfitness.com.au/ 54/pd311/australian-barbell-company-ankle-cuffs
Instruction booklets	121	min print run	1000.00	http://www.printroom.com.au/ presentation-folders.php
			107239.50	
Sub-total Recruitment etc.				
Supervision of programme				
Physiotherapist	43.5 hours	81.38	3540.03	Primary Health Funding Approach of DHS Victoria http://www.dhs.vic.gov.au/rrhacs/ph_funding/faq.htm#1
	44		11.00	
Nurse	210 hours	72	15120.00	Primary Health Funding Approach of DHS Victoria http://www.dhs.vic.gov.au/rrhacs/ph_funding/faq.htm#1
	26 Telephone calls	0.25	6.50	
Subtotal Program Supervision			18677.53	
Total cost			$131,952.28	
Average cost of participation for 1 year based on 121 participants			**$1,090.51**	

Table 9 Implementation costs, home based muscle strengthening and balance retraining model, based on exercise program delivered by general practice nurses

Cost item	Resource use	Unit cost ($AUS)	Total Cost ($AUS)	Comments/Reference
Training course				
Physiotherapist	37.5	81.38	3051.75	Primary Health Funding Approach of DHS Victoria http://www.dhs.vic.gov.au/rrhacs/ph_funding/faq.htm#1
Three nurses				
(a) time	37.5 each	72.00	2700.00	
(b) travel	2220	0.69	1531.80	
(c) accom	5	-	n/a	
Materials	Folders	-	n/a	
Transport	Visits to 15 clients	0.69	n/a	Ato.gov.au
Subtotal Training			7283.55	
Recruitment, programme prescription, follow up				
Time for 3 nurses	4100 hours	72.00	295200.00	Primary Health Funding Approach of DHS Victoria http://www.dhs.vic.gov.au/rrhacs/ph_funding/faq.htm#1
Transport for 3 nurses (km)	4609	0.69	3180.21	
Doctor's time	46 , 0.25 hours ea.	54.00	2484.00	46 AMA appts
General practice staff time	26 , 0.75 hours ea.	25.00	936.00	$25per hour admin rate +28% on costs +50% admin
Typing lists and letters (hours)	78	25.00	2808.00	$25per hour admin rate +28% on costs +50% admin
Postage (stamps)	768	50cents	384.00	
Stationery and photocopying	Paper envelopes	15cents	559.50	
Telephone calls	Local calls, 1 "call minder", 2 mobiles	25cents	3345.00	
Ankle cuff weights	480	49.00	23520.00	
Instruction booklets	3330 folders, paper	booklet costs	2913.00	http://www.cmykonline.com.au/listProductByBrand/ Presentation+Folders/Two+Sided+Coated+Presentation+Folders/Presentation+Folders+Full+Colour+Gloss+Coated+2+sides
Subtotal recruitment			335329.71	
Supervision of programme				
Physiotherapist				
(a) time	703	81.38	57210.14	Primary Health Funding Approach of DHS Victoria http://www.dhs.vic.gov.au/rrhacs/ph_funding/faq.htm#1
(b) travel	2808	0.69	n/a	
(c) accommodation	4 visits to each centre		n/a	
Telephone calls	108	0.25	27.00	www.telstra.com.au
Three nurses	97 hours	72.00	6984.00	Primary Health Funding Approach of DHS Victoria http://www.dhs.vic.gov.au/rrhacs/ph_funding/faq.htm#1
Telephone calls	82	25 cents	20.50	
Travel	2586	0.69	n/a	
Subtotal supervision			64241.64	
Total cost			**406854.90**	
Average cost per participation for 1 year programme 330 participants			**1232.89**	

3.2.3 Assumptions

The following specific assumptions, in addition to those outlined in Chapter 2, were made in establishing this model:

- The trial results of Robertson et al. 2001b can only be generalised to community dwelling older people +80 years with similar levels of fitness and mobility to those in the trial itself;
- The proportion of community dwelling older people with restrictions in their core activities has not changed greatly from 2003 to 2009;
- The participation rate for men is similar to that of women (i.e. the proportion taking up the invitation to participate)
- Intervention costs did not vary between the 75+ years and 80+ years groups;
- The intervention is as effective in a second year for men as it is for women.

3.2.4 Results

Base case for first year

The numbers of falls prevented and hospital admissions averted in the base case scenario (i.e., using the point estimates for the model input variables (Table 7)), are shown in Table 10. If approximately 40% of the eligible population take up the home based program in the first year (2009), 55,222 falls would be prevented, and 3,521 hospital admissions averted. The projected 2009 fall-related hospital admission rate for older people 65+ years would be reduced by 4.6%, and the rate for community dwelling older people 65+ years would be reduced by 5.9%. The comparable reductions in rates for older people 80+ years are 7.1% and 10%. Four people need to participate in the first 12 months in order to prevent one fall, and 60 are needed to prevent one hospital admission.

Falls prevented and hospital admissions averted increased by 19% with the inclusion of the second year (Table 10). The projected 2010 fall-related hospital admission rate for older people 65+ years would be reduced by 2.7%, and the rate for community-dwelling older people 65+ years would be reduced by 3.5%. The comparable reductions in rates for older people 80+ years are 4.2% and 5.9%. Two people need to participate for two years in order to prevent one fall and 22 need to participate for two years to prevent one hospital admission.

Table 10 Estimated number of falls prevented and hospital admissions averted, home based muscle strengthening and balance retraining model, eligible Australian population, 80 years and over, 2009 and 2010

Option	N falls when no intervention	N people taking up/continuing intervention	N falls when intervention offered	N falls prevented	N hosp admissions when no intervention	N hosp admissions when intervention offered	N hospital admissions averted
Base case Year 1 (2009)	497,164	208,386	442,942	54,222	32,283	28,762	3,521
Year 2 (2010)	195,674	127,115	86,286	33,075	12,706	10,558	2,148
Total	692,838	-	529,228	87,297	44,989	39,320	5,669

One way sensitivity analyses

The changes in the base case scenario for the first year generated by changing the values of the model input variables, one at a time, are shown in Table 11. Percentage changes, relative to the base case scenario, are shown. A negative value means that fewer falls and falls hospitalisations would be prevented compared with the base case, eg., the low value for uptake would result in 10% less falls prevented than the base case scenario. However, even with this lower value, 48,800 falls would still be prevented. Clearly, the variables influencing the estimate of the number of falls prevented are the uptake rates and the level of intervention effectiveness, the latter having a substantial impact. The proportion of falls resulting in hospital admission and intervention effectiveness has approximately equal influence on the numbers of hospital admissions averted.

Table 11 One way sensitivity analysis for first year, home based muscle strengthening and balance retraining model, eligible Australian population, 80 years and over, 2009

Option	Falls when no intervene-tion	People taking up interven e-tion	Falls when intervention offered	Falls prevented		Hosp admissions when no intervene-tion	Hosp admissions when intervene-tion offered	Hospital admissions averted	
	n	*n*	*n*	*n*	% [c]	*n*	*n*	*n*	% [c]
Low uptake	497,164	187,549	448,364	48,800	-10	32,283	29,115	3,169	-10
High uptake	497,164	229,223	437,520	59,644	10	32,283	28,410	3,873	10
Low hospitalisation[a]	497,164	208,386	442,942	54,222	0	45,965	40,952	5,013	42
High hospitalisation[a]	497,164	208,386	442,942	54,222	0	18,602	16,573	2,029	-42
More effective intervention[b]	497,164	208,386	417,891	79,273	46	32,283	27,136	5,148	46
Less effective intervention[b]	497,164	208,386	472,041	25,123	-54	32,283	30,652	1,631	-54

[a] Low and high hospitalisation calculations have been made using the uptake rate and intervention effectiveness for base case.

[b] Intervention fall rates set at the upper (less effective) and lower (more effective) bounds of the confidence interval; all other parameters at base case levels

[c] Percentage change from the base case shown in Table 10. While a negative value means that fewer falls would be prevented compared with the base case scenario, some falls would still be prevented.

Cost effectiveness

The unit cost for the district nurse delivered home based exercise intervention was $1090 per participant for the first 12 months of the program (Table 12). This translated to costs of $4,191 and $64,542 per fall prevented and per hospital admission averted respectively, in the base case scenario for the first year (Table 13). These costs are reduced by 30% to $2,922 and $44,997, respectively when the costs and benefits are considered overall for the two year period (Table 14).

The largest influence on the total cost was the mode of intervention delivery (Table 13).

Table 12 Implementation costs per participant for first year, home based muscle strengthening and balance retraining model for eligible Australian population, 80 years and over, 2009

Item	District nurse delivered home based exercise model Cost per participant ($AUS)	General practice-based nurse delivered home based exercise Cost per participant ($AUS)
Training course	$49.88	$22.07
Recruitment, program prescription and follow-up	$886.28	$1016.15
Supervision of program	$154.36	$194.67
Total cost per participant	$1090.52	$1232.89

Table 13 Cost effectiveness for the first year, home based muscle strengthening and balance retraining model for eligible Australian population, 80 years and over, 2009

Scenario	People taking up	Total cost	Cost per fall prevented		Cost per hospital admission averted	
	n	$AUS mill	$AUS	%[d]	$AUS	%[d]
Base case	208,386	227.25	4,191	0	64,542	0
Low uptake	187,549	204.52	4,191	0	64,542	0
High uptake	229,223	249.97	4,191	0	64,542	0
Low hospitalisation[a]	208,386	227.25	4,191	0	45,331	-30
High hospitalisation[a]	208,386	227.25	4,191	0	112,014	74
More effective intervention[b]	208,386	227.25	2,867	-32	44,146	-32
Less effective intervention[b]	208,386	227.25	9,045	116	139,297	116
General practice-based nurse model[c]	208,386	256.92	4,738	13	72,969	13

[a] Low and high hospitalisation calculations have been made using the uptake rate and intervention effectiveness for base case.
[b] Intervention fall rates set at the upper (less effective) and lower (more effective) bounds of the confidence interval; all other input parameters at base case levels
c Input parameters at base case levels
[d] Percentage change from the base case. A negative value means that the cost per health outcome is less than that for the base case scenario

Table 14 Cost per fall and hospitalisation averted over a two year period in population aged 80+ years taking up home based muscle strengthening and balance retraining in 2009.

Year	N people taking up/continuing intervention	Total cost ($AUS mill)	Cost ($AUS) per fall prevented	Cost ($AUS) per hospital admission averted
Year 1 (2009)	208,386	227.25	4,191	64,542
Year 2 (2010)	127,115	27.84	842	12,960
Over 2 year period	n/a	255.09	2,922	44,997

3.3 HOME HAZARD ASSESSMENT AND MODIFICATION

3.3.1 Description of the intervention

The Cochrane review concluded that the home hazard assessment and modification intervention professional prescribed was effective only among community dwelling older people with a history of falling (Gillespie et al., 2006). There were 3 trials including, or undertaking restricted analyses for, this participant group. One of these, an Australian based study, was selected as it was the only one that published sufficient information for the modelling to be undertaken (Cumming et al., 1999).

This intervention comprised a home environmental hazard assessment by an occupational therapist (OT) with the aim of recommending modifications, if required, to reduce the risk of falls (intervention group n=264). The home assessment was conducted with a standardised home assessment form, taking approximately 1 hour. The OT provided a list of specific recommended home modifications to the participant at the end of the home visit. Telephone follow-up was undertaken about 2 weeks later to check that modifications have been made and to encourage compliance. The recommendations included advice about safe footwear and changing the way in which things were done around the home. The control group (n=266) received usual care. Falls occurrence was monitored prospectively from randomisation to the final follow-up, approximately 12 months after recruitment. The falls outcome variable was time to first fall, and the results were reported as adjusted relative risk following Cox proportional hazards modelling with the Anderson-Gill extension. Fall rates per person year were also reported.

Participants were required to be 65+ years and living in the community. Cognitively impaired people were included if there was a carer available to give informed consent and who could report on falls during the follow up period. Most participants were hospital inpatients, being treated for a range of conditions, and were not receiving a home visit from an OT as part of their usual care.

The intervention appeared to be effective only among those participants who had fallen in the previous year (1.25 falls per person year in intervention group, 2.24 falls per person year in the control group; difference 0.99 falls per person year 95% CI 0.17-1.81 falls). Among the previous fallers, the intervention appeared to be equally effective for falls in the home as for falls outside the home.

3.3.2 Data sources

Population data and factors used to select eligible population

The inclusion criteria for this intervention were community dwelling people aged 65+ years that had been hospitalised for any reason and were not to receive an occupational therapy home visit as part of their usual care. To determine the eligible population we estimated the number of people who had been hospitalised for any reason and subtract from this the number of people who had been hospitalised for a fall, since this group were assumed to be discharged with an OT home visit. Other types of inpatients may well routinely receive an OT home visit. However, we were unable to locate sufficient evidence on which to base further exclusions. The most recent available estimate of the number of community dwelling people hospitalised in a year was from the ABS 2004/5 National Health Survey Confidential Unit Record File data. We subtracted from this the number of community dwelling people who had been hospitalised for a fall in 2004/05, which had been enumerated from the national hospital morbidity data as described in Chapter 2. We then calculated the proportion this represented of the 2004 community dwelling population and applied this proportion to the projected 2009 community dwelling population estimate obtained from the ABS. This exercise provided an estimated eligible population of 255,402, which is likely to be an over-estimate due to our inability to exclude all those who would routinely receive an OT home visit on discharge from hospital

Intervention uptake

Participants for this trial were recruited while hospital inpatients (84%), or while attending hospital outpatient clinics or local day care centres. The uptake rate could not be determined from the information published from the trial. Further, neither the recruitment methods nor the setting of other studies reporting on this intervention were comparable and hence the uptake rates from these could not be used. However, recruitment via a hospital was used in a UK multifactorial falls prevention trial, which also included an OT home visit (Close et al., 1999). Participants in this trial were 65+ years and had presented to a hospital emergency department due to a fall. The invitation to participate in the Close et al. trial was extended within the context of hospital treatment, as was the case in the Cumming et al. trial. It was therefore decided to use the uptake rate from the Close et al. trial as an estimate for this model.

Table 15 Estimated base case parameters for the home hazard assessment and modification model

Parameter	Base case value	Range	Sources for value and range
Uptake(%)	55.4	49.9 – 60.9	Close et al. (1999)
Average falls rate per person year (no intervention)	2.24	1.57 – 3.15	Cumming et al. (1999)
Average falls rate per person year (with intervention)	1.25	0.82 – 1.90	Cumming et al. (1999)
Hospitalised falls (% of falls)	2.0	1.4 – 2.6	Tiedemann et al (2008), and L. Day, unpublished data, prospective falls data from Australian trials involving community dwelling older people

Fall rates

The fall rates for both the control and intervention groups were obtained from the published results in Cumming et al., (1999), shown in Table 15.

Confidence intervals for the fall rates

Falls frequency distributions were not provided in the trial publication. As a result we sought falls distributions from trials with participants of similar age and falls risk, and fall rates. The participants in the Close et al. trial were 65+ years and had presented to a hospital emergency department for a fall. The participants in the Cumming et al trial were 65+ years and were hospital inpatients, for a range of conditions. Both groups would have a higher than average falls risk for their age group, given the falls history in the former and co-morbid conditions in the latter. The fall rates for the control groups in these two trials are also similar (Table 15 and Table 21). Consequently, we used the unpublished falls frequency distributions from the sample in Close et al., (1999) were used to calculate the confidence intervals as described in Chapter 2, and shown in Table 15.

Costs of intervention
The approach taken to costing this intervention is based on the economic evaluation of the intervention as delivered in the trial (Salkeld et al., 2000a). We used the published cost items, and applied current Australian unit cost data for wages, office costs and travel (Table 16). The average cost per participant (regardless of who bore the cost) for home modifications in 2000 ($11) was scaled up to 2008 values using the consumer price index (Table 16). The largest cost component is the time required by the OT to visit the home and make an assessment. This was estimated by Salkeld et al., (2000a) to be 4.8 hours per home visit. Hourly OT costs have been based on a survey of OT hourly charge-out rates recently completed by the Occupational Therapists Association (OT Australia). This rate is presumed to cover gross wages, wage on-costs plus overhead. An alternative lower cost option was estimated using wage rates (+ 28% wage on-costs and 50% office overheads) for salaried occupational therapists (DHS, Victoria).

3.3.3 Assumptions

The following specific assumptions, in addition to those outlined in Chapter 2, were made in establishing this model:

- The proportion of community dwelling older people hospitalised in 2009 is no different to that in 2004/5
- The falls frequency distribution for the participants in the Close et al. (1999) trial is generalisable to the participants in the Cumming et al. (1999) trial.
- The mix of home modifications observed in the Cumming et al (1999) trial will remain constant if the intervention were widely implemented.

Table 16 Items and unit costs used to derive intervention costs for the home hazard assessment and modification model

Item	Cost	Reference
Occupational Therapist (OT) time: 16 hours per week for 20 months to deliver intervention to 264 people; 4.8 hrs per person.	Wage rate for publicly employed OTs, (including wage on-costs @28% and overheads@+50%) = \$81.38/hr Private rate: \$100 per hour	Salkeld et al., 2000a Dept Human Services Vic OT Australia www.ausot.com.au
Telephone and letter costs one local telephone call and one standard letter per person	Phone costs of 25 cents Standard letter costs of 50 cents	Telstra standard phone costs www.telstra.com.au www.australiapost.com.au
Travel to each home 10km average round trip	Cost per km @ 69 cents per km for most cars i.e. \$ 6.90 for 10kms	ATO website http://www.ato.gov.au/individuals/ content.asp?doc=/content/33874.htm
Home modification per participant, reflecting the nature of modifications; 32% removal of rugs/mats, 16% change footwear; 14% use non-slip bathmat; 8% add a rail to external stairs (8%); 16% had no modifications	\$11 in 2000 =\$14.25 in 2008 dollars CPI Mar quarter 2000 = 125.2 CPI Mar quarter 2008 = 162.2	Salkeld et al., 2000a ABS

3.3.4 Results

Base case

The numbers of falls prevented and hospital admissions averted in the base case scenario i.e., using the point estimates for the model input variables (Table 15), are shown in Table 17. If 55% of the eligible population take up the OT intervention option, 140,078 falls will be prevented, and 2,802 fall-related hospital admissions averted. The projected 2009 fall-related hospital admission rate for older people 65+ years would be reduced by 3.7%, and the rate for community dwelling older people 65+ years would be reduced by 4.7%. One person in the target group needs to participate in the intervention in order to prevent one fall, and 50 are needed to prevent one hospital admission.

Table 17 Estimated number of falls prevented and hospital admissions averted, home hazard assessment and modification model, eligible Australian population 2009

Option	N falls when no intervention	N people taking up intervention	N falls when intervention offered	N falls prevented	N hosp admissions when no intervention	N hosp admissions when intervention offered	N hospital admission s averted
Base case	572,100	141,493	432,023	140,078	11,442	8,640	2,802

One way sensitivity analyses

The changes in the base case scenario generated by changing the values, one at a time, of the model input variables are shown in Table 18. Percentage changes, relative to the base case scenario, are shown. A negative value means that fewer falls and falls hospitalisations would be prevented compared with the base case, eg., the low value for uptake would result in 10% less falls prevented than the base case scenario. However, even with this lower value, 126,070 falls would still be prevented. Clearly, the variables influencing the estimate of the number of falls prevented are the uptake rates and the level of intervention effectiveness, the latter having a substantial influence. Intervention effectiveness had the greatest influence on the number of hospital admissions averted.

Table 18 One way sensitivity analysis, home hazard assessment and modification model, eligible Australian population 2009

Option	Falls when no □ntervene-tion	People taking up □nterven e-tion	Falls when □ntervene-tion offered	Falls prevented		Hosp admissions when no □ntervene-tion	Hosp admissions when □ntervene-tion offered	Hospital admissions averted	
	n	*n*	*n*	*n*	%[c]	*n*	*n*	*n*	%[c]
Low uptake	572,100	127,343	446,030	126,070	-10	11,442	8,921	2,521	-10
High uptake	572,100	155,642	418,015	154,086	10	11,442	8,360	3,082	10
Low [a] hospitalisation	572,100	141,493	432,023	140,078	0	8,009	6,048	1,961	-30
High [a] hospitalisation	572,100	141,493	432,023	140,078	0	14,875	11,233	3,642	30
More effective intervention[b]	572,100	141,493	370,842	201,258	44	11,442	7,417	4,025	44
Less effective intervention[b]	572,100	141,493	523,414	48,687	-65	11,442	10,468	974	-65

[a] Low and high hospitalisation calculations have been made using the uptake rate and intervention effectiveness for base case.
[b] Intervention fall rates set at the upper (less effective) and lower (more effective) bounds of the confidence interval; all other parameters at base case levels
[c] Percentage change from the base case shown in Table 17. While a negative value means that fewer falls would be prevented compared with the base case scenario, some falls would still be prevented

Cost effectiveness

The unit cost for the home modification intervention was $413 per participant for the lower cost option (used for the base case scenario), and $501 for the higher cost option (Table 19). This translated to costs of $417 and $20,834 per fall prevented and per hospital admission averted respectively, in the base case scenario (Table 20). Two factors influenced the cost per fall prevented: intervention effectiveness and intervention cost. A less effective intervention would have a large influence on both the cost per fall prevented and per hospital admission averted. The largest influences on the total cost were the uptake rate and the variation in the intervention cost (Table 20).

Table 19 Implementation costs per participant, home hazard assessment and modification model

Item	**Lower cost option-public sector wage rates $AUS**	**Higher cost option-hourly fee OT Australia $AUS**
Occupational therapist	390.62	480.00
Phone and letter costs	0.75	0.75
Travel costs	6.90	6.90
Home modification cost	14.25	14.25
Total	**412.52**	**501.09**

Table 20 Cost effectiveness, home hazard assessment and modification model, eligible Australian population, 2009

Scenario	**People taking up intervention**	**Total cost**	**Cost per fall prevented**		**Cost per hospital admission averted**	
	n	$AUS mill	$AUS	%[d]	$AUS	%[d]
Base case	141,493	58.37	417	0	20,834	0
Low uptake	127,343	52.53	417	0	20,834	0
High uptake	155,642	64.21	417	0	20,834	0
Low hospitalization [a]	141,493	58.37	417	0	29,763	43
High hospitalisation [a]	141,493	58.37	417	0	16,026	-23
More effective intervention [b]	141,493	58.37	290	-30	14,501	-30
Less effective intervention [b]	141,493	58.37	1,199	188	59,943	188
Higher cost option[c]	141,493	70.90	506	21	25,308	21

[a] Low and high hospitalisation calculations have been made using the uptake rate and intervention effectiveness for base case.
[b] Intervention fall rates set at the upper (less effective) and lower (more effective) bounds of the confidence interval; all other input parameters at base case levels.
C Input parameters at base case levels.
[d] Percentage change from the base case. A negative value means that the cost per health outcome is less than that for the base case scenario.

3.4 MULTI-DISCIPLINARY, MULTI-FACTORIAL RISK SCREENING AND INTERVENTION

3.4.1 Description of the intervention

Two separate categories of multidisciplinary, multifactorial, health/environmental risk factor screening intervention studies documented in the Cochrane Review were considered for use in this study: the pooled intervention effect of four studies (Fabacher et al., 1994; Jitapunkul et al.,1998; Newbury et al., 2001; Wagner et al., 1994) on community dwelling older people regardless of falls history; and the pooled trial results from five studies (Close et al., 1999, Hogan et al., 2001; Kingston et al., 2001; Lightbody et al., 2002; van Hassstregt et al., 2000) comprising community dwelling population samples of known fallers.

Although the pooled results for community dwelling older people regardless of falls history showed this intervention approach to be effective, information published for these individual studies could not be used in our study for various reasons. These included population groups that are incompatible with the Australian population, as in the case of Fabacher et al., (1994) and Jitapunkul et al., (1998) whose samples comprised US veterans and older people from a slum area in Bangkok, respectively, and, insufficient information from which to determine fall rates (Newbury et al., 2001;and Wagner et al., 1994).

Some of the reviewed studies targeting known fallers also had limitations with regard to applicability to our study. There was insufficient information in Kingston et al., (2001) and van Haastregt et al., (2000) from which to calculate fall rates. Among the remaining three studies (Hogan et al., 2001; Lightbody et al., 2002; and Close et al., 1999), there were differences in methods of recruitment and intervention delivery which meant that we could not pool all three, or two of the three, for the purposes of our modelling. As the study by Close et al. (1999) contained all the required input information for our model, we selected this trial on which to base our modelling.

This intervention involved the identification of risk factors among older people with a history of falling and a structured interdisciplinary approach to manage and prevent further falls (Close et al., 1999). The inclusion criteria were community dwelling people aged 65+ years who had presented to a hospital emergency department with a primary diagnosis of a fall. The exclusion criteria were insufficient English, or cognitive impairment with an abbreviated mental test of less than 7, and being without a regular carer. The intervention comprised a comprehensive medical assessment followed up by appropriate referrals to address the identified risk factors. These referrals included hospital outpatient departments, multidisciplinary day hospital, the general practitioner, and opticians. In addition, all participants received an occupational therapy home visit. The visit consisted of a standard assessment and home hazard audit, advice and education, and home modifications if necessary. Control group participants received usual care and were not subjected to these assessments. Falls occurrence was monitored using a monthly calendar.

Logistic regression showed that the risk of falling was lower in the intervention group (n= 184; control group n=213), when adjusted for baseline differences and number of falls in the 12 months before the index fall (OR 0.39 95%CI 0.23-0.66) (Close et al., 1999).

3.4.2 Data sources

Population data and factors used to select eligible population

An estimate of the number of community dwelling people in Australia presenting or being admitted to hospital as a result of a fall, excluding those with dementia and those unable to speak English was required. The ideal approach would be to first obtain an estimate of this group presenting to hospital, and then subtract those who do not meet the language and cognitive state criteria. However, this was not possible as we were unable to obtain an estimate of the number of community dwelling older people who are not proficient in English.

Our starting point, therefore, was the national estimate of the number of people aged 65+ years, regardless of type of residence, and not proficient in English (n=163,210) from the 2006 ABS census (ABS, 2006). We calculated the percentage this comprised of the 2006 national population aged 65+ years (6.2%) and applied this proportion to the projected 2009 population aged 65 years and over (N=2,971,699). We then proceeded to exclude from this resulting population (n=2,788,288) the percentage who were not community dwelling (6.54%) followed by the number of community dwelling people aged 65+ years who were profoundly limited in their core activities by dementia (n=6,823) (AIHW, 2007). These manipulations provided an estimate of Australian community dwelling people 65+ years who are proficient in English and not profoundly limited by dementia. The final step was to determine the proportion of this group who would present each year to a hospital emergency department (or be admitted to hospital) following a fall.

National estimates of the number of people presenting to hospital emergency departments are not available, nor are they available for all states and territories. Only Victoria and Queensland have state-wide emergency department injury surveillance collection systems, with the Victorian system having the most comprehensive coverage of the two states. Therefore, we used the Victorian dataset to extract the number of community dwelling people aged 65+ years who had presented (including those admitted) to hospital due to a fall (n=17,342) for the most recent year available (2006), as a proxy for the national estimate. This comprised 2.75% of the community dwelling Victorian population aged 65+ years (17,342/630,337).

We then applied this percentage (2.75%) to the estimate of Australian community dwelling people 65+ years who are proficient in English and not profoundly limited by dementia, to obtain the final estimate of the eligible population (n=71,691).

Table 21 Estimated base case parameters for the multi-disciplinary, multi-factorial risk screening and intervention model

Parameter	Base case value	Range	Sources for value and range
Uptake – (%)	55.4	49.9 – 60.9	Close et al., 1999
Average falls rate per person year (no intervention)	2.64	2.01 – 3.47	Close et al., 1999
Average falls rate per person year (intervention)	1.13	0.79 – 1.63	Close et al., 1999
Hospitalised falls (%)	2.0	1.4 – 2.6	Tiedemann et al (2008), and L. Day, unpublished data, prospective falls data from Australian trials involving community dwelling older people

Intervention uptake

Participants who had either presented or had been discharged after admission due to a fall were identified from a hospital computerised registration system, and mailed a letter of invitation which was followed up with a telephone call. The uptake rate was estimated from the published results of the trial in which 397 of the 716 eligible subjects were randomised, representing a 55.4% uptake rate (Close et al. 1999).

Fall rates

Unpublished falls data provided by Close contained the fall frequency distributions for all subjects who had remained in the study for 12 months. Using this follow-up period of one year, we calculated the fall rate for the control and intervention groups by dividing the number of falls by the number of people, in each group, respectively. The fall rates are shown in Table 21.

Confidence intervals for the fall rates

Unpublished fall frequency distributions were provided by Close for both the control and intervention groups. These were used to calculate the 95% confidence intervals as described in Chapter 2, and shown in Table 21.

Costs of intervention

This intervention involves three key components which require costing: an assessment of falls risk factors, an occupational therapy home visit, and referral to a range of other services as determined by the results of the assessment. In the trial, the assessment was conducted in the recruiting hospital as part of the research project, and referrals were made as necessary. For the purposes of costing the intervention if it were to be delivered on a widespread basis, we opted for a model of delivery through general practitioners, as there is already a framework for undertaking comprehensive assessments for older patients within general practice. The treating hospital could identify eligible patients and write to both them and their general practitioner, and follow up patients by telephone as in the trial to encourage them to participate. The assessment and management plan could be undertaken by the general practitioner, under the current annual health check procedures.

The costing of the referral component was made using the published proportions of the trial participants requiring referral to various services: hospital outpatient department (36%), multidisciplinary day hospital (21%), the general practitioner (18%), and optician

(15%) (Close et al., 1999). In addition, 100% received the occupational therapy home visit. The hospital outpatient department, general practitioner and optician referrals were all costed on the basis of standard consultations, with an estimate of any additional treatment costs where possible (Table 22). The multidisciplinary day hospital was costed as treatment in a multidisciplinary falls and balance clinic (Table 23), using published data relating to operation of these clinics in Australia (Hill et al., 2001; 2008). The costs estimated for the occupational therapy intervention (Chapter 3 Section 3.3) were also used here.

Table 22 Items and unit costs used to derive intervention costs for the multidisciplinary, multifactorial, health/environmental risk factor screening intervention model

Item	Cost	Reference
Hospital staff member time to check ED presentation records for eligible patients, write the letter, follow-up with phone call, and make GP appointment	30mins per patient Letter and phone costs included as an overhead cost Plus on costs 28% Plus Office Overheads 50% Assumption of 30 mins per patient Total practice manager time is ½ hour. Therefore cost=1/2*25.90 =$12.95 Plus over heads of 28% and office overheads of 50%=12.95+3.63 +6.48 =$23.06	$25.90 Hourly cash earnings for an office or practice manager from the ABS, http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/6306.0May%202006?OpenDocument admin charge based on casual rate for admin staff.
Development of protocol for medical assessment by doctor	Not costed at this stage but would need developing if suitable protocol does not already exist	
Medical assessment (not specialist doctor, could be GP) 1 hour	Use the Medicare/AMA item for the annual health check, which should include a falls component $171.15	MBS Schedule page 128
Development of plan by doctor	Covered by the Medicare AMA item for a GP management plan $127.70	MBS Schedule page 128
GP Visit to discuss plan with participant	15mis of GP time per MBS, costed as a standard consult level A $15 High cost option, AMA recommended fee $54	MBS Schedule page 102 www.ama.com.au
36% will need referral to a hospital outpatient department	Mainly for cardiovascular or circulatory problems, which may need management by medication or in some cases possibly surgery. Costed as the average cost for outpatient hospital treatment. Not include are any possible additional costs. Mean "bundled" non-admitted patient service cost of $102 in all cost data provided in the months preceding 31 December 2004 = $ 146.67 in 2008 dollars Dec quarter 2004 CPI index 112.8 Mar quarter 2008 CPI index is 162.2	Close et al. 1999 Jackson and Sevil 1996 http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/6401.0Mar%202008?OpenDocument *Table continued on following page*

Item	Cost	Reference
21% will need referral to a multidisciplinary falls clinic	Details follow in Table 23and Table 24 *HIGH COST OPTION* $1885.94 *LOW COST OPTION* $1775.52	
18% will need referral to GP	Many of these referrals were for medication review and management so this could be costed as two visits, medication cost unclear, likely to involve changing dose of current medication, or changing to a different medication, presently excluded Medicare rate, standard consult $21 However the AMA rate is:- $54 Therefore cost of two visits High cost $108 Low cost $42	Close et al. 1999 Medicare Benefits Schedule Book Operating from 1 November 2007, Australian Government Department of Health and Ageing P105 AMA standard rate in 2004
15% will need referral to optometrist	Costed as one optometrist visit for the 15%. Other research trial indicates that among community dwelling older people who are referred to an optometrist following a risk factor screening, 21% may need new glasses and 6% may have cataract surgery. These data used as basis for estimating treatment costs. Cost of optometrist visit $65.15 cost of initial or referred optometric exam Cost of glasses (including new lenses) Frame and lens estimated as $299 DRG item for cataract surgery C16A $4178 Mar quarter 2005 CPI index 148.4, Mar quarter 2008 162.2, Therefore Total in real terms in Mar quarter 2008 = 12138.77 Current dollar cost for cataract surgery is $4566.52 Each additional optometrist appointment $32.10 This component therefore is costed as:- Optometrist appointment + 21% getting glasses and follow up appointment plus 6% cataract surgery = $65.15+($299+$32.10)*.21+.06*$4566.52 =$408.67	Day et al., 2000 Medicare book page 171 http://www.opsm.com/ Pages/default.aspx National hospital cost data collection DRG C16A http://www.health.gov.au/internet/ main/publishing.nsf/Content/ 88F4E78E15620A80CA2571CB 0004DDAA/$File/_R9CWNatEst.xls http://www.abs.gov.au/AUSSTATS/abs@.nsf/ DetailsPage/6401.0Mar%202008?OpenDocument
100% got one OT home visit and assessment	use the total cost calculated per participant for the home modification intervention LOW COST TOTAL $412.52 HIGH COST TOTAL $501.09	

Table 23 Items and unit costs used to derive intervention costs for the multidisciplinary falls clinic component (low cost option), multifactorial, health/environmental risk factor screening intervention model

Intervention	Proportion of falls clinic clients	Resource use	Unit Cost	Cost ($)	Reference/Website
Assessment stage					
geriatrician	100%	1.5hrs	geriatrician assessment	408.80	MBS page 111 item 141
physiotherapist	100%	1hr%	allied health appointment	47.85	MBS page 180 allied health appt
nurse	100%	1hr%	25ph+overhead +on costs	44.50	
admin assistance	100%	0.5hrs	19ph+overhead +on costs	18.41	
0.5 hr to attend team meeting and write referrals	100%		geriatrician/nurse/physio 1/2 plus overheads plus on costs	79.66	nurse https://jobsearch.gov.au/joboutlook/default.aspx?pageId=KeyInfo2&AscoCode=2323 physio, medico https://jobsearch.gov.au/joboutlook/default.aspx?pageId=KeyInfo2&AscoCode=2311
one review assessment for each client	100%	1	geriatric review	255.50	MBS page 111 item 143
		SUBTOTAL ASSESSMENT STAGE		**854.72**	
Intervention stage				**Proportion by unit cost**	
Home exercise programs	47%		1090..51 (low cost)	512.54	Home based exercise program costing (section 3.2)
Day hospital or community therapy service	41%	costed as 1 treatment a week for 10 weeks by physio	47.85	196.19	MBS page 180 allied health appt
Further medical investigations/ medical management of disorder	30%	2 specialist visits	77.25	46.35	geriatric medical specialist, MBS, p108
Group exercise	25%		383 (low cost)	95.75	Tai chi cost (section 3.1)
Gait aid change	25%	cost of walking frame	120.00	30.00	http://www.mobsol.com.au/c/156039/1/walking-frames-walkers.html?gclid=CJH9h4Gvw5MCFQ6WggodS3aDCQ
Footware change	19%	cost of good shoes	80.00	15.20	http://paulswarehouse.netregistry.net/shop/product.php?productid=20134&cat=390&page=2
Footcare	17%	1 podiatrist visit	47.85	8.13	page 180 MBS
Hip protectors	17%	1 "safehip" from sanicare	97.89	16.64	http://www.sanicare.com.au/Default.aspx?ID=4663 phone call to 1800 655 152, 26 May 08, price for safehip classic, all sizes same price
		SUBTOTAL INTERVENTION STAGE		**920.80**	
per client cost				**1775.52**	

Table 24 Items and unit costs used to derive intervention costs for the multidisciplinary falls clinic component (high cost option), multifactorial, health/environmental risk factor screening intervention model

Intervention	Proportion of falls clinic clients	Resource use	Unit Cost	Cost	Reference/Website
Assessment stage					
geriatrician	100%	1.5hrs	geriatrician assessment	408.80	MBS page 111 item 141
physiotherapist	100%	1hr%	allied health appointment	47.85	MBS page 180 allied health appt
nurse	100%	1hr%	25ph+overhead +on costs	44.50	
admin assistance	100%	0.5hrs	19ph+overhead +on costs	18.41	
0.5 hr to attend team meeting and write referrals	100%		geriatrician/nurse/physio 1/2 plus overheads plus on costs	79.66	nurse https://jobsearch.gov.au/joboutlook/default.aspx?pageId=KeyInfo2&AscoCode=2323 physio, medico https://jobsearch.gov.au/joboutlook/default.aspx?pageId=KeyInfo2&AscoCode=2311
one review assessment for each client	100%	1	geriatric review	255.50	MBS page 111 item 143
		SUBTOTAL ASSESSMENT STAGE		**854.72**	
Intervention stage				**Proportion by unit cost**	
Home exercise programs	47%		1232.89 (high cost)	579.46	Home based exercise program costing (section 3.2)
Day hospital or community therapy service	41%	costed as 1 treatment a week for 10 weeks by, physio	47.85	196.19	MBS page 180 allied health appt
Further medical investigations/ medical management of disorder	30%	2 specialist visits	77.25	46.35	geriatric medical specialist, MBS, p108
Group exercise	25%		557 (high cost)	139.25	Tai chi cost (section 3.1)
Gait aid change	25%	cost of walking frame	120.00	30.00	http://www.mobsol.com.au/c/156039/1/walking-frames-walkers.html?gclid=CJH9h4Gvw5MCFQ6WggodS3aDCQ
Footware change	19%	cost of good shoes	80.00	15.20	http://paulswarehouse.netregistry.net/shop/product.php?productid=20134&cat=390&page=2
Footcare	17%	1 podiatrist visit	47.85	8.13	page 180 MBS
Hip protectors	17%	1 "safehip" from sanicare	97.89	16.64	http://www.sanicare.com.au/Default.aspx?ID=4663 phone call to 1800 655 152, 26 May 08, price for safehip classic, all sizes same price
		SUBTOTAL INTERVENTION STAGE		**1031.22**	
Per client cost				**1885.94**	

3.4.3 Assumptions

The following specific assumptions, in addition to those outlined in Chapter 2, were made in establishing this model:

- The proportion of community dwelling Victorians aged 65+ years who either presented or were admitted due to a fall in 2006 is similar to the national proportion;
- The proportion of community dwelling Victorians aged 65+ years who presented or were admitted due to a fall in 2006 will not have changed to any great extent in 2009;
- The proportion of people in Australia who were not proficient in English in 2006 will not have changed to any great extent in 2009;
- The proportion of community dwelling people aged 65+ years who were profoundly limited in their core activities by dementia in 2006 would not have changed to any great extent in 2009;
- Implementation via general practitioners would be as effective as implementation by the hospital in the research setting
- The mix of specific falls prevention measures observed in the Close et al (1999) trial will remain constant if the intervention were widely implemented.

3.4.4 Results

Base case

The numbers of falls prevented and hospital admissions averted in the base case scenario i.e., using the point estimates for the model input variables (Table 21), are shown in Table 25. If 55.4% of the eligible population take up the multidisciplinary multifactorial intervention option, 59,706 falls will be prevented, and 1,194 fall-related hospital admissions averted. The projected 2009 fall-related hospital admission rate for older people 65+ years would be reduced by 1.6%, and the rate for community dwelling older people 65+ years would be reduced by 2.0%. For each person in the target group who participates, 1.5 falls are prevented. Thirty-three people need to participate to prevent one hospital admission.

Table 25 Estimation of number of falls prevented and hospital admissions averted, multi-disciplinary, multi-factorial risk screening and intervention, eligible Australian population 2009

Option	N falls when no intervention	N people taking up intervention	N falls when intervention offered	N falls prevented	N hosp admissions when no intervention	N hosp admissions when intervention offered	N hospital admissions averted
Base case	189,124	39,717	129,418	59,706	3,782	2,588	1,194

One way sensitivity analyses

The changes in the base case scenario generated by changing the values, one at a time, of the model input variables are shown in Table 26. Percentage changes, relative to the base case scenario, are shown. A negative value means that fewer falls and falls hospitalisations would be prevented compared with the base case, eg., the low value for uptake would result in 10% less falls prevented than the base case scenario. However, even with this lower value, 53,735 falls would still be prevented. Clearly, the variables influencing the estimate of the number of falls prevented are the uptake rates and the level of intervention effectiveness, the latter having a notable influence. The proportion of people admitted to hospital, and the intervention effectiveness had a similar influence on the number of hospital admissions averted.

Cost effectiveness

The unit cost for the multidisciplinary multifactorial intervention was $1,244 per participant for the lower cost option (used for the base case scenario), and $1,407 for the higher cost option (Table 27). This translated to costs of $828 and $41,374 per fall prevented and per hospital admission averted respectively, in the base case scenario (Table 28). Two factors influenced the cost per fall prevented: intervention effectiveness and intervention cost. A less effective intervention would have a large influence on both the cost per fall prevented and per hospital admission averted. The largest influences on the total cost were the uptake rate and the variation in the intervention cost (Table 28).

Table 26 One way sensitivity analysis, multi-disciplinary, multi-factorial risk screening and intervention, eligible Australian population 2009

Option	Falls when no interven-tion	People taking up interven-tion	Falls when interven-tion offered	Falls prevented		Hosp admissions when no interven-tion	Hosp admissions when interven-tion offered	Hospital admissions averted	
	n	*n*	*n*	*n*	%[c]	*n*	*n*	*n*	%[c]
Low uptake	189,124	35,745	135,388	53,735	-10	3,782	2,708	1,075	-10
High uptake	189,124	43,688	123,447	65,676	10	3,782	2,469	1,314	10
Low [a] hospitalisation	189,124	39,717	129,418	59,706	0	2,648	1,812	836	-30
High [a] hospitalisation	189,124	39,717	129,418	59,706	0	4,917	3,365	1,552	30
More effective intervention[b]	189,124	39,717	115,707	73,416	23	3,782	2,314	1,468	23
Less effective intervention[b]	189,124	39,717	149,123	40,001	-33	3,782	2,982	800	-33

[a] Low and high hospitalisation calculations have been made using the uptake rate and intervention effectiveness for base case.

[b] Intervention fall rates set at the upper (less effective) and lower (more effective) bounds of the confidence interval; all other parameters at base case levels

[c] Percentage change from the base case shown in Table 25. While a negative value means that fewer falls would be prevented compared with the base case scenario, some falls would still be prevented

Table 27 Implementation costs, multi-disciplinary, multi-factorial risk screening and intervention

Item	Lower cost option- $AUS*	Higher cost option- $AUS*
Hospital register check and referral to GP	23.06	23.06
Medical assessment, plan development and discussion	313.85	352.85
Hospital outpatient dept visit (weighted for 36% participants)	52.80	52.80
Multidisciplinary falls clinic (weighted for 21% participants)	372.86	396.05
GP visit for medication review (weighted for 18% participants)	7.56	19.44
Optometrist visit (weighted for participants 15%)	61.30	61.30
Occupational therapy home visit (100%)	412.52	501.09
Total	**1243.95**	**1406.59**

*Note this is an average cost and may differ depending on scale of intervention and the proportion who receive each component

Table 28 Cost effectiveness, multi-disciplinary, multi-factorial risk screening and intervention, eligible Australian population, 2009

Scenario	People taking up intervention	Total cost	Cost per fall prevented		Cost per hospital admission averted	
	n	$AUS mill	$AUS	%[d]	$AUS	%[d]
Base case	39,717	49.41	827.49	0	41,374	0
Low uptake	35,745	44.67	827.49	0	41,374	0
High uptake	43,688	54.35	827.49	0	41,374	0
Low hospitalization [a]	39,717	49.41	827.49	0	59,106	43
High hospitalisation [a]	39,717	49.41	827.49	0	31,826	-23
More effective intervention [b]	39,717	49.41	672.96	-19	33,648	-19
Less effective intervention [b]	39,717	49.41	1235.11	49	61,756	49
Higher cost option[c]	39,717	55.86	935.68	13	46,784	13

[a] Low and high hospitalisation calculations have been made using the uptake rate and intervention effectiveness for base case.

[b] Intervention fall rates set at the upper (less effective) and lower (more effective) bounds of the confidence interval; all other input parameters at base case levels

c Input parameters at base case levels

[d] Percentage change from the base case. A negative value means that the cost per health outcome is less than that for the base case scenario

3.5 WITHDRAWAL OF PSYCHOTROPIC MEDICATION

3.5.1 Description of intervention

One published study reporting on the withdrawal of psychotropic medication for falls prevention was found suitable for inclusion in the Cochrane Review (Gillespie et al., 2006). This study by Campbell et al. (1999b) actually trialled two interventions in a factorial design: (1) gradual withdrawal of psychotropic medication versus and (2) a home-based exercise program.

The inclusion criteria required participants to be aged 65+ years, ambulatory in their own home, not receiving physiotherapy, currently taking a benzodiazepine, any other hypnotic, or any antidepressant or major tranquilliser, and thought by their general practitioner to benefit from psychotropic medication withdrawal. People were excluded from the study if they were cognitively impaired. Participants were invited to participate by a letter from their general practitioner.

Baseline assessments were carried out and the participants were randomised to one of the four groups (1) medication withdrawal plus exercise (*n*=24); (2) medication withdrawal, no exercise (*n*=24); (3) no medication withdrawal plus exercise (*n*=21); (4) no medication withdrawal and no exercise (*n*=24).

At the beginning of this double blind trial, all participants were given study capsules containing their usual medications. Doses for the intervention group were gradually reduced over 14 weeks: 80% of the original dose after 2 weeks, 60% after five weeks, 40% after eight weeks, and 20% after 11 weeks. By 14 weeks, the contents were replaced with a placebo. The control group continued to take their usual medication. Fall occurrence was monitored by participants through the use of a calendar for 44 weeks.

The relative hazard for falls in the medication withdrawal intervention group compared with those taking their normal medications was 0.34 (95%CI, 0.16,0.74). Results for the exercise program did not show any significant reduction in the risk of falls in this one small trial. The authors concluded that although the risk of falling was reduced by psychotropic medication withdrawal, it was very difficult to achieve permanent withdrawal (Campbell et al., 1999b).

3.5.2 Data sources

<u>Population data and factors used to select eligible population</u>

To determine the number of people eligible for this intervention, we obtained the most recent Disability, Ageing and Carers Survey (ABS, 2003), which classified people living in households by disability status. We excluded people who were under 65 years of age, and those who were profoundly limited in a core activity to satisfy the criterion of mobility and cognitive impairment (see Chapter 2.3.1). After estimating the proportion this group of people comprised in the 2003 population, we applied this proportion to the 2009 ABS projected population to obtain an estimate of the number of community dwelling people aged 65+ years who are mobile in their own home and not cognitively impaired in 2009 (n=2,514,026).

An estimate of the number of community dwelling people aged 65+ years and reporting the use of a psychotropic medication (sleeping tablets or capsules, tablet or capsules or anxiety or nerves, tranquillisers and antidepressants) was obtained from the 2004/5 ABS National Health Survey. This figure of 20.5% is likely to be a slight overestimate as some people in the survey may have been counted more than once depending on the number of medications they were taking. We applied the proportion of 0.205 to the 2009 estimate of community dwelling people 65+ years (mobile and not cognitively impaired) population to achieve an estimate of the number of people eligible for this intervention (n=515,375). It was not possible to estimate either the number of people receiving physiotherapy or the proportion of people for whom psychotropic medication withdrawal would be suitable. Hence, these two groups of people are included in the 2009 eligible population, which therefore may be a slight over-estimate of the total number who would be eligible in 2009.

Table 29 Estimated base case parameters for the withdrawal of psychotropic medication intervention model

Parameter	Base case value	Range	Source
Uptake - (%)	18.9	17.0 – 20-8	Campbell et al., 1999b
Average falls rate per person year (no intervention)	1.82	1.11 - 3.04	Campbell et al., 1999b
Average falls rate per person year (intervention)	0.62	0.36 - 1.07	Campbell et al., 1999b
Hospitalised falls (%)	2.0	1.4 – 2.6	Tiedemann et al. 2008, and L. Day, unpublished data, prospective falls data from Australian trials involving community dwelling older people

Intervention uptake

The uptake rate was determined from the published results of the trial. The number of people randomised (93) was divided by the number of people eligible for the intervention (493) to give an uptake rate of 18.9%. It was not possible to determine a range for this estimate as this is the only study of its kind. We therefore applied a ±10% factor to the uptake estimate to obtain the range. Although this was an arbitrary choice, it can easily be manipulated and the effect on uptake calculated.

Fall rates

For the purposes of the model, we considered fall outcomes from the medication withdrawal only group and the control group receiving neither intervention in this factorial trial (Campbell et al., 1999b). We calculated the fall rate for the control group by dividing the number of falls by the number of people given in Campbell et al. (1999b). This was then divided by the average follow up period (37.7 weeks = 263.9 days) and multiplied by 365 days to obtain the number of falls per person per year. As the trial reported a 66% reduced risk of a fall for the medication withdrawal group, this percentage decrease was applied to the above control group fall rate to obtain the intervention group fall rate. The fall rates are shown in Table 29.

Confidence intervals for the fall rates

Unpublished fall frequency distributions were provided by Robertson for both the control and intervention groups. These were used to calculate the 95% confidence intervals as described in Chapter 2, and shown in Table 29.

Costs of intervention

The aim was to cost the intervention reported by Campbell et al. (1999b), which involved the gradual reduction over a 14 week period of the dosage of selected psychotropic medication. The major issue with this intervention is the practicality of reproducing the medication withdrawal regime in line with the reported protocol of reduction to 80%, 60%, 40% and 20% of original dose over a 14-week period, as doses available under the Pharmaceutical Benefits Scheme (PBS) are not consistent with this regime. For example, sertraline is only dispensed in Australia in a 50mg or 100mg dose and paroxetine is only dispensed as a 20mg tablet (Pharmaceutical Benefits Scheme). Reducing dosages by asking participants to physically split tablets is also problematic as it still may not provide the required dosage options and has practical constraints, especially for some older people.

In the research trial, medications were reformulated by a study pharmacist. Contact with a pharmacist (and university researcher) indicated that for certain medications, reformulation to reduced doses by a community pharmacist would be possible, but at considerable cost, estimated at $100 per script.

We considered two different modes for intervention delivery: reformulation by a community pharmacist (high and low cost options), and "off-the-shelf" dosage reduction using venlafaxine as an example of one of the few common psychotropic medications for which a range of dosages are available. The reformulation low cost option was used for the base case scenario.

Average daily cost for medications in this group were calculated. The most commonly used psychotropic medications among community dwelling people 65+ years were identified from the 2004-2005 National Health Survey (ABS, 2006), and the most commonly prescribed doses, and the matching cost, were obtained from the PBS. These data were combined to calculate a weighted average daily cost, which was then used in the reformulation mode cost options (Table 30). The actual daily cost of venlafaxine was used in the "off-the-shelf" dosage reduction mode.

Both modes included costs to allow for a GP to identify prospective patients for this intervention, and six medical visits over the course of the dosage reduction (Table 31).

The cost estimates do not adjust for failure of patients in maintaining the adjusted dosage. However, the trial analysis was conducted on an intention to treat basis, so the impact of non-compliance is reflected in the falls rate in the presence of the intervention. Other than the GP visits, there are no costs for supporting the reduction in dosage. There are no costs included for GP education which would be required regardless of the intervention delivery mode.

Table 30 Weighted daily costs for most commonly used psychotropic medications among community dwelling older people 65+ years, psychotropic medication withdrawal intervention model

Name	Quantity	Price	Daily price	Popn % use	Weighted cost $
Temazepam	25	11.95	0.48	24	0.211
Oxazepam	25	11.32	0.45	6.8	0.057
Diazepam	50	12.28	0.25	6.5	0.030
Sertraline	30	31.30	1.04	5	0.097
Amitryptyline	50	12.23	0.24	4.5	0.020
Paroxetine	30	31.3	1.04	4.1	0.080
Venlafaxine	28	41.3	1.22	2.9	0.065
TOTAL					**0.55**

Table 31 Items and unit costs used to derive intervention costs for the psychotropic medication withdrawal intervention model

Item	Cost	Reference
Time for practice manager/nurse to check register	Assume 10 mins. per patient = 1/6 x $25.9 x1.28 x1.5) - $8.25	Hourly cash earnings for an office or practice manager from the ABS = 25.90 http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/6306.0May%202006?OpenDocument admin charge based on casual rate for admin staff. (wage over heads of 28% and office overheads of 50%
Time for GP to look over the list and confirm suitable patients	10 mins GP time per patient = $15	Costed as a brief consult level A MBS Schedule
6 initial standard GP consultations (assuming one visit at start and finish, and one for each point in the dosage reduction schedule)	6 standard visits Medicare rate, standard consult $21 However the AMA rate is:- $54	Medicare Benefits Schedule Book Operating from 1 November 2007, Australian Government Department of Health and Ageing P105 AMA standard rate in 2004
Cost of medication reformulation	Contact with pharmacist indicated cost of ~$100 per script	Personal communication practicing pharmacist* *Note: may be advisable to check with other community pharmacists

3.5.3 Assumptions

The following specific assumptions, in addition to those outlined in Chapter 2, were made in establishing this model:

- As we were unable to estimate the number of people who might benefit from this intervention (as was done in the study) we have assumed that the entire estimated eligible population would benefit in our study;
- Proportion of people on psychotropic medication in 2009 does not differ to proportion in 2004/5.
- The estimate of an uptake of ±10% is reasonable

3.5.4 Results

Base case

The numbers of falls prevented and hospital admissions averted in the base case scenario i.e., using the point estimates for the model input variables (Table 29), are shown in Table 32. If approximately 19% of the eligible population take up the withdrawal of psychotropic medication intervention option, 117,208 falls will be prevented, and 2,344 fall-related hospital admissions averted. The projected 2009 fall-related hospital admission rate for older people 65+ years would be reduced by 3.1%, and the rate for community dwelling older people 65+ years would be reduced by 3.9%. For each person in the target group who participates, 1.2 falls are prevented. Forty-two people need to participate to prevent one hospital admission.

Table 32 Estimation of number of falls prevented and hospital admissions averted, withdrawal of psychotropic medication intervention, Australian population 2009

Option	Falls when no intervention	People taking up intervention	Falls when intervention offered	Falls prevented	Hosp admissions when no intervention	Hosp admissions when intervention offered	Hospital admissions averted
	n	*n*	*n*	*n*	*n*	*n*	*n*
Base case	939620	97406	822412	117208	18792	16448	2344

One way sensitivity analyses

The changes in the base case scenario generated by changing the values, one at a time, of the model input variables are shown in Table 33. Percentage changes, relative to the base case scenario, are shown. A negative value means that fewer falls and falls hospitalisations would be prevented compared with the base case, eg., the low value for uptake would result in 5% less falls prevented than the base case scenario. However, even with this lower value, 105,487 falls would still be prevented. Clearly, the variables influencing the estimate of the number of falls prevented are the uptake rates and the level of intervention effectiveness, the latter having a notable influence. The proportion of people admitted to hospital, and the intervention effectiveness had a similar influence on the number of hospital admissions averted.

Cost effectiveness

The unit cost for the psychotropic medication withdrawal intervention was $604 per participant for the reformulation mode lower cost option (used for the base case scenario), and $798 for the higher cost option (Table 34). The "off-the-shelf" dosage reduction mode was considerably less at $251 per participant. However, there are a limited number of medications for which this option would be available. This translated to costs of $502 and $25,092 per fall prevented and per hospital admission averted respectively, in the base case scenario (Table 35). Two factors influenced the cost per fall prevented: intervention effectiveness and intervention cost. A less effective intervention would have a large influence on both the cost per fall prevented and per hospital admission averted. The largest influences on the total cost were the uptake rate and the variation in the intervention cost (Table 35). There are no costs included for GP education which would be required regardless of the intervention delivery mode, and are likely to significantly increase the costs.

Table 33 One way sensitivity analysis, withdrawal of psychotropic medication intervention, eligible Australian population, 2009

Option	Falls when no interven-tion	People taking up interven-tion	Falls when interven-tion offered	Falls prevented		Hosp admissions when no intervention	Hosp admissions when intervention offered	Hospital admissions averted	
	n	*n*	*n*	*n*	%[c]	*n*	*n*	*n*	%[c]
Low uptake	939,620	87,665	834,133	105,487	-10	18,792	16,683	2,110	-10
High uptake	939,620	107,147	810,691	128,929	10	18,792	16,214	2,579	10
Low [a] hospitalisation	939,620	97,406	822,412	117,208	0	13,155	11,514	1,641	-30
High [a] hospitalisation	939,620	97,406	822,412	117,208	0	24,430	21,383	3,047	30
More effective intervention[b]	939,620	97,406	796,925	142,696	22	18,792	15,938	2,854	22
Less effective intervention[b]	939,620	97,406	866,401	73,220	-38	18,792	17,328	1,464	-38

[a] Low and high hospitalisation calculations have been made using the uptake rate and intervention effectiveness for base case.
[b] Intervention fall rates set at the upper (less effective) and lower (more effective) bounds of the confidence interval; all other parameters at base case levels
[c] Percentage change from the base case

Table 34 Implementation costs, withdrawal of psychotropic medication intervention

Item	Reformulation mode, lower cost option- $AUS	Reformulation mode, higher cost option- $AUS	"Off-the-shelf" dosage reduction $AUS
Identification of suitable patients by GP	23.25	23.25	23.25
6 visits to GP	126.00 (MBS rate)	324.00 (AMA rate)	126.00 (MBS rate)
14 weeks at average medication cost	54.62	54.62	85.22*
Reformulation of medication (4 times)	400.00	400.00	N/a
Total	**603.87**	**797.87**	**234.47**

*Daily cost is higher than average for this group of medications

Table 35 Cost effectiveness, withdrawal of psychotropic medication intervention, eligible Australian population, 2009

Scenario	People taking up intervention	Total cost	Cost per fall prevented		Cost per hospital admission averted	
	n	$AUS mill	$AUS	%[d]	$AUS	%[d]
Base case-reformulation low cost	97,406	58.82	502	0	25,092	0
Low uptake	87,665	52.94	502	0	25,092	0
High uptake	107,147	64.70	502	0	25,092	0
Low hospitalization [a]	97,406	58.82	502	0	35,846	43
High hospitalisation [a]	97,406	58.82	502	0	19,302	-23
More effective intervention [b]	97,406	58.82	412	-18	20,610	-18
Less effective intervention [b]	97,406	58.82	803	60	40,167	60
Reformulation high cost option[c]	97,406	77.72	663	32	33,154	32
"Off-the-shelf" dosage reduction option[c]	97,406	22.84	195	-61	9,743	-61

[a] Low and high hospitalisation calculations have been made using the uptake rate and intervention effectiveness for base case.

[b] Intervention fall rates set at the upper (less effective) and lower (more effective) bounds of the confidence interval; all other input parameters at base case levels

c Input parameters at base case levels

[d] Percentage change from the base case. A negative value means that the cost per health outcome is less than that for the base case scenario

3.6 CARDIAC PACING

3.6.1 Description of intervention

One published study that reported the effectiveness of cardiac pacing in fallers who were found to have cardioinhibitory carotid sinus hypersensitivity (CSH) was found suitable for inclusion in the Cochrane Review. CSH is an age-related condition rarely diagnosed in those younger than 50 years. It causes recurrent syncope and is therefore associated with frequent falls. It can be treated by cardiac pacing (Kenny et al., 2001).

In the research trial, potential eligible participants were screened from a hospital emergency department registration database by dedicated research staff over a 29 month period (Kenny et al., 2001). Initial screening selected those who were 50+ years, had presented because of a non-accidental fall (i.e., there was no external cause) for which there was no medical explanation, and not cognitively impaired. A clinical assessment was then carried out to diagnose the condition through carotid sinus massage. Participants who were identified as having CSH were randomised to receive a pacemaker or usual treatment.

The primary outcome was the number of falls during the 12 months following randomisation, monitored prospectively with weekly diary cards. Multilevel logistic regression analysis showed that paced patients (n=87) were less likely to fall than controls (n=88) (OR 0.42; 95% CI: 0.23, 0.75) (Kenny et al., 2001).

3.6.2 Data sources

Population data and factors used to select eligible population

The first step in determining the eligible population for the model involved applying the proportion of diagnosed people with cardioinhibitory CSH among emergency department attendees 50+ years from the trial (218/24,251; 0.9%), to the number of hospital emergency presentations in 2006 by those aged 50+ years in the Victorian hospital emergency presentations dataset (17,879). This produced an estimate of 161 people. This represented 0.0103% of the Victorian population aged 50 years and over in 2006. This percentage was then applied to the national projected population for 2009 to obtain the number of eligible people for this intervention in Australia in 2009 (n=706).

Table 36 Estimated base case parameters for the cardiac pacing intervention model

Parameter	Base case value	Range	Source
Uptake - (%)	80	72.0 – 88.0	Kenny et al., 2001
Average falls rate per person year (no intervention)	9.3	6.2 - 13.9	Kenny et al., 2001
Average falls rate per person year (intervention)	4.1	2.7 - 6.3	Kenny et al., 2001
Hospitalised falls (%)	2.0	1.4 – 2.6	Tiedemann et al. 2008, and L. Day, unpublished data, prospective falls data from Australian trials involving community dwelling older people

Intervention uptake

The uptake rate was determined from the published results of the trial. The number of people randomised (175) was divided by the number of people eligible for the intervention (218) to give an uptake rate of 80.3%. It was not possible to determine a range for this estimate as there are insufficient similar studies. We therefore applied a ±10% factor to the uptake estimate to obtain the range (Table 36). Although this was an arbitrary choice, it can easily be manipulated and the effect on uptake calculated.

Fall rates

Fall rates for the control and intervention groups were taken directly from the published results (Kenny et al., 2001). Control and intervention fall rates were 9.3 and 4.1 falls per person per year, respectively.

Confidence intervals for the fall rates

Published fall rates for this intervention were not available nor were we able to source them. However, using published information from the trial we were able to reconstruct the falls distribution using a negative binomial model. The inputs into this model were the fall rate, sample size and standard deviation of the number of falls for both the control and intervention groups (control: 9.3, n = 88, SD = 18.1; intervention: 4.1, n = 87, SD = 8.3). The resulting confidence intervals are shown in Table 36.

Costs of intervention

The resource use is based on the description of the intervention given in Kenny et al (2001). The intervention includes the cost of screening to identify suitable recipients and the cost of the inserting the pacemaker. Screening occurred in two stages:

- an initial screen, based on a review of demographic, clinical and falls related data collected on falls patients who presented at Emergency Department,
- a second carotid screen based on a detailed clinical assessment, with eligible patients referred for pacemaker insertion.

It is assumed that the initial screen would be based on information collected routinely at ED; and as such has not been costed as part of this intervention. If this information is not collected routinely, this intervention will involve an additional cost.

In relation to clinician costs, two alternative scenarios are costed; one based on the Australian Medical Association (AMA) suggested fees and the other the Medicare Benefits Schedule (MBS) fees. Results are provided as a high or low option reflecting the two scenarios.

Items, cost and the sources for the costs are shown in Table 37.

3.6.3 Assumptions

The following specific assumptions, in addition to those outlined in Chapter 2, were made in establishing this model:

- The prevalence of CSH in the trial is generalisable to Australians 50+ years presenting to hospital emergency departments following a fall
- The pattern of emergency department presentations following a fall among those 50+ years in Victoria is generalisable to Australia.
- The estimate of an uptake of ±10% is reasonable

Table 37 Items and unit costs used to derive intervention costs for the cardiac pacing intervention model

Item	Cost	Reference
Screening by carotid sinus massage	$169.50 per scan 7.5 carotid sinus screens are undertaken per eligible patient [1]; so cost per eligible patient = $1271 (7.5x 169.50)	Medicare Benefits Schedule Book, p550 Based on the flow chart, illustrated on page 1493 of Kenny et al (2001)
Cardio vascular assessment	a) low cost: Standard Medicare item for a first visit to a cardio- vascular specialist b) high cost: AMA schedule fee $250	Medicare Benefits Schedule Book [2] P108 http://feeslist.ama.com.au/ Excerpt Provided by AMA
Insertion of pacemaker	DRG cost is inclusive of pacemaker, theatre fees, anesthetist, surgeon, accommodation etc. DRG cost 2004-05 for insertion of pacemaker = $11,106 (direct $9,520 + overhead $1,586). Adjust to 2008$ using CPI	National Hospital Cost Data Collection (p.16) Public Sector - (2004-05), CPI adjustment: (Mar quarter. 2005 148.4, Mar quarter 2008 162.2)
Post pacemaker visit	6 week check with specialist post pacemaker insertion. MBS $77.25 AMA fee $114	MBS P108 Provided by AMA

3.6.4 Results

Base case

The numbers of falls prevented and hospital admissions averted in the base case scenario i.e., using the point estimates for the model input variables (Table 36), are shown in Table 3.6.3. If 80% of the eligible population take up the cardiac pacing intervention option, 3,619 falls will be prevented, and 59 fall-related hospital admissions averted. Although the selection criteria included those 50+ years, the average age of the intervention group in the trial was 73 years (Kenny et al., 2001). Therefore the impact on the projected 2009 fall-related hospital admission rate was calculated for older people 65+ years, the target group for most falls prevention priorities. The projected 2009 fall-related hospital admission rate for older people 65+ years would be reduced by 0.08%, and the rate for community dwelling older people 65+ years would be reduced by 0.1%. For each person in the target group who participates, 5 falls are prevented. Ten people need to participate to prevent one hospital admission.

Cardiac pacemakers can be expected to function for at least 5 years (www.betterhealth.vic.gov.au). If we assume that the reduced fall rate is sustained over this period, then this one investment in the cardiac pacing intervention could be expected to prevent approximately 14,735 falls over a five-year period and avert approximately 295 fall-related hospital admissions. Twenty-six falls would be prevented over this period for each person who receives a pacemaker. Two people would need to receive a pacemaker to prevent one fall related hospital admission.

Table 38 Estimation of number of falls prevented and hospital admissions averted, cardiac pacing intervention, eligible Australian population 2009

Option	N falls when no intervention	N people taking up intervention	N falls when intervention offered	N falls prevented	N hosp admissions when no intervention	N hosp admissions when interventio n offered	N hospital admissions averted
Base case	6,566	567	3,619	2,947	131	72	59

One way sensitivity analyses

The changes in the base case scenario generated by changing the values, one at a time, of the model input variables are shown in Table 39. Percentage changes, relative to the base case scenario, are shown. A negative value means that fewer falls and falls hospitalisations would be prevented compared with the base case, eg., the low value for uptake would result in 10% less falls prevented than the base case scenario. However, even with this lower value, 2,643 falls would still be prevented. Clearly, the variables influencing the estimate of the number of falls prevented are the uptake rates and the level of intervention effectiveness. The proportion of people admitted to hospital had a major influence on the number of hospital admissions averted. The level for the less effective intervention had a substantial impact on hospital admissions averted.

Table 39 One way sensitivity analysis, cardiac pacing intervention, eligible Australian population 2009

Option	Falls when no interven-tion	People taking up interven-tion	Falls when interven-tion offered	Falls prevented		Hosp admissions when no interven-tion	Hosp admissions when interven-tion offered	Hospital admissions averted	
	n	*n*	*n*	*n*	%[c]	*n*	*n*	*n*	%[c]
Low uptake	6,566	508	3,923	2,643	-10	131	78	53	-10
High uptake	6,566	621	3,335	3,231	10	131	67	65	10
Low [a] hospitalisation	6,566	567	3,619	2,947	0	92	51	41	-30
High [a] hospitalisation	6,566	567	3,619	2,947	0	171	94	77	30
More effective intervention[b]	6,566	567	2,808	3,758	28	131	56	75	28
Less effective intervention[b]	6,566	567	4,923	1,643	-44	131	98	33	-44

[a] Low and high hospitalisation calculations have been made using the uptake rate and intervention effectiveness for base case.
[b] Intervention fall rates set at the upper (less effective) and lower (more effective) bounds of the confidence interval; all other parameters at base case levels
[c] Percentage change from the base case

Cost effectiveness

The unit cost for the cardiac pacing intervention was $13,526.07 per participant for the lower cost option (used for the base case scenario), and $13,744.02 for the higher cost option (Table 40). This translated to costs of $2,601 and $130,058 per fall prevented and per hospital admission averted respectively, in the base case scenario (Table 41). The main influence on the cost per fall prevented was a less effective intervention. The proportion of fallers admitted to hospital was the main influence on the cost per hospital admission averted. The largest influence on the total cost were the uptake rate (Table 41).

Table 40 Implementation costs, cardiac pacing intervention

Item	Lower cost option-$AUS*	Higher cost option-$AUS*
Carotid screening	1271.25	1271.25
Initial specialist consultation	77.25	250.00
Pacemaker insertion	12,138.77	12,138.77
Post-pacemaker insertion visit	38.80	114.00
Total	**13,526.07**	**13,744.02**

Table 41 Cost effectiveness, cardiac pacing intervention, eligible Australian population 2009

Scenario	People taking up intervention	Total cost	Cost per fall prevented		Cost per hospital admission averted	
	n	$AUS mill	$	%[d]	$	%[d]
Base case	567	7.67	2601	0	130,058	0
Low uptake	508	6.88	2601	0	130,058	0
High uptake	621	8.40	2601	0	130,058	0
Low hospitalization [a]	567	7.67	2601	0	185,798	43
High hospitalisation [a]	567	7.67	2601	0	100,045	-23
More effective intervention [b]	567	7.67	2040	-22	101,990	-22
Less effective intervention [b]	567	7.67	4666	79	233,300	79
Higher cost option[c]	567	7.79	2643	2	132,154	2

[a] Low and high hospitalisation calculations have been made using the uptake rate and intervention effectiveness for base case.
[b] Intervention fall rates set at the upper (less effective) and lower (more effective) bounds of the confidence interval; all other input parameters at base case levels
c Input parameters at base case levels
d Percentage change from the base case. A negative value means that the cost per health outcome is less than that for the base case scenario

3.7 EXPEDITED CATARACT SURGERY

3.7.1 Description of intervention

One study published after the time period covered by the Cochrane review undertook a randomised trial of the effect of expedited first eye cataract surgery on vision and falls (Harwood et al., 2005). The intervention was to expedite the time of surgery for the first eye cataract, with the aim of reducing the waiting time from 13 months (the current routine waiting time) to 1 month. The actual difference in median waiting time achieved in the trial was 310 days (44.3 weeks, 10.2 months). The surgery was characterised by a small incision approach and implantation of a silicone intra-ocular lens under local anaesthetic. Participants randomised were women, 70+ years, referred to one of three consultant ophthalmologists, who had not had previous eye surgery. The following exclusion criteria were applied: cataract unsuitable for surgery by phacoemulsification, severe refractive error in the second eye, visual field defects, severe co-morbid eye disease, registrable as partially sighted (whose surgery would be normally expedited), and memory problems.

Falls occurrence was monitored prospectively for 12 months using participant diaries. Participants were contacted at three monthly intervals to record the dates of falls.

The rate of falls was reported as 1.00/1000 patient days in the intervention group (n=154), and 1.52/1000 patient days in the control group (n=152) (RR 0.66, 95% CI 0.45-0.96) (Harwood et al., 2005).

3.7.2 Data sources

<u>Population data and factors used to select eligible population</u>

If this intervention is to be considered for implementation in the Australian eligible population, the current median waiting time for cataract removal needs to be at least equal to or greater than 310 days (the reduction in median waiting time) for there to be a falls benefit of comparable magnitude to that in the trial.

Potential sources of information on waiting times in the public sector were the Medicare Benefits Schedule (MBS) website and the Australian Institute of Health and Welfare (AIHW). Waiting times were provided for broadly categorised surgical specialties such as ophthalmology, which cover a range of different types of eye surgery. However, waiting times for cataract surgery specifically were not published. The MBS website also provided information on the number of cataract removal procedures, with no distinction made between first and second eye cataract surgery.

The AIHW (2006) reports the number of days waited on the public waiting list at the 50th and 90th percentile and also makes no distinction between first and second eye cataract removal. The number of days waited at the 50th and 90th percentile is 93 and 342, respectively. This means that the median waiting time for cataract surgery in Australia is 93 days, substantially less than the 310 days by which surgery was expedited in the trial. As 90% of the people on the waiting list have had their surgery by 342 days, the remainder on the waiting list have had to wait longer than 342 days, identifying them as a group for whom it would be possible to reduce their waiting time by 310 days, and therefore to whom a similar falls benefit as experienced in the trial would apply.

We were unable to source information on waiting times for the private sector. However, anecdotal evidence suggests that waiting times in the private sector are considerably less than the public sector, suggesting that few patients in the private sector would be likely to benefit from this intervention.

The unpublished figure for the number of people (of all ages) on the waiting list at the census taken at 30 June 2006 (19,658) was provided to us by the AIHW for use in this study. Based on the waiting time data above, 10% of these people who would be potentially eligible for the intervention (1,966). The best estimate available of the proportion of those eligible aged 70 years and over was obtained from AIHW (2006). This report showed that the proportion of people aged 65 years or over who underwent the *Lens extraction* procedure in 2005-06 was 83.6%.

Applying 83.6% to our sample of 1,966 people we obtained 1,643 people who would be potentially eligible. However, the lens extraction procedure is carried out for a range of diagnoses, some of which were used as exclusion criteria in the trial. We obtained an estimate from AIHW (2006) of the proportion of people who had a lens extraction procedure with a principal diagnosis of *other cataract* in the public sector (29,131/51,632). Therefore the total number of people eligible for this intervention is 933.

Table 42 Estimated and assumed base case parameters for the expedited cataract surgery intervention

Parameter	Base case value	Range	Source
Uptake - (%)	98.7	93.8 - 100	Harwood et al. 2005
Average falls rate per person year (no intervention)	0.55	0.42 - 0.73	Harwood et al. 2005
Average falls rate per person year (intervention)	0.36	0.30 - 0.44	Harwood et al. 2005
Hospitalised falls (%)	2.0	1.4 – 2.6	Tiedemann et al. (2008), and L. Day, unpublished data, prospective falls data from Australian trials involving community dwelling older people

<u>Intervention uptake</u>
The intervention uptake rate is expected to be 98.7%, based on the trial (Harwood et al., 2005). It is anticipated that the only reason for refusal would be due to ill health as was the case in the trial. In determining the lower end of the range, we assumed a 5% maximum refusal rate relative to the base case and a 100% maximum uptake. The values are shown in Table 42.

<u>Fall rates</u>
Falls rates for both the control and intervention groups were obtained from the published trial (Harwood et al., 2005) The rates, which were originally presented as per 1000 patient days were converted to per patient years for use in this study and are shown in Table 42.

Confidence intervals for the fall rates

Confidence intervals for this intervention could not be determined as we were unable to obtained the falls distributions from the trial nor we were able to locate an applicable falls frequency distribution from any other published study. Therefore we decided to construct the confidence intervals by applying a percentage increase and decrease of 15%, which was of similar magnitude to other trials in this study of comparable sample size and intervention effectiveness.

Costs of intervention

Expediting surgery could be achieved by adopting one of two main strategies. The first would be to re-prioritise the waiting lists so that those waiting for cataract surgery would be brought forward, while those waiting for some other category of surgery would be moved back. Moving people up the waiting list would presumably not cost more than the normal management of patients on surgical waiting lists. The cost of surgery would be the same, given that the expedited surgery is occurring within 12 months of when the cost for routine surgery would have occurred ("reverse" discounting would be required if the waiting time was being reduced by more than 12 months). This strategy would also require additional capacity among ophthalmologists to undertake cataract surgery, and sufficient availability of hospital resources (theatres, equipment, nursing and other associated staff). Hospital resources could be available as a consequence of moving other patients down the waiting list, perhaps with the exception of specialised equipment required for cataract surgery. The decision to re-prioritise the waiting list would obviously be a complex one, requiring careful consideration of the type of surgery for which people would have to wait longer. Since most cataract surgery involves a one-day stay, this has implications for the type of surgery which could be moved down the waiting list. Economic costs, poor health, and prolonged pain could arise among those who would have to be waiting longer for their surgery, depending on the category selected. Under this circumstance, any benefit arising from bringing forward cataract surgery could be offset by adverse effects arising from moving other surgery back.

The second strategy would be to increase the overall capacity of the hospital system, so that additional cataract surgery could be undertaken. This would require the availability of additional day case beds, theatre time, equipment, and medical, nursing and other personnel. In some jurisdictions the infrastructure (beds, theatres, equipment) might be available, although additional personnel might be required. In other jurisdictions the infrastructure might not be available and would need to be established, at considerable cost.

Due to these complexities and likely differing approaches in different jurisdictions, we have not attempted to cost this intervention.

3.7.3 Alternative modelling approach

Given the problems in being able to adequately estimate the eligible Australian population to whom the trial results could be reasonably applied, a different approach to that outlined above was also adopted. The number of people who would need to be brought forward on the waiting list to prevent one fall, and one fall related hospital admission were estimated. This was achieved by estimating the difference in the intervention and control group fall rates, and then mathematically deriving the number of people who would need to be brought forward on the waiting list (number needed to treat).

3.7.4 Assumptions

- Expediting cataract surgery is as effective in terms of preventing falls among men as it was among women in the research trial
- The waiting time for cataract surgery in the private sector is relatively short, with very few people waiting long enough for this intervention to be applicable
- The estimates for uptake are reasonable.

3.7.5 Results

Standard approach: base case

The numbers of falls prevented and hospital admissions averted in the base case scenario i.e., using the point estimates for the model input variables (Table 42) are shown in Table 43. If 921 people are brought forward on the waiting list and their wait reduced by 310 days, then 175 falls would be prevented and 3 hospital admissions averted. Six people would need to be treated to prevent 1 fall, and 307 to avert one hospital admission.

Table 43 Estimation of number of falls prevented and hospital admissions averted, expedited cataract surgery intervention, eligible Australian population 2009

Option	#Falls in population when no intervention offered	# People taking up intervention per Year	# Falls in population when intervention offered	# Falls Prevented when intervention offered	# Hosp Admissions in population when no intervention offered	# Hosp Admissions in population when intervention offered	# Hospital Admissions Averted when intervention offered
Base case	518	921	343	175	10	7	3

Standard approach: one way sensitivity analyses

The changes in the base case scenario generated by changing the values, one at a time, of the model input variables are shown in Table 44. Percentage changes, relative to the base case scenario, are shown. A negative value means that fewer falls and falls hospitalisations would be prevented compared with the base case, eg., the low value for uptake would result in 5% less falls prevented than the base case scenario. However, even with this lower value, 166 falls would still be prevented. Intervention effectiveness is clearly important for the number of falls prevented. The proportion of people admitted to hospital and intervention effectiveness had a major influence on the number of hospital admissions averted.

Table 44 One way sensitivity analysis, expedited cataract surgery intervention, eligible Australian population 2009

Option	Falls when no intervention	People taking up intervention	Falls when intervention offered	Falls prevented		Hosp admissions when no intervention	Hosp admissions when intervention offered	Hospital admissions averted	
	n	*n*	*n*	*n*	%[c]	*n*	*n*	*n*	%[c]
Low uptake	518	875	352	166	-5	10	7	3	-5
High uptake	518	933	341	177	1	10	7	4	1
Low [a] hospitalisation	518	921	343	175	0	7	5	2	-30
High [a] hospitalisation	518	921	343	175	0	13	9	5	30
More effective intervention[b]	518	921	283	234	34	10	6	5	34
Less effective intervention[b]	518	921	412	106	-40	10	8	2	-40

[a] Low and high hospitalisation calculations have been made using the uptake rate and intervention effectiveness for base case.
[b] Intervention fall rates set at the upper (less effective) and lower (more effective) bounds of the confidence interval; all other parameters at base case levels
[c] Percentage change from the base case

Alternative approach

The difference in the fall rates between the intervention and control groups in the trial was 0.52 falls per 1000 patient days. The intervention reduced the median waiting time by 310 days (44.3 weeks). This is the time period during which the benefit of the intervention would accrue, since the eye surgery would have been performed without the intervention, just at a later time. Hence the intervention benefit can be calculated as:

$$\frac{0.52 \text{ falls} \times 310 \text{ patient days}}{1000 \text{ patient days}}$$

=0.16 falls prevented per patient whose surgery is brought forward by 44.3 weeks.

Therefore, 6 people would need to have their surgery brought forward by 44.3 weeks to prevent one fall. Assuming 2% of falls require admission to hospital (as used in our modelling of the other interventions), 50 falls need to be prevented in order to avert one hospital admission. This being the case, 300 people would need to have their surgery brought forward by 44.3 weeks in order to avert one hospital admission for a fall. These figures are comparable to those calculated above using the output from the standard modelling approach.

Potential impact on falls reduction and fall-related hospital admissions

The extent to which this intervention would impact on reducing falls and fall-related hospital admissions depends to a degree on the current average waiting times for cataract removal in the Australian health care system. The published trial provides evidence regarding the falls reduction benefit in bringing forward cataract surgery by 310 days (44.3 weeks). As noted above, this would be possible for only about 10% of those on the public sector waiting list. It is not known if the relationship between falls reduction and waiting time is linear. If it is, then bringing 600 people forward by just over 22 weeks might result in the same hospital admission reduction (1 admission), as bringing 300 people forward by 44.3 weeks. If this were the case, then a much larger proportion of people on the waiting list could benefit. In order to produce a comparable impact on the hospital admission rate to that of the tai chi intervention (279 admissions averted, 0.4% reduction in the rate), 167,400 people would need to be brought forward by 22.15 weeks. This figure is substantially higher than the total number of people of all ages on the waiting list for cataract surgery as at June 2006 (19,658).

3.8 COMPARISON OF INTERVENTIONS

A comparison in tabular format of six of the interventions modelled can be found in Table 45. The expedited cataract surgery intervention was not included in this table due to the uncertainties inherent in estimating the eligible population and in estimating the potential benefit of this intervention for shorter reductions in the waiting time than that tested in the trial. The table compares the base case model outputs i.e., those derived using the best available point estimates for the model input parameters. The time period is 12 months for all interventions, plus two and five year estimates for the muscle strengthening and balance re-training exercise program and cardiac pacing interventions, respectively.

Table 45 Summary comparison of falls interventions

	Tai chi	Muscle-strengthening and balance re-training		OT home hazard assess and modification	Multi-dis. multi-factor. risk screening	Psychotropic medication withdrawal	Cardiac pacing	
Target group	70+ years, community dwelling, mobile	80+ years, community dwelling, mobile		65+ years, hospital inpatient not receiving OT visit as routine care, fall in previous 12 mths	65+ years, presenting to hospital ED for fall	65+ years, community dwelling, taking psychotropic medication	50+ years, presenting to hospital ED for fall, cardioinhibitory carotid sinus hypersensitivity	
		Year 1	Over 2 years				Year 1	Over 5 years
Uptake (% eligible population)	1.9	39.4		55.4	55.4	18.9	80.0	
Population uptake (n)	31,998	208,386		141,493	39,717	97,406	567	567
Falls reduction (%)	48.9	27.7	27.7	44.2	57.2	65.9	55.9	55.9
Cost per participant ($)	470	1,091	1,310	413	1,244	604 [c]	13,526	13,526
Falls prevented (n)	13,926	54,222	87,297	140,078	59,706	117,208	2,947	14,735
Hospital admissions averted (n)	279	3,521	5,669	2,802	1,194	2344	59	295
Reduction in fall-related hospital admission rate for 65+ years (%)	0.4	4.6[a]	2.7[b]	3.7	1.6	3.1	0.08	Not calculated
Reduction in fall-related hospital admission rate for community dwelling 65+ years (%)	0.5	5.9 [a]	3.5 [b]	4.7	2.0	3.9	0.1	Not calculated
Total cost ($M)	15.03	227.25	255.09	58.37	49.41	58.82 [c]	7.67	7.67
Cost/fall prevented ($)	1079	4,191	2,922	417	828	502 [c]	2,601	520
Cost/hospital admission averted ($)	53,974	64,542	44,997	20,834	41,374	25,092 [c]	130,058	25,986

[a] reductions for 80+ yrs and community dwelling 80+ yrs were 7.1% and 10.0% respectively
[b] for second year only, not years 1 and 2 combined; [c] additional implementation costs likely

4 POLICY SECTOR CONSULTATION

Falls policy development and implementation in Australia generally follows the National Public Health Partnership Planning Framework for Public Health Practice (National Public Health Partnership, 2000). This framework identifies a planning cycle consisting of six inter-related steps, built around the specific health issue context and stakeholders:

1. identify the determinants of the health problem
2. access the risk and benefits posed by these determinants
3. identify intervention options and appraise their level of evidence
4. decide the portfolio of interventions for the health problem
5. implement the portfolio
6. evaluate the effect.

The output from the epidemiological modelling component of this project contributes to step 4 in this process – deciding and specifying the intervention portfolio. In this framework, a portfolio is defined as a mix of interventions that best meets specified public health needs within given resources (National Public Health Partnership, 2000). The modelling results assist with the identification of the relative effectiveness and efficiency of the most promising falls interventions, which could then be incorporated into falls prevention portfolios.

It is important that the results of the modelling exercise are in a format that policy officers can readily use to support decisions regarding the mix of interventions to be delivered in their respective jurisdictions. Therefore, the aim of this component of the project was to design and test formats for conveying model findings to policy officers and practitioners.

4.1 METHODS

An iterative action research approach was used to consult with, and seek input from, the key stakeholders in falls prevention policy development and implementation in Australia's states and territories.

The state and territory health department officers with responsibility for falls prevention policy have formed the National Injury Prevention Working Group, which meets on a regular basis for the purposes of co-ordination and information and resource exchange. This group was identified as the key stakeholder group who would be using modelling results to inform policy decisions. The group meets several times each year, with usually one meeting on a face-to-face basis and the remainder by teleconference.

A series of three consultations, using the tai chi intervention as an example, were undertaken with National Injury Prevention Working Group to develop a format for the model output that would be readily useable by falls policy officers.

The first consultation occurred in March 2007, and consisted of two parts. The agenda included an orientation to the project and the proposed approach, an opportunity to provide general feedback guided by some questions as discussion starters, and the tabling of a proposed format for the model output with an opportunity to provide specific feedback on this component. A background paper was circulated prior to the meeting, which included the project overview, the discussion starter questions, and the proposed format. The consultation was undertaken face to face in conjunction with a two day meeting of the policy officers. Detailed notes were taken by a dedicated scribe, who was not involved in the discussion.

Two main sources were used to define the elements for inclusion in the proposed model output. Several members of the project team have previously been involved in formal and informal consultations which falls prevention policy officers in Australia, including both active and advisory participation in policy development and implementation processes. This combined experience had exposed project team members to many of the issues faced by Australian policy officers when deciding on interventions to be included in policies, and when implementing these interventions.

The second source was the published literature. There are no published examples of similar work in the falls area. However, the National Public Health Partnership Planning Framework for Public Health Practice included a useful discussion of the issues for consideration when selecting a portfolio (National Public Health Partnership, 2000). These issues had been informed by work undertaken by Rychetnik et al (2002) in identifying criteria for evaluating evidence on public health interventions. In addition, Australian obesity researchers had developed a specific framework for translation current evidence into action on obesity, in which the required outputs for policy purposes from any modelling exercise were articulated (Swinburn et al., 2005).

Following the first consultation, the proposed model format was revised in accordance with the discussion and circulated to the policy officer group. The revised format was discussed with the group in November 2007, in conjunction with a one day face to face meeting. A final iteration of revision and consultation took place in April 2008, in conjunction with a teleconference of the policy officer group.

4.2 RESULTS

The initial draft format for the modelling output was based on the principle of providing succinct information and consisted of two sections. The first section contained information about the intervention, the geographic area to which the results related, the time period, the target population, and the modelling results (point estimates and the range) for the numbers of falls and falls hospitalisations that would be prevented, the percentage change in the falls hospitalisation rate, and the cost per fall prevented in table format. The second section contained associated information, including commentary on specific issues that would need to be considered: timing of the benefit, other likely benefits, capacity building and workforce training, sustainability, and acceptability.

The first consultation in March 2007 confirmed the anticipated benefits of this modelling approach. It was clear that more detail would be appreciated and that the associated information needed to be expanded to cover additional issues. The revision resulted in more detail being included in the first section, and the following additional headings being included in the second section: model assumptions, timing of expenditure and benefits, infrastructure requirements, feasibility and equity. The costed inputs contributing to the cost per fall prevented were also included in table form.

The second consultation in November 2007 resulted in the need for few substantial changes to the format. Additional items were requested for the tabular information (total eligible population, cost per fall hospitalisation prevented). Concern was expressed regarding potential under-costing of interventions, and the need to include recruitment and follow-up (if a feature of the trial) costs was noted. Model scenarios in which some costs were recovered from the participants were requested. In addition, a summary of the key data inputs for the model and an indication of the level of confidence in these data inputs was recommended.

The third and final consultation in April 2008 confirmed that the model output format had been optimised. (Outputs for each intervention shown in agreed format in Appendix 2)

4.3 DISCUSSION

A major factor critical to underpinning the success of our iterative interaction process was the fact that the first major meeting was face-to-face. Every member of the research team made the effort to attend this meeting to meet the policy officers and to show their support and commitment to the project. This meeting demonstrated mutual commitment to the project and facilitated a two-way exchange which clarified expectations and developed agreement regarding the way in which the policy sector consultation would be developed.

Having said this, it was also important that at least some members of the research team had already had direct experience in working and consulting with some of the policy officers. This provided some credibility to the research team and assured the policy makers that we were a team that would be responsive to them. Importantly, good working relationships between policy makers and researchers need time to develop, to ensure a common language can be adopted and mutual respect is generated (Christoffel and Gallagher, 2006).

Through the direct consultative process, the researchers learnt a number of key things about the policy process and needs of policy makers. Before the consultation started, the research team believed that policy makers would require information in a “bare bones” or just “bottom-line” fashion whereby the results of the epidemiological modelling would be provided in simple, uncomplicated tables. It became very apparent early on that this was a mistaken belief and that, whilst clear and concise data presentations were needed, the policy makers also needed to know why certain assumptions and modelling decisions were made too. This observation was also noted by Mitton et al who summarised the situation as researchers tending to focus on the “what”, whereas policy makers need to know the “why” and “what if” (Mitton et al., 2008). This was also the conclusions of a translation task group formed to understand the balance between research and policy specifically in the falls prevention context (Poulos et al., 2007).

It was also found that the direct input of the policy makers was required for the modelling process, due to their extensive knowledge about implementation of falls prevention programs. As the research team was attempting to cost the various components for inclusion in its cost-effectiveness model, it became apparent that much of the information needed to cost intervention delivery, particularly in a local context, was not available from the published literature. Reliance solely on the available literature would therefore have led to unrealistic and under-developed models of implementation costs that would not have been useful for the policy makers.

The research team also believed the consultation process to be an excellent forum in which to explain research ideas and approaches. This required precise non-jargonistic communication and clarity regarding the value of this project. The policy makers responded with interest and suggested some fine-tuning to the model, to take into account the policy context in which it would need to be applied. These two different, but complementary, approaches to scientific knowledge have been identified as key components to translating falls scientific knowledge into policy (Poulos et al., 2007).

Similarly, the interactive consultation process allowed the views and needs of the policy makers to be presented, listened to and acted on by the researchers. There were instances where policy makers articulated some of their implementation concerns and experiences that led to direct refinement of the developed model. This was particularly in relation to the inclusion of further “what if” scenarios into the epidemiological modelling.

As noted above, policy makers need to know the “why” behind facts leading to policy decisions (Mitton et al., 2008). During the face-to-face consultations, in particular, the policy makers had ample opportunity to ask the researchers why we were adopting particular conventions and assumptions in our models. Where these did not fully mirror the real world policy context, the policy makers were able to provide advice back to the researchers about how some of the rationale underpinning the modelling could be improved.

5 DISCUSSION

5.1 STRENGTHS AND LIMITATIONS OF MODELLING METHODS

While epidemiological modelling has considerable appeal in forecasting potential benefits of program implementation, some limitations do apply. Our methods relied on piecing together information from a range of sources and time periods to model the impact of proven falls interventions on preventing falls and reducing consequent hospital admissions. Often these sources were incomplete or inadequate in relation to the specific requirements of our model. The level of certainty on the resulting projections is necessarily linked to the level of certainty regarding the estimates for the model input parameters.

Our estimates of the eligible population for the interventions sometimes relied on historical data from Australian surveys or research studies, necessitating assumptions regarding the rates of change in some population demographics and health characteristics. In some instances, it was not possible to enumerate the Australian (or state or territory) sub-groups that would exactly match the eligibility criteria used in the trials. Therefore, the estimates of the eligible population are truly estimates and it is difficult to indicate the level of certainty regarding these. However, the reality is that the number of people that could be reached by a particular intervention will be determined by the finite budget available for falls prevention. The eligible population estimates, coupled with the uptake rates, in this study can be used to provide some indication of the program reach (i.e. the proportion of the target population that could receive an intervention) that current falls prevention budgets would allow.

Uptake of the interventions if offered to the eligible population was estimated by assuming that the level would be the same as that achieved in the research trials. Although we based the models on the same recruitment methods used in the trial (which were sometimes quite intensive eg., letter followed by telephone call), the extent to which the same level of uptake would be achieved in a non-research setting in the broader community is unknown. Nonetheless, it does provide some indication of the likely level of interest in a particular intervention if it was made available to people. It may be that with some modest investment in strategies to increase uptake and compliance/maintenance that the cost-effectiveness could be improved drastically – however we did not assess this.

We assumed that the same level of falls reduction as that observed in the research trials would be achieved with wide spread implementation. This is unlikely to be the case. Although we have only generalised the research findings to those segments of the older population with similar characteristics as those in the trial, volunteers who participate in a research trial are likely to bring a higher level of commitment to maintaining the required participation than might be achieved with broader implementation. Therefore, the estimated falls reductions are likely to be optimistic, and the less effective intervention scenario for each intervention would be more realistic. Even this may be an over-estimate if the actual falls reductions achieved were less than the lower bounds of intervention effectiveness than those observed in the trials.

The estimate of the proportion of falls that require admission to hospital is a key parameter for determining the number of hospital admission that might be prevented by the interventions. Given that this proportion was estimated from a relatively small number of falls episodes for most of the interventions modelled, there is a reasonable degree of uncertainty in this estimate. If the actual proportion has been under-estimated (or over-estimated) even to a relatively small extent, then the impact of the interventions on the number of hospital admissions, and the hospital admission rate, could be significantly under-estimated (or over-estimated). However, as the same estimate was used for all of the interventions except the home based exercise program among the 80+ group, the relative comparison of the impact of the interventions on hospital admissions would remain unchanged.

We have assumed that the interventions would not reduce the probability of being admitted to hospital when a fall does occur, and therefore that the reduction in hospital admissions is directly related to the reduction in falls. In the one study modelled which examined injurious falls, as well as all falls, there was no evidence that the rate for injurious falls was reduced significantly more than the rate for all falls (Robertson et al., 2002).

The modelling for expedited cataract surgery has several limitations that impact substantially on the degree of confidence in the results. Estimation of the eligible population was very approximate as waiting lists do not distinguish between those waiting for first and second eye procedures, and the terms used for cataract surgery in the various reference sources were somewhat ambiguous. Further, we were not able to establish whether people in the private sector would be likely to benefit i.e., whether the waiting time was long enough to warrant significant efforts to reduce it. An additional complication was that the trial reduced the waiting time by 310 days. As far as we could establish, only about 10% of people on the public sector waiting list for cataract surgery currently wait much longer than 310 days. There may be more merit in this intervention as a falls prevention strategy, if a similar magnitude of falls reduction could be achieved by shortening waiting times by somewhat less than the 310 days tested in the trial. We also noted that the baseline fall rate for the control group (women 70+ years) in the trial (0.55 falls per person year) was lower than our estimate of the fall rate for Australian community dwelling older people (men and women 65+ years) (0.89 falls per person year). It was substantially lower than that reported for the control group (women 70+ years) by the same investigators in a trial of expedited second eye cataract surgery (1.57 falls per person year) (Foss et al., 2006). Finally, we were not able to provide an indication of the cost-effectiveness of this approach.

We are reasonably confident of our estimates of the intervention costs. Good information about the resources required to deliver the interventions was available and we used standard sources, or obtained quotes, for the actual unit costs to derive the total cost. In the case of the occupational therapy home visit intervention, the average cost of the home modifications was based on that in the published economic evaluation associated with this trial (Salkeld et al., 2000). In that study, the average cost of the home modifications was \$11 in 2000, which increased to \$14 when adjusted by the consumer price index to 2008. This seemed to be quite low, considering that some home modifications could require installation of hand rails, or bathroom modifications. However, a relatively small proportion of participants in the trial had hand rails installed, for example (8%), and the most common modifications were quite low cost (32% removal of rugs and mats, 16% change of footwear, 14% change to non-slip bathmat) (Cumming et al., 1999). The cost of this intervention could change if the mix of modifications recommended was sufficiently different to that in the trial. A similar caveat would apply to the cost for the multi-disciplinary, multi-factorial risk intervention, in that our costs were based on the mix of specific interventions delivered to the sample of trial participants. If the actual mix was sufficiently different to that in the trial, then the cost per participant and cost per health outcome could vary significantly

5.2 RELATIVE COSTS AND BENEFITS OF THE INTERVENTIONS

In examining the relative benefits of the interventions over the first 12 months, the occupational therapy home visit and withdrawal of psychotropic medication interventions provided the best returns per fall prevented and hospital admission averted, just ahead of the multi-factorial intervention and considerably ahead of the other interventions. In addition, these two interventions were ranked second and third in terms of the percentage reduction in the hospital admission rates. The next most cost effective intervention was the multi-factorial intervention which was about 65% more expensive than the withdrawal of psychotropic medications. However, the impact of the multi-factorial intervention on the hospital admission rate was approximately half that of these other two interventions.

It is noteworthy that despite the relatively high proportions of intervention participants in the withdrawal of psychotropic medication trial resumed their normal medications before the trial finishing, this intervention was relatively cost-effective. If it is possible to achieve a similar dose reduction regime to that used in the trial, without having to reformulate the medications, then the return for this intervention might be improved. Cost-effectiveness may also be improved if some additional support was provided during the withdrawal stage eg., ideas for strategies to improve sleep quality. This would add to the cost, but the overall cost-effectiveness may be improved.

Although the fall reducing effect of the tai chi intervention was relatively high among this group of interventions, it is not a particularly good investment when the cost per fall prevented is compared to the other interventions. The major cost of delivery is the instructor salary. It may seem feasible to reduce this cost per participant by increasing class sizes (our model used 12 per class). However, anecdotal reports from leaders suggest that the quality of instruction is likely to decrease as class size increases, particularly in this age group. Further, as class sizes increase, it becomes increasingly difficult to find appropriate venues. Some jurisdictions may be able to deliver tai chi at a reduced cost compared with our model, depending on the availability of, and costs for, trained leaders. The cost of this intervention to the health sector could also be reduced under a participant co-payment model. However, co-payments would need to each almost $10 per class before the cost per participant was reduced to a similar level as the OT home hazard assessment and modification intervention.

The home based exercise program for people aged 80+ years had the greatest impact on the hospital admission rates, but was the most expensive in terms of cost per fall prevented, and second most expensive in terms of cost per hospital admission averted.

We had sufficient evidence for the home-based exercise program and the cardiac pacing interventions to extend the estimation of the benefits to two and five years respectively. The extended period of benefit improved the cost-effectiveness of the home-based exercise program, but it remained a relatively expensive intervention. If this program could be delivered, with the same sustained falls reduction benefit, in a group setting or perhaps by a practice nurse at the time of regular visits to the general practitioner, then it could become more cost effective. However, costs would need to be reduced by a factor of 5 (for the two year program), in order for this program to approach the cost-effectiveness of some of the other interventions.

When the extended benefit period is taken into account for the cardiac pacing intervention, the cost per fall prevented and per hospital admission averted becomes comparable with the cost effectiveness of the occupational therapy home visit and withdrawal of psychotropic medication interventions. However, due to the relatively low numbers of people eligible for cardiac pacing for CSH, the overall impact on the hospital admission rates would remain low.

It is likely that some falls prevention benefits would also persist beyond 12 months for the occupational therapy home visit, withdrawal of psychotropic medication and multi-factorial interventions, without further investment. We were not able to estimate benefits of these interventions beyond 12 months as there is insufficient evidence on which to base the necessary modelling. However, if there are sustained benefits, then the cost-effectiveness of these interventions would improve, and their positions as relatively cost-effective interventions would strengthen.

5.3 IMPACT OF INTERVENTIONS ON FALL-RELATED HOSPITAL ADMISSION RATES

There are a number of significant limitations with respect to the data and methods available for forecasting the impact of the interventions on hospitalisation rates. Consequently, a high degree of caution should be exercised in drawing conclusions particularly about the magnitude of the impact on these rates.

First, we were unable to accurately determine the person-based rate of falls hospital admissions. The current Australian hospital data to which we had access for this study are episode-based rather than person-based. Therefore, more than one record could occur for a single hospitalised fall if for example the person falls and sustains a fracture, is admitted to a nearby hospital for assessment, is subsequently transferred to another hospital for specialised treatment, and then "discharged" to an inpatient rehabilitation unit. We were able to eliminate some of the discrepancy between episodes of care and numbers of people admitted due to falls, but it is unlikely that we have eliminated it entirely, and we are unable to estimate the residual.

Second, due to the way in which falls and other diagnoses are coded, for some categories of episodes of hospital care, it is not possible to determine whether the fall was the factor determining admission eg, if there was a medical condition, such as a stroke, for which the person would have been admitted regardless of sustaining a fall just prior to admission. We excluded this category of hospital episodes from our rate calculation, but this may result in an under-estimation of the actual fall related episodes resulting in hospitalisation. Certainly other work by some of the research team has demonstrated the impact of different case definitions on the rate of hospitalised falls (Boufous and Finch, 2005). Person linked data would overcome these issues.

Third, we have assumed that the same average annual trend in hospital admission rates as in 2002/03-2004/05 will apply in 2009. However, during that period the age-standardised rates of fall-related hospital admission as defined in this study were increasing by an average of 1.6% per year. By using the average annual rate for that period, the trend has been captured to some extent in our modelling. However, if the trend continues during the period between 2005 and 2009, then we will have under-estimated the numerator for the 2009 rate, and thereby over-estimated the likely percentage reduction in the fall-related hospital admission rates that could arise from the interventions. The meaning of the rising trend in the age standardised falls hospitalisations is not clear. It could be due to increasing population incidence of cases, and /or to increasing likelihood of admission, increasing co-morbidities in people with falls injury, or to related information factors (eg., case being counted as admitted in later years that would not have been counted as such in earlier years). A further complication in estimating the impact of the interventions on the future hospital admission rates arises from other current trends. Although the overall rate of fall-related hospital admissions is increasing, and with it the bed days associated with falls, the rate of hospital admission due to fall-related hip fractures appears to be decreasing in some parts of Australia (Boufous et al., 2004; Cassell and Clapperton, 2008).

The uncertainties surrounding the estimates of the hospital admission rates, and the trends in these rates, mean that there is a degree of uncertainty in the rates we have used in this study. However, since this affects all interventions equally, the ranking of the interventions in terms of their impact on the hospital admissions rate would be unchanged, even if more accurate determinations of the hospital admission rate were possible. The magnitude of any reduction in hospital admission rates that could be expected for any of the interventions modelled must be treated as very preliminary, until our results can be confirmed, or otherwise, using person linked data.

5.4 OTHER BENEFITS OF FALLS REDUCTION

Falls are a major threat to the safety, health and independence of older people. Apart from injury, falls among older people result in a multitude of adverse effects including:

• *Loss of confidence and mobility and a general reduction in activity, independence*. Even when an injury does not occur, the experience of at least two non-injurious falls is associated with reduced social activities after controlling for co-morbidities, and experiencing one injurious fall is independently associated with decreased physical activity (Tinetti and Williams, 1998). Fear of falling has been associated with an increased risk of falling, and decreased functional capacity (Cumming et al., 2000).

• *Subsequent decline in health* - A large US longitudinal study reported that fallers and, especially repeat fallers, were at greater risk of subsequent hospitalisation and frequent doctor visits than were non-fallers, after controlling for age, sex, self-perceived health status, and difficulties with activities of daily living. Fallers were also at greater risk of reporting subsequent difficulties with physically demanding tasks and regular activities of daily living (Kiel et al., 1991).

• *Decreased quality of life* – in an Australian study of quality of life with a time trade-off, 80% of women age 75 years reported a preference for death over the loss of independence and quality of life associated with a hip fracture that results in admission to a nursing home (Salkeld et al., 2000b)

• *Precursor to institutional care* - Falls and fall-related fractures are frequent precursors to long term residence in a nursing home (Kiel et al., 1991; US Department of Health and Human Services, 2004). One-time, and repeat, fallers are respectively 2.5 times and 3.5 times more likely than non-fallers to be admitted to a nursing home over a 12 month period (Kiel et al., 1991).

Consequently preventing falls reduces acute care costs to the health care system for hospital admissions, emergency department presentations, and general practitioner visits. In addition, preventing falls reduces the demand for rehabilitation services, and allied health care associated with treating and rehabilitating people following a fall. Preventing falls as our population ages will also reduce the capital costs required to expand acute care infrastructure, a need which has been predicted based on our ageing population and current falls rates (Moller, 2003).

Beyond the impact on acute health care services and infrastructure, preventing falls reduces demand for in-home support services (such as home help, domiciliary nursing, meals on wheels), and for supported accommodation and nursing home places. Preventing falls may well also prevent or slow the rate of physical disability among older people.

The cost per hospital admission averted by the interventions modelled may appear to be relatively large compared with the average cost of a fall-related hospitalisation for an older person. However, if all health related economic savings due to falls reduction are considered, it may be apparent that the current falls prevention interventions are an attractive investment. Our model was not intended to include all health related economic savings, but rather to indicate the falls prevention benefits of the selected interventions.

5.5 OTHER HEALTH OUTCOMES FROM FALLS INTERVENTIONS

We were only able to estimate the impact of the interventions on falls reductions. However, most of the interventions modelled are likely to have other health benefits, all of which would need to be taken into consideration when considering the overall benefit and savings that are likely to arise from these interventions. Exercise is known to have a range of health benefits for older people. Health benefits of tai chi as demonstrated in randomised controlled trials include improvement in systolic blood pressure, confidence and self-efficacy among community dwelling older people, improved physical performance among older people with arthritis, hypertension, some cardiac conditions and post-menopausal bone loss, and decreased impairment. Similarly, the home based exercise program could be expected to have other health benefits such as improved general well-being and confidence, decreased depression, and decreased or slower rate of onset of physical impairment. The walking component could improve cardio-vascular health and increase vitamin D levels.

The multi-factorial intervention leading to early diagnosis improved and management of chronic disease generally and cardiovascular or circulatory problems specifically, improved vision and mobility, and decreased impairment. Other health benefits accruing from the other interventions are less readily identified. The occupational therapy home visit intervention could improve independence, while the psychotropic withdrawal intervention could lead to fewer side effects from long term use of psychotropic medications. Similarly, long term adverse health effects as a consequence of CSH would be avoided with the cardiac pacing intervention.

Some of the interventions may have some adverse effects on health. As the exercise based interventions are generally increasing physical activity, there is a theoretical possibility of increased injury rates as a consequence of increased exposure. However, there was no evidence from the home-based exercise program results to support this notion. Injurious falls, as well as non-injurious falls, were decreased (Robertson et al., 2002). Adverse mental health outcomes could arise as a result of the withdrawal of psychotropic medication withdrawal, although close monitoring by the general practitioner during the withdrawal period should reduce the likelihood of adverse events. As the cardiac pacing intervention involves surgery, the usual attendant risks would apply. However, overall the health benefits of the interventions are likely to outweigh the dis-benefits.

The potential net health benefits of other health outcomes from the falls interventions are likely to result in decreased demands for acute health care and community support services, in addition to those achieved via falls reduction.

5.6 IMPLEMENTATION OF THE INTERVENTIONS BEYOND THE RESEARCH SETTING

Analysis of specific implementation issues associated with each intervention can be found in the policy officer summaries in Appendix 2. General comments on the issues can be found here.

5.6.1 Feasibility

Implementation of most of the interventions modelled to the numbers of people estimated to take up these programs would be a substantial undertaking. We have assumed that this would be achieved over a 12 month period. In reality, delivery to these numbers of people may need to occur over a longer period of time for some of the interventions. The benefits would remain essentially unchanged, but would accrue over a longer time period. Similarly, expenditure would occur over a longer period.

A particularly important consideration for implementation is workforce requirements and availability. The home-based exercise program, occupational therapy home hazard assessment and modification program, and the multidisciplinary multifactorial risk assessment and management program, all require allied health personnel. The psychotropic medication withdrawal program requires the availability of community pharmacists to reformulate the medications. The multidisciplinary program also requires general and specialist medical personnel. The occupational therapy home hazard assessment and modification program is a case in point. Implementation would require routine referral of hospital inpatients, meeting the eligibility criteria, to occupational therapy services. One full time equivalent occupational therapist could deliver the intervention to approximately 340 people over a 12 month period. Therefore, 416 full time equivalent occupational therapists would be required to deliver this intervention to the estimated number of people who would take up the intervention. In some parts of Australia, including some capital cities as well as regional areas, there are shortages in the medical and allied health workforce that would need to be addressed before these programs could be widely implemented. The policy officer summaries in the appendices provide estimations of the full time equivalent staff required to deliver the various interventions.

5.6.2 Acceptability and equity

The acceptability to older people of the different types of interventions will vary. Exercise programs are not appealing to all, and some people may prefer home based to community-based programs. The occupational therapy home hazard assessment and modification, and the multi-disciplinary multi-factorial intervention, may have a wider acceptability among the target group as these are programs that would be initiated, and to some extent delivered, within the health care system. Similarly cardiac pacing is likely to be well accepted by the target group as this intervention would be seen as medical treatment for a specific problem. The psychotropic medication withdrawal program is likely to have relatively low acceptance among the target group, since people are reluctant to withdraw from these medications once use is established (Campbell et al., 1999b).

Equity will be a consideration for any program that requires older people to contribute to the cost, or may be more accessible to those with private health insurance. Delivery of many of these interventions will be more difficult in rural and remote areas, and accessibility is likely to be reduced. Language may be a barrier, particularly in recruiting people into exercise programs. Inability to access appropriate transport, either due to financial or physical limitations, or lack of transport options, may also disproportionately inhibit participation.

5.6.3 Sustainability

The cardiac pacing intervention has the longest anticipated period of benefit, at least five years. The home based exercise intervention has a sustained falls prevention benefit for two years, if a relatively small investment is made in the second year. The remaining interventions may have some ongoing benefit, but this is likely to decay over time. Continued investment would be required to make any of these interventions available to additional cohorts of eligible people in the years following 2009.

5.7 IMPLICATIONS FOR FALLS PREVENTION POLICY

Occupational therapy delivered home hazard assessment and modification for older people with a recent fall history, as modelled here, represents the best falls prevention investments among those interventions examined in this study.

Cardiac pacing for those with cardio-inhibitory carotid sinus hypersensitivity is a good falls prevention investment over the medium term, although unlikely on its own to have a major impact on population level falls-related hospital admission rates.

The relative cost-effectiveness of the psychotropic medication withdrawal intervention in this model is high, although some issues with implementation would need to be addressed, and further implementation costs included, prior to any major initiative.

The multi-disciplinary multi-factorial risk management intervention represents good clinical practice for those individuals with a falls history, but was not relatively cost-effective for widespread implementation.

Tai chi programs may represent good value for falls prevention resources, if local circumstances allow the cost per participant to be reduced substantially compared with the model in this study.

There appears to be limited potential to impact on falls rates in Australia by expediting cataract surgery, given the current waiting periods. This finding may need confirmation.

The preliminary results of this work relating to the potential reductions in the fall-related hospitalisation rates associated with these interventions suggest that substantial investment in falls prevention will be required to have large effects on the fall-related hospitalisation rates.

The total health benefits from the falls interventions modelled in this study have not been included in our models, and this should be considered when using this study to make decisions regarding investment in falls prevention programs.

5.8 RECOMMENDATIONS AND FUTURE DIRECTIONS

The cost-effectiveness of a number of the modelled interventions could be improved by variations to the implementation processes such as measures to increase uptake, or decrease the cost per participant. These would need to be developed and tested.

Person linked data would facilitate more accurate estimations of the impact of these interventions on the falls-related hospitalisation rates. The need for person linked hospital data in Australia is apparent and should be given high priority, not just for the purposes of this study, but for all epidemiological and health service research.

There may be some merit in undertaking more focussed work on modelling the effect on fall-related hospitalisation rates in those states, such as New South Wales and Western Australia, where person linked data are already available.

Some of the modelling work was limited by the type of data available in the publications of the randomised controlled trials. The definition of a set of data required for epidemiological modelling of falls interventions, including information about the level of intervention uptake, compliance and maintenance, should be developed. Journal editors should be encouraged to require that these datasets be posted on the journal website when falls trials are published.

The benefits of other health outcomes arising from falls prevention measures should be included in cost benefit analyses of falls programs. Some of the required evidence may already be available for some of the interventions included in this study eg., tai chi.

Australia will continue to benefit by close collaboration between falls researchers, policy officers and program managers. Opportunities for formal and informal networking should be encouraged.

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APPENDIX 1

FALL-RELATED HOSPITAL SEPARATIONS DATA

Table A 1 Fall-related hospital separations, 65+ years, Australia

1999–00								
	65–69	**70–74**	**75–79**	**80–84**	**85–89**	**90–94**	**95+**	**Total**
Males	1,889	2,392	3,016	2,840	2,707	936	220	14,000
Females	3,012	4,844	7,395	8,601	9,329	3,628	1,049	37,858
Persons	4,901	7,236	10,411	11,441	12,036	4,564	1,269	51,858
2000–01								
	65–69	**70–74**	**75–79**	**80–84**	**85–89**	**90–94**	**95+**	**Total**
Males	1,792	2,401	2,995	3,135	2,743	1,245	288	14,599
Females	2,980	4,783	7,341	8,915	8,924	4,766	1,397	39,106
Persons	4,772	7,184	10,336	12,050	11,667	6,011	1,685	53,705
2001–02								
	65–69	**70–74**	**75–79**	**80–84**	**85–89**	**90–94**	**95+**	**Total**
Males	2,022	2,465	3,252	3,323	2,748	1,369	331	15,510
Females	2,992	4,769	7,577	9,714	9,384	5,264	1,572	41,272
Persons	5,014	7,234	10,829	13,037	12,132	6,633	1,903	56,782
2002–03								
	65–69	**70–74**	**75–79**	**80–84**	**85–89**	**90–94**	**95+**	**Total**
Males	1,912	2,529	3,253	3,661	2,982	1,458	348	16,143
Females	3,060	4,756	7,728	10,075	9,486	5,516	1,717	42,338
Persons	4,972	7,285	10,981	13,736	12,468	6,974	2,065	58,481
2003–04								
	65–69	**70–74**	**75–79**	**80–84**	**85–89**	**90–94**	**95+**	**Total**
Males	1,934	2,584	3,453	4,002	3,202	1,608	366	17,149
Females	3,212	4,824	7,905	10,606	10,074	5,892	1,823	44,336
Persons	5,146	7,408	11,358	14,608	13,276	7,500	2,189	61,485
2004–05								
	65–69	**70–74**	**75–79**	**80–84**	**85–89**	**90–94**	**95+**	**Total**
Males	2,164	2,597	3,691	4,364	3,396	1,684	479	18,375
Females	3,488	4,652	7,835	11,146	9,878	6,216	2,003	45,218
Persons	5,652	7,249	11,526	15,510	13,274	7,901	2,482	63,594
2005–06								
	65–69	**70–74**	**75–79**	**80–84**	**85–89**	**90–94**	**95+**	**Total**
Males	2,358	2,808	3,899	4,712	3,757	1,913	469	19,916
Females	3,624	4,812	7,922	11,649	10,784	6,949	2,238	47,978
Persons	5,982	7,620	11,821	16,361	14,541	8,862	2,707	67,894
2002–06 Total								
	65–69	**70–74**	**75–79**	**80–84**	**85–89**	**90–94**	**95+**	**Total**
Persons	21,752	29,562	45,686	60,215	53,559	31,237	9,443	251,454

Table A 2 Fall-related hospital separation rates per 100,000 people, 65+ years, Australia

	65–69	70–74	75–79	80–84	85–89	90–94	95+	Crude rate	Age-std rate
1999–00									
Males	567.6	805.6	1,399.2	2,455.6	4,914.9	5,811.1	5,769.7	1,351.5	1,568
Females	871.7	1,452.9	2,604.4	4,619.9	8,186.7	8,291.8	8,384.6	2,869.6	2,702
Persons	722.5	1,148.0	2,084.3	3,790.6	7,120.6	7,624.3	7,773.8	2,201.9	2,256
2000–01									
Males	537.3	796.6	1,342.0	2,539.8	4,728.2	7,202.4	6,762.2	1,375.8	1,587
Females	862.1	1,431.5	2,534.1	4,559.1	7,537.9	10,178.1	10,462.9	2,910.6	2,690
Persons	702.6	1,130.4	2,015.4	3,777.7	6,613.9	9,375.8	9,567.9	2,233.3	2,253
2001–02									
Males	595.0	812.6	1,415.2	2,512.3	4,544.5	7,400.8	7,311.7	1,424.6	1,616
Females	853.3	1,431.1	2,587.9	4,716.1	7,689.5	10,590.5	11,062.6	3,015.6	2,747
Persons	726.2	1,136.4	2,072.2	3,854.3	6,647.5	9,725.4	10,156.4	2,310.7	2,300
2002–03									
Males	548.2	836.7	1,380.0	2,610.7	4,796.5	7,538.8	7,827.3	1,450.5	1,641
Females	852.0	1,440.7	2,616.2	4,686.6	7,643.1	10,661.4	11,755.4	3,045.7	2,755
Persons	702.4	1,152.0	2,067.6	3,867.0	6,693.1	9,811.8	10,838.8	2,336.4	2,309
2003–04									
Males	538.8	858.4	1,426.4	2,694.6	5,024.0	7,827.9	8,282.4	1,505.3	1,694
Females	870.3	1,475.1	2,651.6	4,730.9	8,023.7	10,913.1	12,162.3	3,137.8	2,821
Persons	706.9	1,179.5	2,102.5	3,919.5	7,013.7	10,062.8	11,278.9	2,409.1	2,366
2004–05									
Males	584.5	864.8	1,494.8	2,803.8	5,077.1	7,713.1	10,747.1	1,575.6	1,757
Females	918.4	1,429.4	2,619.6	4,812.0	7,673.6	10,912.7	12,936.8	3,146.4	2,807
Persons	753.6	1,158.4	2,110.9	4,004.9	6,785.8	10,027.4	12,447.3	2,442.7	2,378
2005–06									
Males	619.3	931.9	1,555.6	2,900.7	5,185.3	8,186.4	10,068.7	1,665.7	1,826
Females	930.5	1,478.1	2,646.3	4,915.1	7,985.8	11,557.6	13,491.7	3,279.2	2,887
Persons	776.7	1,215.6	2,149.3	4,095.9	7,007.9	10,614.1	12,741.2	2,553.6	2,455
2002–06 annual average age-specific rates									
Persons	735.8	1,176.3	2,107.9	3,975.6	6,878.2	10,145.3	11,856.2		

Table A 3 Fall-related hospital separations, community-dwelling people 65+ years, Australia

2002–03								
	65–69	**70–74**	**75–79**	**80–84**	**85–89**	**90–94**	**95+**	**Total**
Males	1,823	2,344	2,946	3,093	2,330	1,038	215	13,789
Females	2,943	4,513	6,904	8,117	6,938	3,462	913	33,790
Persons	4,766	6,857	9,850	11,210	9,268	4,500	1,128	47,579
2003–04								
	65–69	**70–74**	**75–79**	**80–84**	**85–89**	**90–94**	**95+**	**Total**
Males	1,842	2,377	3,040	3,341	2,443	1,104	220	14,367
Females	3,112	4,526	6,905	8,525	7,027	3,580	854	34,529
Persons	4,954	6,903	9,945	11,866	9,470	4,684	1,074	48,896
2004–05								
	65–69	**70–74**	**75–79**	**80–84**	**85–89**	**90–94**	**95+**	**Total**
Males	2,059	2,394	3,229	3,560	2,574	1,117	281	15,214
Females	3,383	4,349	6,863	8,801	6,909	3,684	911	34,900
Persons	5,442	6,743	10,092	12,361	9,483	4,802	1,192	50,115
2005–06								
	65–69	**70–74**	**75–79**	**80–84**	**85–89**	**90–94**	**95+**	**Total**
Males	2,245	2,583	3,398	3,878	2,838	1,249	270	16,461
Females	3,479	4,498	6,901	9,248	7,429	3,995	1,121	36,671
Persons	5,724	7,081	10,299	13,126	10,267	5,244	1,391	53,132
2002–06 Total								
	65–69	**70–74**	**75–79**	**80–84**	**85–89**	**90–94**	**95+**	**Total**
Persons	20,886	27,584	40,186	48,563	38,488	19,230	4,785	199,722

Table A 4 Fall-related hospital separation rates per 100,000 community dwelling people, 65+ years, Australia

2002–03	**65–69**	**70–74**	**75–79**	**80–84**	**85–89**	**90–94**	**95+**	**Crude rate**	**Age-std rate**
Males	526.1	786.1	1,286.6	2,348.6	4,319.7	7,095.0	6,907.6	1,280.3	1,512
Females	824.5	1,388.2	2,436.7	4,216.5	7,247.5	11,169.5	13,731.4	2,616.8	2,631
Persons	677.5	1,100.1	1,922.7	3,457.7	6,192.4	9,863.0	11,555.6	2,009.0	2,172
2003–04	**65–69**	**70–74**	**75–79**	**80–84**	**85–89**	**90–94**	**95+**	**Crude rate**	**Age-std rate**
Males	516.5	800.5	1,292.7	2,397.4	4,413.3	7,115.0	7,404.9	1,303.8	1,532
Females	848.3	1,405.0	2,413.2	4,248.7	7,256.3	11,169.3	12,902.3	2,633.3	2,636
Persons	684.8	1,115.0	1,907.7	3,489.9	6,222.3	9,846.9	11,199.2	2,026.2	2,178
2004–05	**65–69**	**70–74**	**75–79**	**80–84**	**85–89**	**90–94**	**95+**	**Crude rate**	**Age-std rate**
Males	559.7	807.9	1,346.1	2,439.0	4,422.1	6,801.9	9,681.3	1,349.3	1,572
Females	896.2	1,356.4	2,390.2	4,244.0	6,943.2	10,880.1	13,894.6	2,619.1	2,608
Persons	730.1	1,093.0	1,914.9	3,498.4	6,012.7	9,550.1	12,601.8	2,037.1	2,175
2005–06	**65–69**	**70–74**	**75–79**	**80–84**	**85–89**	**90–94**	**95+**	**Crude rate**	**Age-std rate**
Males	593.4	868.6	1,395.4	2,543.3	4,487.3	7,063.1	8,944.8	1,424.4	1,629
Females	898.7	1,402.0	2,401.2	4,347.9	7,073.0	11,037.0	15,763.2	2,703.6	2,665
Persons	747.8	1,145.4	1,939.8	3,594.4	6,101.2	9,732.7	13,731.5	2,115.1	2,232
2002–06 annual average age-specific rates									
	65–69	**70–74**	**75–79**	**80–84**	**85–89**	**90–94**	**95+**		
Persons	711.0	1,113.4	1,921.4	3,512.1	6,130.1	9,743.8	12,288.0		

APPENDIX 2

NATIONAL, STATE AND TERRITORY MODELLING RESULTS

MONASH University
Accident Research Centre

Modelling the impact, costs and benefits of falls prevention measures to support policy-makers and program planners

Intervention: Tai chi-10 forms selected from a review of 108 tai chi forms[1]

Brief description: Group based tai chi twice per week for 15 weeks, with encouragement to practice twice per day for 15 mins. Progression of moves involved gradual reduction of based of standing support until single limb stance achieved, increased boy and trunk rotation, and reciprocal arm movements. Participants recruited by paid advertising in local newspapers. Follow-up of participants who missed sessions was included. This program has been tested in a randomised trial[2] and currently is the only tai chi intervention to be noted as highly likely to be beneficial in the Cochrane review of falls interventions[3]. Note that the predictions below may not necessarily be applicable to other types of tai chi programs.

Modelling for: Australia

Time period: Benefits in 2009 of intervention delivered in 2009

Target group: Men and women 70 years and over, live in unsupervised environment (i.e., not supported accommodation, hostel, nursing home), ambulatory, no debilitating conditions (such as severe cognitive impairments, Parkinson's disease, crippling arthritis, profound visual deficits). To estimate the size of this target group, we used estimates of the number of community dwelling older people from the Australian Bureau of Statistics, and subtracted the number estimated to be profoundly limited in, and requiring assistance with, core activities of communication, mobility and self care (14.4%) by the Disability, Ageing and Carers Survey.4 The estimated number of people in this group in Australia in 2009 is 1,684,091.

Setting: includes metropolitan and rural population

Base case prediction:

Outcome	Estimate
Eligible population who would uptake	31,998
Falls prevented (n)	13,926
Fall hospitalisations prevented (n)	279
Reduction in fall hospitalisation rate for 65+ years (%)	0.4*
Reduction in fall hospitalisation rate for community dwelling 65+ years (%)	0.5*
Total cost ($ million)	15.03
Cost per fall prevented ($)	1,079
Cost per fall hospitalisation prevented ($)	53,974

*Approximations only due to data limitations and trend predictions. Interpret with caution

Key data inputs:

Parameter	Base case value	Range	Sources for value and range
Uptake - recruitment via newspaper advertising (%)	1.9	0.95 – 2.85	A. Voukelatos, unpublished data, Australian tai chi trial among community dwelling older people
Average falls rate per person year (no tai chi)	0.83	0.72 – 1.09	Based on data from Australian studies[5,6]
Average falls rate per person year (tai chi)	0.42	0.38 – 0.55	Derived by applying falls reduction obtained in Wolf et al[2], to the average falls rate per person year (no intervention
Hospitalised falls- same value for both groups (%)	2.0	1.4 – 2.6	Tiedemann et al[11], and Day, unpublished data, prospective falls data from Australian trials involving community dwelling older people
Cost per participant for 15 week course ($)	470	383-557	Derived from quotes obtained for the various inputs (see table on page 17)

Data inputs have been derived using the best possible available information from Australian sources, with the exception of the size of the falls reduction (49%) used to estimate the falls rate per person year (tai chi). The extent to which this reduction is generalisable from the US based research trial to the Australian population obviously underpins the degree of confidence in the model results. Given the reduction of 33% noted in the only Australian tai chi trial, based on one session per week compared with Wolf's trial[2] of two sessions per week, there is a good degree of confidence in using the Wolf reduction. The major component of the cost per participant (see table on page 17) is the instructor rate, which according to the quotes obtained could vary by 30%.

Other scenarios:

	People uptake (n)	Falls prevented (n)	Hospital admissions prevented (n)	Total cost ($ M)	Cost per fall prevented ($)	Cost per hospital admission prevented ($)
Low uptake	15,931	6,934	139	7.48	1,079	53,974
High uptake	47,929	20,859	417	22.52	1,079	53,974
Low hospitalisation	31,998	13,926	195	15.03	1,079	77,106
High hospitalisation	31,998	13,926	362	15.03	1,079	41,518
More effective intervention	31,998	16,422	328	15.03	915	45,769
Less effective intervention	31,998	10,942	219	15.03	1,374	62,689
More costly intervention	31,998	926	279	17.83	1,280	63,992
Less costly intervention	31,998	926	279	12.26	880	44,002

All scenarios vary one parameter, and keep the values from the base case for the other parameters. Low and high uptake and hospitalisation scenarios use the lower and upper ranges shown in the key data inputs table above. The more and less effective intervention scenarios use the average falls rate per person year without tai chi, and the lower and upper ranges, respectively, of the average falls rate per person year with tai chi. The more and less costly intervention scenarios use the lower and upper ranges shown in the key data inputs table above. If participants paid a fee of $3 per class, the total cost in the base case scenario would be reduced to $M12.16, and the cost per fall prevented and per hospital admission averted would be respectively reduced to $931 and $46,540. If participants paid a fee of $5 per class, then these costs would be reduced to $M10.24, $784, and $39,192.

Modelling for: **Queensland**

The estimated number of eligible people for the tai chi intervention in Queensland in 2009 is 296,001.

Base case prediction:

Outcome	Estimate
Eligible population who would uptake	5,624
Falls prevented (n)	2,448
Fall hospitalisations prevented (n)	49
Reduction in fall hospitalisation rate for 65+ years (%)	Not available
Reduction in fall hospitalisation rate for community dwelling 65+ years (%)	Not available
Total cost ($ million)	2.64
Cost per fall prevented ($)	1,079
Cost per fall hospitalisation prevented ($)	53,974

Other scenarios:

	People uptake (n)	Falls prevented (n)	Hospital admissions prevented (n)	Total cost ($ M)	Cost per fall prevented ($)	Cost per hospital admission prevented ($)
Low uptake	5,062	2,203	44	2.38	1079	53974
High uptake	6,186	2,692	54	2.91	1079	53974
Low hospitalisation	5,624	2,448	34	2.64	1079	77106
High hospitalisation	5,624	2,448	64	2.64	1079	41518
More effective intervention	5,624	2,886	58	2.64	915	45769
Less effective intervention	5,624	1,923	38	2.64	1374	68689
More costly intervention	5,624	2,448	49	3.13	1280	63992
Less costly intervention	5,624	2,448	49	2.15	880	44002

Modelling for: **New South Wales**

The estimated number of eligible people for the tai chi intervention in New South Wales in 2009 is 587,848.

Base case prediction:

Outcome	**Estimate**
Eligible population who would uptake	11,169
Falls prevented (n)	4,861
Fall hospitalisations prevented (n)	97
Reduction in fall hospitalisation rate for 65+ years (%)	0.4*
Reduction in fall hospitalisation rate for community dwelling 65+ years (%)	0.5*
Total cost ($ million)	5.25
Cost per fall prevented ($)	1,079
Cost per fall hospitalisation prevented ($)	53,974

*Approximations only due to data limitations and trend predictions. Interpret with caution.

Other scenarios:

	People uptake (n)	**Falls prevented (n)**	**Hospital admissions prevented (n)**	**Total cost ($ M)**	**Cost per fall prevented ($)**	**Cost per hospital admission prevented ($)**
Low uptake	10,052	4,375	87	4.72	1,079	53,974
High uptake	12,286	5,347	107	5.77	1,079	53,974
Low hospitalisation	11,169	4,861	68	5.25	1,079	77,106
High hospitalisation	11,169	4,861	126	5.25	1,079	41,518
More effective intervention	11,169	5,732	115	5.25	9,15	45,769
Less effective intervention	11,169	3,820	76	5.25	13,74	68,689
More costly intervention	11,169	4,861	97	6.22	12,80	63,992
Less costly intervention	11,169	4,861	97	4.28	880	44,002

Modelling for: **Victoria**

The estimated number of eligible people for the tai chi intervention in Victoria in 2009 is 423,079.

Base case prediction:

Outcome	**Estimate**
Eligible population who would uptake	8,038
Falls prevented (n)	3,498
Fall hospitalisations prevented (n)	70
Reduction in fall hospitalisation rate for 65+ years (%)	0.3*
Reduction in fall hospitalisation rate for community dwelling 65+ years (%)	0.4*
Total cost ($ million)	3.78
Cost per fall prevented ($)	1,079
Cost per fall hospitalisation prevented ($)	53,974

*Approximations only due to data limitations and trend predictions. Interpret with caution.

Other scenarios:

	People uptake (n)	**Falls prevented (n)**	**Hospital admissions prevented (n)**	**Total cost ($ M)**	**Cost per fall prevented ($)**	**Cost per hospital admission prevented ($)**
Low uptake	7,235	3,149	63	3.40	1,079	53,974
High uptake	8,842	3,848	77	4.15	1,079	53,974
Low hospitalisation	8,038	3,498	49	3.78	1,079	77,106
High hospitalisation	8,038	3,498	91	3.78	1,079	41,518
More effective intervention	8,038	4,126	83	3.78	915	45,769
Less effective intervention	8,038	2,749	55	3.78	1,374	68,689
More costly intervention	8,038	3,498	70	4.48	1,280	63,992
Less costly intervention	8,038	3,498	70	3.08	880	44,002

Modelling for: **Tasmania**

The estimated number of eligible people for the tai chi intervention in Tasmania in 2009 is 44,515.

Base case prediction:

Outcome	Estimate
Eligible population who would uptake	846
Falls prevented (n)	368
Fall hospitalisations prevented (n)	7
Reduction in fall hospitalisation rate for 65+ years (%)	0.5*
Reduction in fall hospitalisation rate for community dwelling 65+ years (%)	0.6*
Total cost ($ million)	0.40
Cost per fall prevented ($)	1,079
Cost per fall hospitalisation prevented ($)	53,974

*Approximations only due to data limitations and trend predictions. Interpret with caution.

Other scenarios:

	People uptake (n)	**Falls prevented (n)**	**Hospital admissions prevented (n)**	**Total cost ($ M)**	**Cost per fall prevented ($)**	**Cost per hospital admission prevented ($)**
Low uptake	761	331	7	0.36	1079	53974
High uptake	930	405	8	0.44	1079	53974
Low hospitalisation	846	368	5	0.40	1079	77106
High hospitalisation	846	368	10	0.40	1079	41518
More effective intervention	846	434	9	0.40	915	45769
Less effective intervention	846	289	6	0.40	1374	68689
More costly intervention	846	368	7	0.47	1280	63992
Less costly intervention	846	368	7	0.32	880	44002

Modelling for: **South Australia**

The estimated number of eligible people for the tai chi intervention in South Australia in 2009 is 150,638.

Base case prediction:

Outcome	**Estimate**
Eligible population who would uptake	2,862
Falls prevented (n)	1,246
Fall hospitalisations prevented (n)	25
Reduction in fall hospitalisation rate for 65+ years (%)	0.4*
Reduction in fall hospitalisation rate for community dwelling 65+ years (%)	0.5*
Total cost ($ million)	1.34
Cost per fall prevented ($)	1,079
Cost per fall hospitalisation prevented ($)	53,974

*Approximations only due to data limitations and trend predictions. Interpret with caution.

Other scenarios:

	People uptake (n)	**Falls prevented (n)**	**Hospital admissions prevented (n)**	**Total cost ($ M)**	**Cost per fall prevented ($)**	**Cost per hospital admission prevented ($)**
6.1.1.1.1 Low uptake	2,576	1,121	22	1.21	1079	53974
High uptake	3,148	1,370	27	1.48	1079	53974
Low hospitalisation	2,862	1,246	17	1.34	1079	77106
High hospitalisation	2,862	1,246	32	1.34	1079	41518
More effective intervention	2,862	1,469	29	1.34	915	45769
Less effective intervention	2,862	979	20	1.34	1374	68689
More costly intervention	2,862	1,246	25	1.59	1280	63992
Less costly intervention	2,862	1,246	25	1.10	880	44002

Modelling for: **Western Australia**

The estimated number of eligible people for the tai chi intervention in Western Australia in 2009 is 155,380.

Base case prediction:

Outcome	**Estimate**
Eligible population who would uptake	2,952
Falls prevented (n)	1,285
Fall hospitalisations prevented (n)	26
Reduction in fall hospitalisation rate for 65+ years (%)	0.4*
Reduction in fall hospitalisation rate for community dwelling 65+ years (%)	0.5*
Total cost ($ million)	1.39
Cost per fall prevented ($)	1,079
Cost per fall hospitalisation prevented ($)	53,974

*Approximations only due to data limitations and trend predictions. Interpret with caution.

Other scenarios:

	People uptake (n)	**Falls prevented (n)**	**Hospital admissions prevented (n)**	**Total cost ($ M)**	**Cost per fall prevented ($)**	**Cost per hospital admission prevented ($)**
Low uptake	2,657	1,156	23	1.25	1079	53974
High uptake	3,247	1,413	28	1.53	1079	53974
Low hospitalisation	2,952	1,285	18	1.39	1079	77106
High hospitalisation	2,952	1,285	33	1.39	1079	41518
More effective intervention	2,952	1,515	30	1.39	915	45769
Less effective intervention	2,952	1,010	20	1.39	1374	68689
More costly intervention	2,952	1,285	26	1.64	1280	63992
Less costly intervention	2,952	1,285	26	1.13	880	44002

Modelling for: **Northern Territory**

The estimated number of eligible people for the tai chi intervention in the Northern Territory in 2009 is 5,018.

Base case prediction:

Outcome	Estimate
Eligible population who would uptake	95
Falls prevented (n)	41
Fall hospitalisations prevented (n)	1
Reduction in fall hospitalisation rate for 65+ years (%)	0.5*
Reduction in fall hospitalisation rate for community dwelling 65+ years (%)	0.5*
Total cost ($ million)	0.04
Cost per fall prevented ($)	1,079
Cost per fall hospitalisation prevented ($)	53,974

*Approximations only due to data limitations and trend predictions. Interpret with caution.

Other scenarios:

	People uptake (n)	Falls prevented (n)	Hospital admissions prevented (n)	Total cost ($ M)	Cost per fall prevented ($)	Cost per hospital admission prevented ($)
Low uptake	86	37	1	0.04	1079	53974
High uptake	105	46	1	0.05	1079	53974
Low hospitalisation	95	41	1	0.04	1079	77106
High hospitalisation	95	41	1	0.04	1079	41518
More effective intervention	95	49	1	0.04	915	45769
Less effective intervention	95	33	1	0.04	1374	68689
More costly intervention	95	41	1	0.05	1280	63992
Less costly intervention	95	41	1	0.04	880	44002

Modelling for: **Australian Capital Territory**

The estimated number of eligible people for the tai chi intervention in the Australian Capital Territory in 2009 is 19,861.

Base case prediction:

Outcome	Estimate
Eligible population who would uptake	377
Falls prevented (n)	164
Fall hospitalisations prevented (n)	3
Reduction in fall hospitalisation rate for 65+ years (%)	Not available
Reduction in fall hospitalisation rate for community dwelling 65+ years (%)	Not available
Total cost ($ million)	0.18
Cost per fall prevented ($)	1,079
Cost per fall hospitalisation prevented ($)	53,974

Other scenarios:

	People uptake (n)	Falls prevented (n)	Hospital admissions prevented (n)	Total cost ($ M)	Cost per fall prevented ($)	Cost per hospital admission prevented ($)
Low uptake	340	148	3	0.16	1079	53974
High uptake	415	181	4	0.20	1079	53974
Low hospitalisation	377	164	2	0.18	1079	77106
High hospitalisation	377	164	4	0.18	1079	41518
More effective intervention	377	194	4	0.18	915	45769
Less effective intervention	377	129	3	0.18	1374	68689
More costly intervention	377	164	3	0.21	1280	63992
Less costly intervention	377	164	3	0.14	880	44002

ASSOCIATED INFORMATION

Underlying assumptions

- The reduction in falls risk from the Wolf et al. trial[2] is generalisable to the sections of Australian population with comparable characteristics to those who participated in the trial
- The Wolf et al. trial[2] results can only be generalised to community dwelling older people over 70 years of age with similar levels of fitness and mobility to those in the trial itself
- Uptake of the intervention within the eligible population would be the same as that observed in the trials
- Compliance with the intervention delivered to the population will be the same as that achieved in the trial, resulting in the same level of falls reduction
- The intervention does not affect the probability of admission to hospital should a fall occur.
- The control group activities in the Wolf et al trial[2] had very little impact on falls outcome
- The intervention did not reduce serious falls injury to a greater extent than the reduction in falls
- The frequency (and rate) of falls in people who are offered an intervention, but do not adopt it, is the same as that amongst people who are not offered the intervention (control group)
- The rate of falls hospital admissions in Australia (and the states and territories) will not change significantly from the average rate for the four year period 2002/03 – 2005/06
- The proportion of falls among older people that require admission to hospital will be the same in 2009, as was observed in the time period from which this estimate was calculated
- The proportion of community dwelling older people with restrictions in their core activities has not changed greatly from 2003 to 2009

Timing of expenditure and benefits

Expenditure would be required prior to the commencement of the first group and for the time required to deliver the 15 week program to the eligible population. Known falls benefits would occur in the 12 month period from commencement of each group exercise program. If all eligible people participated in 2009, then fall reductions, and associated cost savings, would start to occur from completion of the first group and continue for 12 months after commencement of the last group. The likelihood of maintaining a lower fall rate among the participants after this 12 month period is unknown. The most likely scenario is one of decay over a period of perhaps 1 or 2 years during which time the falls rate of the participants may gradually return to average. It may be possible to maintain a lower falls rate in this group if additional resources are committed to encouraging and supporting ongoing participation on tai chi. However, there is little research evidence to support this notion.

Other potential benefits

Other health benefits of tai chi as demonstrated in randomised controlled trials include improvement in systolic blood pressure, confidence and self-efficacy among community dwelling older people, improved physical performance among older people with arthritis, hypertension, some cardiac conditions and post-menopausal bone loss, and decreased impairment. These other health benefits have not been included in this model.

Capacity building and workforce training

Intervention requires a trained workforce to deliver. There is no indication in the various trial publications on the extent of training required to deliver this particular program. Certified training programs for tai chi leaders typically require 2 days (course fee approx $330) and are aimed at people with a background in allied health, human movement or fitness. Additional training required to enable accredited tai chi leaders to deliver this specific program could reasonably be achieved in 1 day.

Infrastructure requirements

The intervention requires the availability of suitable locations for classes. Community halls, community health centres, bowling clubs, senior citizen centres and neighbourhood houses often have suitable rooms with flooring in good condition, good lighting and adequate space for a group of 12. Older people prefer not to be attending exercise classes in fitness centres or gyms. Venues which requiring participants to walk up flights of stairs are not ideal. Available parking and ready access to public transport facilitates attendance.

Acceptability

Group based exercise is not acceptable to all older people, and even among those who would participate in group based exercise programs, tai chi may not be a preferred type. However, uptake among the eligible population has taken this into account for the purposes of our model.

Feasibility

National implementation would require delivery of the 15 week program to 2,667 groups of 12 people (base case scenario). If this were to occur in a 12 month period, 889 groups would need to be run across Australia in each of three 15 week periods. Assuming that a tai chi leader could run 5 groups per week for 45 weeks, then 178 trained leaders would be required across Australia. There are currently 329 leaders registered on the tai chi for Arthritis web site.

Equity

If participants were asked to bear the full cost, participation may be limited to those who have the financial resources. Inability to access appropriate transport, either due to financial or physical limitations, or lack of transport options, may also disproportionately inhibit participation. Language may be a barrier to uptake, but once participation has commenced may be less of a problem due to the visual nature of tai chi instruction. tai chi would be highly acceptable to people from Asian backgrounds. Implementation may be more difficult in regional and rural areas due to a limited trained workforce, lack of critical mass required to make class groups viable, and fewer transport options.

Sustainability

Continued tai chi practice is required to maintain the health benefits. This can be done outside the context of structured group sessions, but requires a high level of commitment from the person. Additional expenditure would be required to make this intervention available on an ongoing basis beyond one year.

Costed inputs for economic analysis

ITEM	**COST $**
Fixed costs	
recruitment	428.00
co-ordination	800.00
Fixed costs per participant for 15 week course (12 participants per group)	***102.30***
Recurrent costs	
instructor time per class	115
venue hire per class	30
music licence fee per class	2
Recurrent costs per participant for 15 week course (two classes per week, 12 participants per class)	***367.50***
Total cost per participant for 15 week course	***469.80***

Costed as independent instructors delivering the intervention outside the auspices of an agency or organisation, and therefore it is assumed that leaders would carry their own professional indemnity insurance, and that the venues would carry their own public liability insurance. If instructors were conducting classes under the auspices of an organisation, then the actual costs are likely to be similar, when salary related and organisational overheads are taken into account. Recruitment costs are based on advertising in local newspapers, assuming that two advertisements would fill one class of 12 participants. Co-ordination includes arranging the venue, leader, advertising, registering people for the class and follow up of those missing classes. These costs do not include any cost recovery from participants. If participants contributed $3, $5, or $10 per class, the cost per participant would be reduced by 20%, 32% and 64% respectively. Costs of training tai chi leaders has not been included.

Acknowledgements

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We are grateful for advice and data provided by Professor Steve Wolf, Emory University, USA, and Mr Alex Voukelatos, Injury Prevention Co-ordinator, Sydney South West Area Health Service, Australia.

This project was funded by:

The Australian Government Department of Health and Ageing, and the Australian National Health and Medical Research Council

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Modelling the impact, costs and benefits of falls prevention measures to support policy-makers and program planners

Intervention: Home based muscle strengthening and balance retraining

Brief description: Tailored muscle strengthening and balance retraining exercises progressing in difficulty, and a walking plan. The program is individually prescribed in a series of 5 home visits by an instructor at weeks 1, 2,4, and 8, with a booster visit after 6 months. Ankle cuff weights are used. Program is intended to be performed at least three times a week at home, with walking at least twice per week. The program duration in the trial was 12 months. Participants were recruited by letter from their general practitioners. This program has been tested in several randomised controlled trials in New Zealand involving just over 1,000 older people, and has been successfully delivered by physiotherapists in a research context, and community nurses and general practice nurses, in their respective settings.[1] It has been shown to be most effective among those 80+ years. The program has been noted as highly likely to be beneficial in the Cochrane review of falls interventions[2]. As there is evidence regarding the impact of this intervention over a two-year period[3], we modelled its impact over both one and two years. The research indicated that 61% of people having learnt the program in the first year, kept exercising in the second year. The only support provided was a monthly phone call, achieving continued benefit for marginal extra cost. The reduced fall rate was maintained in the second year.

Modelling: Australia

Time period:
(1) Benefits in 2009 of intervention delivered in 2009
(2) Benefits in 2009 and 2010 of intervention delivered in 2009 and continued in 2010

Target group: Men and women 80+ years, able to walk around own residence and able to understand program requirements. To estimate the size of this target group, we used estimates of the number of community dwelling older people from the Australian Bureau of Statistics, and subtracted the number estimated to be profoundly limited in, and requiring assistance with, core activities of communication, mobility and self care (14.4%) by the Disability, Ageing and Carers survey.4 The estimated number of people in this target group in Australia in 2009 is 529,461.

Setting: includes metropolitan and rural population

Base case prediction:

Outcome	Estimate year one	Estimate year two	Over two-year period
Eligible population who would uptake/continue	208,386	127,115	N/a
Falls prevented (n)	54,222	33,075	87,297
Fall hospitalisations prevented (n)	3,521	2,148	5,669
Reduction in fall hospitalisation rate 65+ years (%)[1]	4.6	2.7	Not calculated
Reduction in fall hospitalisation rate for community dwelling 65+ years (%)[1]	5.9	3.5	Not calculated
Reduction in fall hospitalisation rate 80+ years (%)[1]	7.1	4.2	Not calculated
Reduction in fall hospitalisation rate for community dwelling 80+ years (%)[1]	10.0	5.9	Not calculated
Total cost ($ million)[2]	227.25	27.84	255.09
Cost per fall prevented ($)[2]	4,191	842	2,992
Cost per fall hospitalisation prevented ($)[2]	64,542	12,960	44,997

[1]Approximations only due to data limitations and trend predictions. Interpret with caution.
[2]Delivery by district nursing network

Key data inputs:

Parameter	Base case value	Range	Source
Uptake - recruitment via letter from GP (%)	39.4	36.2 – 43.3	Campbell et al., 1997[5]
Average falls rate per person year (no exercise)	0.94	0.71 – 1.23	Robertson et al., 2001b[6]
Average falls rate per person year (exercise)	0.68	0.56 – 0.82	Robertson et al., 2001b[6]
Hospitalised falls (%)	6.50	3.74 – 9.25	Robertson et al., 2002[1], and unpublished data from Robertson
Cost per participant ($)	1091	n/a	For delivery via district nursing networks, based on Robertson et al., 2001a[7]
Cost per participant ($)	1233	n/a	For delivery by nurses based in general practice setting, based on Robertson et al., 2001b[6]

Data inputs have been derived using the data available from the New Zealand trials. The extent to which these data are generalisable to the Australian population obviously underpins the degree of confidence in the model results. Given the similarities between New Zealand and Australia, there is a high degree of confidence.

Other scenarios: benefits in 2009 only

	N people uptake	N falls prevented	N hospital admissions prevented	Total cost ($ million)	Cost ($) per fall prevented	Cost ($) per hospital admission prevented
Low uptake	187,549	48,800	3,169	204.52	4,191	64,542
High uptake	222,223	59,644	3,873	249.97	4,191	64,542
Low hospitalisation	208,386	54,222	5,013	227.25	4,191	45,331
High hospitalisation	208,386	54,222	2,029	227.25	4,191	112,014
More effective intervention	208,386	79,273	5,148	227.25	2,867	44,146
Less effective intervention	208,386	25,123	1,631	227.25	9,045	139,297
General practice nurse model	208,386	54,222	5,013	256.92	4,738	72,969

All scenarios vary one parameter, and keep the values from the base case for the other parameters. Low and high uptake and hospitalisation scenarios use the lower and upper ranges shown in the key data inputs table above. The more and less effective intervention scenarios use the average falls rate per person year without home based exercise, and the lower and upper ranges, respectively, of the average falls rate per person year with home based exercise.

Modelling for: **Queensland**

The estimated number of eligible people for the muscle strengthening and balance retraining intervention in Queensland in 2009 is 83,067.

Base case prediction:

Outcome	Estimate year one	Estimate year two	Over two-year period
Eligible population who would uptake/continue	32,694	19,943	N/a
Falls prevented (n)	8,507	5,189	13,696
Fall hospitalisations prevented (n)	552	337	889
Reduction in fall hospitalisation rate 65+ years (%)[1]	Not available	Not available	Not available
Reduction in fall hospitalisation rate for community dwelling 65+ yrs (%)[1]	Not available	Not available	Not available
Reduction in fall hospitalisation rate 80+ years (%)[1]	Not available	Not available	Not available
Reduction in fall hospitalisation rate for community dwelling 80+ yrs(%)[1]	Not available	Not available	Not available
Total cost ($ million)[2]	35.65	4.37	40.02
Cost per fall prevented ($)[2]	4,191	842	2,922
Cost per fall hospitalisation prevented ($)[2]	64,542	12,960	44,997

[1]Approximations only due to data limitations and trend predictions. Interpret with caution.
[2]Delivery by district nursing network

Other scenarios: benefits in 2009 only

	N people uptake	N falls prevented	N hospital admissions prevented	Total cost ($ million)	Cost ($) per fall prevented	Cost ($) per hospital admission prevented
Low uptake	29,424	7,656	497	32.09	4191	64542
High uptake	35,963	9,358	608	39.22	4191	64542
Low hospitalisation	32,694	8,507	786	35.65	4191	45331
High hospitalisation	32,694	8,507	318	35.65	4191	112014
More effective intervention	32,694	12,437	808	35.65	2867	44146
Less effective intervention	32,694	3,942	256	35.65	9045	139297
General practice nurse model	32,694	8,507	552	40.31	4738	72969

Modelling for: **New South Wales**

The estimated number of eligible people for the muscle strengthening and balance retraining intervention in New South Wales in 2009 is 191,773.

Base case prediction:

Outcome	Estimate year one	Estimate year two	Over two-year period
Eligible population who would uptake/continue	75,478	46,042	N/a
Falls prevented (n)	19,639	11,980	31,619
Fall hospitalisations prevented (n)	1,275	778	2,053
Reduction in fall hospitalisation rate 65+ years (%)[1]	4.8	2.8	Not calculated
Reduction in fall hospitalisation rate for community dwelling 65+ yrs (%)[1]	6.1	3.6	Not calculated
Reduction in fall hospitalisation rate 80+ years (%)[1]	7.4	4.3	Not calculated
Reduction in fall hospitalisation rate for community dwelling 80+ yrs (%)[1]	10.3	6.1	Not calculated
Total cost ($ million)[2]	82.31	10.08	92.39
Cost per fall prevented ($)[2]	4,191	842	2,922
Cost per fall hospitalisation prevented ($)[2]	64,542	12,962	44,997

[1]Approximations only due to data limitations and trend predictions. Interpret with caution.
[2]Delivery by district nursing network

Other scenarios: benefits in 2009 only

	N people uptake	N falls prevented	N hospital admissions prevented	Total cost ($ million)	Cost ($) per fall prevented	Cost ($) per hospital admission prevented
Low uptake	67,930	17,675	1,148	74.08	4191	64542
High uptake	83,026	21,603	1,403	90.54	4191	64542
Low hospitalisation	75,478	19,639	1,816	82.31	4191	45331
High hospitalisation	75,478	19,639	735	82.31	4191	112014
More effective intervention	75,478	28,713	1,864	82.31	2867	44146
Less effective intervention	75,478	9,100	591	82.31	9045	139297
General practice nurse model	75,478	19,639	1,275	93.06	4738	72969

Modelling for: **Victoria**

The estimated number of eligible people for the muscle strengthening and balance retraining intervention in Victoria in 2009 is 130,688.

Base case prediction:

Outcome	**Estimate year one**	**Estimate year two**	**Over two-year period**
Eligible population who would uptake/continue	51,436	31,376	N/a
Falls prevented (n)	13,384	8,164	21,548
Fall hospitalisations prevented (n)	869	530	1,399
Reduction in fall hospitalisation rate 65+ years (%)[1]	4.1	2.4	Not calculated
Reduction in fall hospitalisation rate for community dwelling 65+ yrs (%)[1]	5.4	3.2	Not calculated
Reduction in fall hospitalisation rate 80+ years (%)[1]	6.2	3.7	Not calculated
Reduction in fall hospitalisation rate for community dwelling 80+ yrs (%)[1]	9.0	5.3	Not calculated
Total cost ($ million)[2]	56.09	6.87	62.96
Cost per fall prevented ($)[2]	4,191	842	2,922
Cost per fall hospitalisation prevented ($)[2]	64,542	12,962	44,997

[1]Approximations only due to data limitations and trend predictions. Interpret with caution.
[2]Delivery by district nursing network

Other scenarios: benefits in 2009 only

	N people uptake	**N falls prevented**	**N hospital admissions prevented**	**Total cost ($ million)**	**Cost ($) per fall prevented**	**Cost ($) per hospital admission prevented**
Low uptake	46,293	12,045	782	50.48	4191	64542
High uptake	56,580	14,722	956	61.70	4191	64542
Low hospitalisation	51,436	13,384	1,237	56.09	4191	45331
High hospitalisation	51,436	13,384	501	56.09	4191	112014
More effective intervention	51,436	19,567	1,271	56.09	2867	44146
Less effective intervention	51,436	6,201	403	56.09	9045	139297
General practice nurse model	51,436	13,384	869	63.42	4738	72969

Modelling for: **Tasmania**

The estimated number of eligible people for the muscle strengthening and balance retraining intervention in Tasmania in 2009 is 13,883.

Base case prediction:

Outcome	Estimate year one	Estimate year two	Over two-year period
Eligible population who would uptake/continue	5,464	3,333	N/a
Falls prevented (n)	1,422	867	2,289
Fall hospitalisations prevented (n)	92	56	149
Reduction in fall hospitalisation rate 65+ years (%)[1]	6.1	3.6	Not calculated
Reduction in fall hospitalisation rate for community dwelling 65+ yrs (%)[1]	7.4	4.4	Not calculated
Reduction in fall hospitalisation rate 80+ years (%)[1]	9.6	5.6	Not calculated
Reduction in fall hospitalisation rate for community dwelling 80+ yrs (%)[1]	12.7	7.5	Not calculated
Total cost ($ million)[2]	5.96	0.73	6.69
Cost per fall prevented ($)[2]	4,191	842	2,922
Cost per fall hospitalisation prevented ($)[2]	64,542	12,962	44,997

[1]Approximations only due to data limitations and trend predictions. Interpret with caution.
[2]Delivery by district nursing network

Other scenarios: benefits in 2009 only

	N people uptake	N falls prevented	N hospital admissions prevented	Total cost ($ million)	Cost ($) per fall prevented	Cost ($) per hospital admission prevented
Low uptake	4,918	1,280	83	5.36	4191	64542
High uptake	6,010	1,564	102	6.55	4191	64542
Low hospitalisation	5,464	1,422	131	5.96	4191	45331
High hospitalisation	5,464	1,422	53	5.96	4191	112014
More effective intervention	5,464	2,079	135	5.96	2867	44146
Less effective intervention	5,464	659	43	5.96	9045	139297
General practice nurse model	5,464	1,422	92	6.74	4738	72969

Modelling for: **South Australia**

The estimated number of eligible people for the muscle strengthening and balance retraining intervention in South Australia in 2009 is 51,487.

Base case prediction:

Outcome	Estimate year one	Estimate year two	Over two-year period
Eligible population who would uptake/continue	20,264	12,361	N/a
Falls prevented (n)	5,273	3,216	8,489
Fall hospitalisations prevented (n)	342	209	551
Reduction in fall hospitalisation rate 65+ years (%)[1]	5.6	3.4	Not calculated
Reduction in fall hospitalisation rate for community dwelling 65+ yrs (%)[1]	7.0	4.1	Not calculated
Reduction in fall hospitalisation rate 80+ years (%)[1]	8.4	5.0	Not calculated
Reduction in fall hospitalisation rate for community dwelling 80+ yrs (%)[1]	11.3	5.9	Not calculated
Total cost ($ million)[2]	22.10	2.71	24.81
Cost per fall prevented ($)[2]	4,191	842	2,922
Cost per fall hospitalisation prevented ($)[2]	64,542	12,962	44,997

[1]Approximations only due to data limitations and trend predictions. Interpret with caution.
[2]Delivery by district nursing network

Other scenarios: benefits in 2009 only

	N people uptake	N falls prevented	N hospital admissions prevented	Total cost ($ million)	Cost ($) per fall prevented	Cost ($) per hospital admission prevented
Low uptake	18,238	4,746	308	19.89	4191	64542
High uptake	22,291	5,800	377	24.31	4191	64542
Low hospitalisation	20,264	5,273	487	22.10	4191	45331
High hospitalisation	20,264	5,273	197	22.10	4191	112014
More effective intervention	20,264	7,709	501	22.10	2867	44146
Less effective intervention	20,264	2,443	159	22.10	9045	139297
General practice nurse model	20,264	5,273	342	24.98	4738	72969

Modelling for: **Western Australia**

The estimated number of eligible people for the muscle strengthening and balance retraining intervention in Western Australia in 2009 is 49,973.

Base case prediction:

Outcome	Estimate year one	Estimate year two	Over two-year period
Eligible population who would uptake/continue	19,668	11,998	N/a
Falls prevented (n)	5,118	3,122	8,240
Fall hospitalisations prevented (n)	332	203	535
Reduction in fall hospitalisation rate 65+ years (%)[1]	5.4	3.2	Not calculated
Reduction in fall hospitalisation rate for community dwelling 65+ yrs (%)[1]	6.9	4.0	Not calculated
Reduction in fall hospitalisation rate 80+ years (%)[1]	8.3	4.9	Not calculated
Reduction in fall hospitalisation rate for community dwelling 80+ yrs (%)[1]	11.5	6.7	Not calculated
Total cost ($ million)[2]	21.45	2.63	24.08
Cost per fall prevented ($)[2]	4,191	842	2,922
Cost per fall hospitalisation prevented ($)[2]	64,542	12,962	44,997

[1]Approximations only due to data limitations and trend predictions. Interpret with caution.
[2]Delivery by district nursing network

Other scenarios: benefits in 2009 only

	N people uptake	N falls prevented	N hospital admissions prevented	Total cost ($ million)	Cost ($) per fall prevented	Cost ($) per hospital admission prevented
Low uptake	17,702	4,606	299	19.30	4191	64542
High uptake	21,635	5,629	366	23.59	4191	64542
Low hospitalisation	19,668	5,118	473	21.45	4191	45331
High hospitalisation	19,668	5,118	191	21.45	4191	112014
More effective intervention	19,668	7,482	486	21.45	2867	44146
Less effective intervention	19,668	2,371	154	21.45	9045	139297
General practice nurse model	19,668	5,118	332	24.25	4738	72969

Modelling for: **Northern Territory**

The estimated number of eligible people for the muscle strengthening and balance retraining intervention in Northern Territory in 2009 is 1,159.

Base case prediction:

Outcome	Estimate year one	Estimate year two	Over two-year period
Eligible population who would uptake/continue	456	278	N/a
Falls prevented (n)	119	72	191
Fall hospitalisations prevented (n)	8	5	12
Reduction in fall hospitalisation rate 65+ years (%)[1]	3.6	2.2	Not calculated
Reduction in fall hospitalisation rate for community dwelling 65+ yrs (%)[1]	4.3	2.6	Not calculated
Reduction in fall hospitalisation rate 80+ years (%)[1]	7.7	4.6	Not calculated
Reduction in fall hospitalisation rate for community dwelling 80+ yrs (%)[1]	10.1	6.1	Not calculated
Total cost ($ million)[2]	0.50	0.06	0.56
Cost per fall prevented ($)[2]	4,191	842	2,922
Cost per fall hospitalisation prevented ($)[2]	64,542	12,962	44,997

[1]Approximations only due to data limitations and trend predictions. Interpret with caution.
[2]Delivery by district nursing network

Other scenarios: benefits in 2009 only

	N people uptake	N falls prevented	N hospital admissions prevented	Total cost ($ million)	Cost ($) per fall prevented	Cost ($) per hospital admission prevented
Low uptake	411	107	7	0.45	4191	64542
High uptake	502	131	8	0.55	4191	64542
Low hospitalisation	456	119	11	0.50	4191	45331
High hospitalisation	456	119	4	0.50	4191	112014
More effective intervention	456	174	11	0.50	2867	44146
Less effective intervention	456	55	4	0.50	9045	139297
General practice nurse model	456	119	8	0.56	4738	72969

Modelling for: **Australian Capital Territory**

The estimated number of eligible people for the muscle strengthening and balance retraining intervention in Australian Capital Territory in 2009 is 6,073.

Base case prediction:

Outcome	Estimate year one	Estimate year two	Over two-year period
Eligible population who would uptake/continue	2,390	1,458	N/a
Falls prevented (n)	622	379	1,001
Fall hospitalisations prevented (n)	40	25	65
Reduction in fall hospitalisation rate 65+ years (%)[1]	Not available	Not available	Not calculated
Reduction in fall hospitalisation rate for community dwelling 65+ yrs (%)[1]	Not available	Not available	Not calculated
Reduction in fall hospitalisation rate 80+ years (%)[1]	Not available	Not available	Not calculated
Reduction in fall hospitalisation rate for community dwelling 80+ yrs (%)[1]	Not available	Not available	Not calculated
Total cost ($ million)[2]	2.61	0.32	2.93
Cost per fall prevented ($)[2]	4,191	842	2,922
Cost per fall hospitalisation prevented ($)[2]	64,542	12,962	44,997

[1]Approximations only due to data limitations and trend predictions. Interpret with caution.
[2]Delivery by district nursing network

Other scenarios: benefits in 2009 only

	N people uptake	N falls prevented	N hospital admissions prevented	Total cost ($ million)	Cost ($) per fall prevented	Cost ($) per hospital admission prevented
Low uptake	2,151	560	36	2.35	4191	64542
High uptake	2,629	684	44	2.87	4191	64542
Low hospitalisation	2,390	622	58	2.61	4191	45331
High hospitalisation	2,390	622	23	2.61	4191	112014
More effective intervention	2,390	909	59	2.61	2867	44146
Less effective intervention	2,390	288	19	2.61	9045	139297
General practice nurse model	2,390	622	40	2.95	4738	72969

ASSOCIATED INFORMATION

Underlying assumptions

- The reduction in falls risk, and the proportion of older people requiring admission to hospital as a result of a fall, from the trial is generalisable to sections of the Australian population with comparable characteristics to those who participated in the trial
- Uptake of the intervention within the eligible population would be the same as that observed in the trial
- Compliance with the intervention delivered to the population will be the same as that achieved in the trials, resulting in the same level of falls reduction
- The intervention does not affect the probability of admission to hospital should a fall occur.
- Any control group activities provided in the trials had no impact on falls outcome
- The intervention does not reduce serious falls injury to a greater extent than the reduction in falls
- The frequency (and rate) of falls in people who are offered an intervention, but do not adopt it, is the same as that amongst people who are not offered the intervention (control group)
- The rate of falls hospital admissions in Australia (and the states and territories) will not change significantly from the average rate for the four year period 2002/03 – 2005/06
- The trial results of Robertson 2001b[6] can only be generalised to community dwelling older people +80 years with similar levels of fitness and mobility to those in the trial itself
- The proportion of community dwelling older people with restrictions in their core activities has not changed greatly from 2003 to 2009
- Intervention costs did not vary between the 75+ years and 80+ years groups
- The intervention is as effective in a second year for men as it is for women

Timing of expenditure and benefits

Expenditure would be required for training of the nurses prior to commencement of the first participant, and for the 12 month period, although most of the expenditure would occur in the first 2 months. Known falls benefits would occur in the two-year period from commencement for each participant. The reduced fall rate would be maintained in the second year, without further home visits but would require ongoing telephone contact, and therefore additional resources[3].

Other potential benefits

There is the potential for some other health benefits to accrue as a result of this intervention. Overall, this intervention could improve general well-being and confidence, decrease depression, and decrease or slow the rate of onset of physical impairment. The walking component could improve cardio-vascular health and increase vitamin D levels. These other health benefits have not been included in this model.

Capacity building and workforce training

Nurses require one week of training to be able to deliver intervention. A number of site visits and telephone contact is required from the training physiotherapist to ensure quality control. The training and quality control has been included in the costs. One full time equivalent nurse could deliver the intervention to approximately 250 people over a 12 month period, assuming that no more than 50 k travel would be required per participant.

Infrastructure requirements

The intervention requires very little additional infrastructure. Nurses would be working within existing organisational settings. Motor vehicles would need to be supplied. Motor vehicle purchase has not been included in the costs, but running costs are included.

Acceptability

The intervention is likely to be relatively well accepted by older people, particularly those who are not interested in group based programs.

Feasibility

National implementation would require delivery to 208,386 people across Australia (base case scenario). If this were to occur in a 12 month period, approximately 834 full time equivalent nurses would be required. The number of nurses required would likely be higher than this since delivery in rural and remote areas would be less time efficient. A considerably smaller number of physiotherapists would be required for training and ongoing supervision. The second year requires substantially less staff time – approximately 146 full time equivalent nurses for the follow-up telephone calls.

Equity

There are few barriers on equity grounds, unless participants are asked for a co-contribution. Language may be a barrier to uptake, but once participation has commenced may be less of a problem due to the visual nature of instruction. Nurses from culturally relevant backgrounds may be required for delivery to some culturally and linguistically diverse groups. Implementation may be more difficult in regional and rural areas due to a limited allied health workforce.

Sustainability

Continued exercise and walking is required to maintain the health benefits beyond the initial 12 months. If additional support is provided in the form of monthly telephone calls, then the benefits are maintained over a second 12 month period. A high level of commitment from the participant would be required once the support was no longer provided.

Costed inputs for economic analysis

Item	**District nurse delivered home based exercise model Cost per participant ($)**	**General practice-based nurse delivered home based exercise Cost per participant ($)**
Training	$49.88	$22.07
Recruitment, program prescription and follow-up	$886.28	$1016.15
Supervision of program-quality control	$154.36	$194.67
Total cost per participant	**$1090.52**	**$1232.89**

Two of the four trials presented economic evaluations for two slightly different modes of intervention delivery: one used the district nursing network for delivery of the home based exercise program[7], and the other used nurses based in general practice to deliver the program[6]. We costed each delivery mechanism separately using the published cost items, and applying current Australian unit cost data. Training costs were included in recognition that there is no existing workforce trained to deliver this particular program. Recruitment costs included time for the doctors and their practice staff to identify appropriate patients and mail out the letters of invitation. Ankle cuff weights and instruction booklets are included.

Acknowledgements

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We are extremely grateful to Dr Claire Robertson from the University of Otago for her generosity in sharing data from the original research trials for use in the models.

This project was funded by:
The Australian Government Department of Health and Ageing, and the Australian National Health and Medical Research Council

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Modelling the impact, costs and benefits of falls prevention measures to support policy-makers and program planners

Intervention: home hazard assessment and modification delivered by occupational therapists

Brief description: Routine occupational therapy home assessment using standardised assessment form, followed by supervision of any recommended home modifications for people with falls history. Participants recruited while hospital inpatients or while attending hospital outpatient clinics or local day care centres. This type of program has been tested in three randomised trial and has been noted as highly likely to be beneficial in the Cochrane review of falls interventions[1]. One of these trials, an Australian based study, was selected for modelling as it was the only one publishing sufficient information for this purpose[2].

Modelling for: AUSTRALIA

Time period: Benefits in 2009 of intervention delivered in 2009

Target group: Men and women 65+ years, and normally community dwelling, admitted to hospital for any reason, but not receiving occupational therapist visit as part of discharge plan, and with a history of falling in the previous 12 months. Cognitively impaired people with carers were included. We obtained an estimate of the eligible population by combining information from the published trial2, National Health Survey, the National Hospital Separations Database and the projected population for 2009 from the ABS. The estimated number of people in this group in Australia in 2009 is 255,402.

Setting: includes metropolitan and rural population

Base case prediction:

Outcome	Estimate
Eligible population who would uptake	141,493
Falls prevented (n)	140,078
Fall hospitalisations prevented (n)	2,802
Reduction in fall hospitalisation rate 65+ years (%)	3.7*
Reduction in fall hospitalisation rate for community dwelling 65+ years (%)	4.7*
Total cost ($ million)	58.37
Cost per fall prevented ($)	471
Cost per fall hospitalisation prevented ($)	20,834

*Approximations only due to data limitations and trend predictions. Interpret with caution.

Key data inputs:

Parameter	Base case value	Range	Source
Uptake (%)	55.4	49.9 – 60.9	Close et al.[3]
Average falls rate per person year (no intervention)	2.24	1.57 – 3.15	Cumming et al.[2]
Average falls rate per person year (with intervention)	1.25	0.82 – 1.90	Cumming et al. [2]
Hospitalised falls (%)	2.0	1.4 – 2.6	Tiedemann et al[4], and L. Day, unpublished data, prospective falls data from Australian trials involving community dwelling older people
Cost per participant ($)	413	501 (higher cost option)	Based on Salkeld et al[5]; higher cost option is associated with higher salary levels for occupational therapists (see table on page 4)

Data inputs have been derived using the best possible available information from Australian sources, with the exception of the uptake rate which was derived from a UK trial.

Other scenarios:

	People uptake (n)	Falls prevented (n)	Hospital admissions averted (n)	Total cost ($ M)	Cost per fall prevented ($)	Cost per hospital admission prevented ($)
Low uptake	127,343	126,070	2,521	58.37	417	20,834
High uptake	155,642	154,086	3,082	52.53	417	20,834
Low hospitalisation	141,493	140,078	1,961	64.21	417	20,834
High hospitalisation	141,493	140,078	3,642	58.37	417	29,763
More effective intervention	141,493	201,258	4,025	58.37	417	16,026
Less effective intervention	127,343	126,070	974	58.37	290	14,501
Higher cost option	141,493	140,078	2,802	58.37	1,199	59,943

All scenarios vary one parameter, and keep the values from the base case for the other parameters. Low and high uptake and hospitalisation scenarios use the lower and upper ranges shown in the key data inputs table above. The more and less effective intervention scenarios use the average falls rate per person year without the intervention, and the lower and upper ranges, respectively, of the average falls rate per person year with the intervention. The higher cost option is associated with a higher salary range for occupational therapists (see later table).

Modelling for: **Queensland**

The estimated number of eligible people for the home hazard assessment and modification intervention delivered by occupational therapists in Queensland in 2009 is 47,799.

Base case prediction:

Outcome	Estimate
Eligible population who would uptake	26,481
Falls prevented (n)	26,216
Fall hospitalisations prevented (n)	524
Reduction in fall hospitalisation rate 65+ years (%)	Not available
Reduction in fall hospitalisation rate for community dwelling 65+ years (%)	Not available
Total cost ($ million)	10.92
Cost per fall prevented ($)	417
Cost per fall hospitalisation prevented ($)	20,834

*Approximations only due to data limitations and trend predictions. Interpret with caution.

Other scenarios:

	People uptake (n)	Falls prevented (n)	Hospital admissions averted (n)	Total cost ($ M)	Cost per fall prevented ($)	Cost per hospital admission prevented ($)
Low uptake	23,833	23,594	472	9.83	417	20834
High uptake	29,129	28,837	577	12.02	417	20834
Low hospitalisation	26,481	26,216	367	10.92	417	29763
High hospitalisation	26,481	26,216	682	10.92	417	16026
More effective intervention	26,481	37,666	753	10.92	290	14501
Less effective intervention	26,481	9,112	182	10.92	1199	59943
Higher cost option	26,481	26,216	524	13.27	506	25308

Modelling for: **New South Wales**
The estimated number of eligible people for the home hazard assessment and modification intervention delivered by occupational therapists in New South Wales in 2009 is 87,332.

Base case prediction:

Outcome	**Estimate**
Eligible population who would uptake	48,382
Falls prevented (n)	47,898
Fall hospitalisations prevented (n)	958
Reduction in fall hospitalisation rate 65+ years (%)	3.6*
Reduction in fall hospitalisation rate for community dwelling 65+ years (%)	4.6*
Total cost ($ million)	19.96
Cost per fall prevented ($)	417
Cost per fall hospitalisation prevented ($)	20,834

*Approximations only due to data limitations and trend predictions. Interpret with caution.

Other scenarios:

	People uptake (n)	**Falls prevented (n)**	**Hospital admissions averted (n)**	**Total cost ($ M)**	**Cost per fall prevented ($)**	**Cost per hospital admission prevented ($)**
Low uptake	43,544	43,108	862	17.96	417	20834
High uptake	53,220	52,688	1,054	21.95	417	20834
Low hospitalisation	48,382	47,898	671	19.96	417	29763
High hospitalisation	48,382	47,898	1,245	19.96	417	16026
More effective intervention	48,382	68,818	1,376	19.96	290	14501
Less effective intervention	48,382	16,648	333	19.96	1199	59943
Higher cost option	48,382	47,898	958	24.24	506	25308

Modelling for: **Victoria**

The estimated number of eligible people for the home hazard assessment and modification intervention delivered by occupational therapists in Victoria in 2009 is 64,116.

Base case prediction:

Outcome	Estimate
Eligible population who would uptake	35,520
Falls prevented (n)	35,165
Fall hospitalisations prevented (n)	703
Reduction in fall hospitalisation rate 65+ years (%)	3.3*
Reduction in fall hospitalisation rate for community dwelling 65+ years (%)	4.3*
Total cost ($ million)	14.65
Cost per fall prevented ($)	417
Cost per fall hospitalisation prevented ($)	20,834

*Approximations only due to data limitations and trend predictions. Interpret with caution.

Other scenarios:

	People uptake (n)	Falls prevented (n)	Hospital admissions averted (n)	Total cost ($ M)	Cost per fall prevented ($)	Cost per hospital admission prevented ($)
Low uptake	31,968	31,649	633	13.19	417	20834
High uptake	39,072	38,682	774	16.12	417	20834
Low hospitalisation	35,520	35,165	492	14.65	417	29763
High hospitalisation	35,520	35,165	914	14.65	417	16026
More effective intervention	35,520	50,524	1,010	14.65	290	14501
Less effective intervention	35,520	12,222	244	14.65	1199	59943
Higher cost option	35,520	35,165	703	17.80	506	25308

Modelling for: **Tasmania**

The estimated number of eligible people for the home hazard assessment and modification intervention delivered by occupational therapists in Tasmania in 2009 is 6,714.

Base case prediction:

Outcome	Estimate
Eligible population who would uptake	3,720
Falls prevented (n)	3,682
Fall hospitalisations prevented (n)	74
Reduction in fall hospitalisation rate 65+ years (%)	4.9*
Reduction in fall hospitalisation rate for community dwelling 65+ years (%)	6.0*
Total cost ($ million)	1.53
Cost per fall prevented ($)	417
Cost per fall hospitalisation prevented ($)	20,834

*Approximations only due to data limitations and trend predictions. Interpret with caution.

Other scenarios:

	People uptake (n)	Falls prevented (n)	Hospital admissions averted (n)	Total cost ($ M)	Cost per fall prevented ($)	Cost per hospital admission prevented ($)
Low uptake	3,348	3,314	66	1.38	417	20834
High uptake	4,092	4,051	81	1.69	417	20834
Low hospitalisation	3,720	3,682	52	1.53	417	29763
High hospitalisation	3,720	3,682	96	1.53	417	16026
More effective intervention	3,720	5,291	106	1.53	290	14501
Less effective intervention	3,720	1,280	26	1.53	1199	59943
Higher cost option	3,720	3,682	74	1.86	506	25308

Modelling for: **South Australia**

The estimated number of eligible people for the home hazard assessment and modification intervention delivered by occupational therapists in South Australia in 2009 is 21,757.

Base case prediction:

Outcome	Estimate
Eligible population who would uptake	12,053
Falls prevented (n)	11,933
Fall hospitalisations prevented (n)	239
Reduction in fall hospitalisation rate 65+ years (%)	3.9*
Reduction in fall hospitalisation rate for community dwelling 65+ years (%)	4.9*
Total cost ($ million)	4.97
Cost per fall prevented ($)	417
Cost per fall hospitalisation prevented ($)	20,834

*Approximations only due to data limitations and trend predictions. Interpret with caution.

Other scenarios:

	People uptake (n)	Falls prevented (n)	Hospital admissions averted (n)	Total cost ($ M)	Cost per fall prevented ($)	Cost per hospital admission prevented ($)
Low uptake	10,848	10,740	215	4.48	417	20834
High uptake	13,259	13,126	263	5.47	417	20834
Low hospitalisation	12,053	11,933	167	4.97	417	29763
High hospitalisation	12,053	11,933	310	4.97	417	16026
More effective intervention	12,053	17,145	343	4.97	290	14501
Less effective intervention	12,053	4,147	83	4.97	1199	59943
Higher cost option	12,053	11,933	239	6.04	506	25308

Modelling for: **Western Australia**

The estimated number of eligible people for the home hazard assessment and modification intervention delivered by occupational therapists in Western Australia in 2009 is 23,580.

Base case prediction:

Outcome	Estimate
Eligible population who would uptake	13,063
Falls prevented (n)	12,933
Fall hospitalisations prevented (n)	259
Reduction in fall hospitalisation rate 65+ years (%)	4.2*
Reduction in fall hospitalisation rate for community dwelling 65+ years (%)	5.3*
Total cost ($ million)	5.39
Cost per fall prevented ($)	417
Cost per fall hospitalisation prevented ($)	20,834

*Approximations only due to data limitations and trend predictions. Interpret with caution.

Other scenarios:

	People uptake (n)	Falls prevented (n)	Hospital admissions averted (n)	Total cost ($ M)	Cost per fall prevented ($)	Cost per hospital admission prevented ($)
Low uptake	11,757	11,639	233	4.85	417	20834
High uptake	14,370	14,226	285	5.93	417	20834
Low hospitalisation	13,063	12,933	181	5.39	417	29763
High hospitalisation	13,063	12,933	336	5.39	417	16026
More effective intervention	13,063	18,581	372	5.39	290	14501
Less effective intervention	13,063	4,495	90	5.39	1199	59943
Higher cost option	13,063	12,933	259	6.55	506	25308

Modelling for: **Northern Territory**

The estimated number of eligible people for the home hazard assessment and modification intervention delivered by occupational therapists in Northern Territory in 2009 is 969.

Base case prediction:

Outcome	Estimate
Eligible population who would uptake	537
Falls prevented (n)	531
Fall hospitalisations prevented (n)	11
Reduction in fall hospitalisation rate 65+ years (%)	5.0*
Reduction in fall hospitalisation rate for community dwelling 65+ years (%)	5.9*
Total cost ($ million)	0.22
Cost per fall prevented ($)	417
Cost per fall hospitalisation prevented ($)	20,834

*Approximations only due to data limitations and trend predictions. Interpret with caution.

Other scenarios:

	People uptake (n)	Falls prevented (n)	Hospital admissions averted (n)	Total cost ($ M)	Cost per fall prevented ($)	Cost per hospital admission prevented ($)
Low uptake	483	478	10	0.20	417	20834
High uptake	591	585	12	0.24	417	20834
Low hospitalisation	537	531	7	0.22	417	29763
High hospitalisation	537	531	14	0.22	417	16026
More effective intervention	537	764	15	0.22	290	14501
Less effective intervention	537	185	4	0.22	1199	59943
Higher cost option	537	531	11	0.27	506	25308

Modelling for: **Australian Capital Territory**

The estimated number of eligible people for the home hazard assessment and modification intervention delivered by occupational therapists in the Australian Capital Territory in 2009 is 3,120.

Base case prediction:

Outcome	Estimate
Eligible population who would uptake	1,728
Falls prevented (n)	1,711
Fall hospitalisations prevented (n)	34
Reduction in fall hospitalisation rate 65+ years (%)	Not available
Reduction in fall hospitalisation rate for community dwelling 65+ years (%)	Not available
Total cost ($ million)	0.71
Cost per fall prevented ($)	417
Cost per fall hospitalisation prevented ($)	20,834

*Approximations only due to data limitations and trend predictions. Interpret with caution.

Other scenarios:

	People uptake (n)	Falls prevented (n)	Hospital admissions averted (n)	Total cost ($ M)	Cost per fall prevented ($)	Cost per hospital admission prevented ($)
Low uptake	1,556	1,540	31	0.64	417	20834
High uptake	1,901	1,882	38	0.78	417	20834
Low hospitalisation	1,728	1,711	24	0.71	417	29763
High hospitalisation	1,728	1,711	44	0.71	417	16026
More effective intervention	1,728	2,459	49	0.71	290	14501
Less effective intervention	1,728	595	12	0.71	1199	59943
Higher cost option	1,728	1,711	34	0.87	506	25308

ASSOCIATED INFORMATION

Underlying assumptions

- The reduction in falls risk from the Cumming et al trail[2] is generalisable, and can only be generalised, to the section of Australia population with comparable characteristics to those who participated in the trial
- Compliance with the intervention delivered to the population will be the same as that achieved in the trial, resulting in the same level of falls reduction
- Participation in the intervention does not affect the probability of admission to hospital should a fall occur.
- The intervention did not reduce serious falls injury to a greater extent than the reduction in falls
- The proportion of community dwelling older people hospitalised in 2004/5 did not change significantly in 2009.
- The falls frequency distribution for the participants in the Close et al. (1999) trial is generalisable to the participants in the Cumming et al. (1999) trial.
- The mix of home modifications observed in the Cumming et al (1999) trial will remain constant if the intervention were widely implemented.

Timing of expenditure and benefits

Falls benefits would occur in the 12 month period after the home visit for each person. If all eligible people participated in 2009, then fall reductions, and associated cost savings, would start to occur from commencement, but would increase over the 12 month period. The likelihood of maintaining a lower fall rate among the participants after this 12 month period is unknown. The impact of the intervention on falls is likely to occur due to both the advice provided by the occupational therapist about doing things differently around the home, and from the home modifications themselves. It is likely that the impact of the home modifications would endure beyond the first 12 months (provided these modifications remain in place), and therefore some falls reduction could be anticipated in the subsequent years.

Other potential benefits

Other health benefits related to maintaining independence as a consequence of occupational therapy advice may occur. These other health benefits have not been included in this model.

Capacity building and workforce training

The intervention requires a trained workforce to deliver. There is currently a shortage of occupational therapists, particularly in rural and regional areas.

Infrastructure requirements

The intervention requires very little additional infrastructure. Occupational therapists would be working within existing organisational settings. Motor vehicles would need to be supplied. Motor vehicle purchase has not been included in the costs, but running costs are included.

Acceptability

The occupational therapy home visit is likely to be relatively well accepted, although the recommended home modifications may not be always accepted, depending on the nature of the modification. For example, in the trial 19% of participants for whom a rail for external stairs was recommended, were compliant with this recommendation at the end of the 12 month period[2].

Feasibility
Implementation would require routine referral of hospital inpatients, meeting the eligibility criteria, to occupational therapy services. One full time equivalent occupational therapist could deliver the intervention to approximately 340 people over a 12 month period. Therefore, 416 full time equivalent occupational therapists would be required to deliver this intervention to the estimated number of people who would take up the intervention.

Equity
Implementation may be more difficult in regional and rural areas due to a limited trained workforce. Language may be a barrier to participation, unless interpreter services are available.

Sustainability
Some falls prevention benefit is likely to be maintained beyond the first 12 months, without additional expenditure. However, additional expenditure would be required to make this intervention available on an ongoing basis.

Costed inputs for economic analysis

Item	**Lower cost option-public sector wage rates $**	**Higher cost option-hourly fee OT Australia $**
Occupational therapist	390.62	480.00
Phone and letter costs	0.75	0.75
Travel costs	6.90	6.90
Home modification cost	14.25	14.25
Total	**412.52**	**501.09**

The approach taken to costing this intervention is based on the economic evaluation of the intervention as delivered in the trial[5]. We used the published cost items, and applied current Australian unit cost data for wages, office costs and travel. The average cost per participant (regardless of who bore the cost) for home modifications in 2000 ($11) was scaled up to 2008 values using the consumer price index. The two different cost options reflect different wage rates for occupational therapists. Both options include wage on-costs plus overheads.

Acknowledgements

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We are grateful to Professor Glen Salkeld, University of Sydney, Dr Jacqueline Close, Prince of Wales Medical Research Institute, and A/Professor Lindy Clemson, University of Sydney, for provision of advice and data.

<u>This project was funded by:</u>

The Australian Department of Health and Ageing, and the Australian National Health and Medical Research Council.

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MONASH University
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Modelling the impact, costs and benefits of falls prevention measures to support policy-makers and program planners

Intervention: Multi-disciplinary, multi-factorial risk screening and intervention

Brief description: Identification of risk factors using a multi-factorial screening tool and a structured interdisciplinary approach to management and prevention of falls. This program has been tested in randomised trials and noted as highly likely to be beneficial for both unselected, and selected (i.e., with a history of falls or other key risk factors), community dwelling older people in the Cochrane review of falls interventions[1]. The predictions below only apply to community dwelling people 65+ years who have presented to a hospital emergency department for following a fall, and are based one of the studies[2] included in the Cochrane Review. In the research trial, participants were recruited by the presenting hospital and the initial assessment was made in the hospital day clinic, with referrals made as necessary to hospital outpatient departments, a multidisciplinary day hospital, general practitioners, and opticians. In addition, all participants received an occupational therapy home visit. The model presented here opted for delivery through general practitioners rather than the presenting hospital.

***Modelling for*:** Australia

***Time period*:** Benefits in 2009 of intervention delivered in 2009

***Target group*:** community dwelling men and women 65+ years, presenting to a hospital emergency department following a fall, excluded cognitively impaired people without a regular carer and those with limited English. To estimate the size of this target group, we combined data from the Victorian Injury Surveillance Unit, ABS population estimates, estimates of cognitively impaired community dwelling older people from the AIHW, and estimates of those with limited English from the ABS. The estimated number of people in this group in Australia is 71,691.

Setting: includes metropolitan and rural population

Base case prediction:

Outcome	Estimate
Eligible population who would uptake	55.4
Falls prevented (n)	59,706
Fall hospitalisations prevented (n)	1,194
Reduction in fall hospitalisation rate (%)	1.6*
Reduction in fall hospitalisation rate for community dwelling 65+ years (%)	2.0*
Total cost ($ million)	49.41
Cost per fall prevented ($)	828
Cost per fall hospitalisation prevented ($)	41,374

*Approximations only due to data limitations and trend predictions. Interpret with caution.

Key data inputs:

Parameter	Base case value	Range	Sources for value and range
Uptake – recruitment by presenting hospital (%)	55.4	49.9 – 60.9	Close et al., 1999[2]
Average falls rate per person year (no intervention)	2.64	2.01 – 3.47	Close et al., 1999[2]
Average falls rate per person year (with intervention)	1.13	0.79 – 1.63	Close et al., 1999[2]
Hospitalised falls-same value for both groups (%)	2.0	1.4 – 2.6	Tiedemann et al[3], and Day, unpublished data, prospective falls data from Australian trials involving community dwelling older people
Cost per participant ($)	1,244	1,407	Resources required based on Close et al., 1999[2] and other published studies[4,5]; higher cost option is associated with higher salary levels for some professionals (see table on page 4); unit costs obtained from published sources

Data inputs have been derived to a large extent from the trial[2], which was conducted in England, supplemented with Australian sources[3-5]. The extent to which the English study is generalisable to those in the Australian population who meet the eligibility criteria obviously underpins the degree of confidence in the model results.

Other scenarios:

	People uptake (n)	Falls prevented (n)	Hospital admissions prevented (n)	Total cost ($ M)	Cost per fall prevented ($)	Cost per hospital admission prevented ($)
Low uptake	35,745	53,735	1,075	44.47	828	41374
High uptake	43,688	65,676	1,314	54.35	828	41374
Low hospitalisation	39,717	59,706	836	49.41	828	59106
High hospitalisation	39,717	59,706	1,552	49.41	828	31826
More effective intervention	39,717	73,416	1,468	49.41	673	33648
Less effective intervention	39,717	40,001	800	49.41	1235	61756
More costly intervention	39,717	59,706	1,194	55.87	936	46784
Less costly intervention	39,717	59,706	1,194	49.41		41374

All scenarios vary one parameter, and keep the values from the base case for the other parameters. Low and high uptake and hospitalisation scenarios use the lower and upper ranges shown in the key data inputs table above. The more and less effective intervention scenarios use the average falls rate per person year without the intervention, and the lower and upper ranges, respectively, of the average falls rate per person year with the intervention. The more and less costly intervention scenarios use the lower and upper ranges shown in the key data inputs table above.

Modelling for: **Queensland**
The estimated number of eligible people for the disciplinary, multi-factorial risk screening and intervention in Queensland in 2009 is 13,407.

Base case prediction:

Outcome	Estimate
Eligible population who would uptake	7,427
Falls prevented (n)	11,166
Fall hospitalisations prevented (n)	223
Reduction in fall hospitalisation rate (%)	Not available
Reduction in fall hospitalisation rate for community dwelling 65+ years (%)	Not available
Total cost ($ million)	9.24
Cost per fall prevented ($)	828
Cost per fall hospitalisation prevented ($)	41,374

Other scenarios:

	People uptake (n)	Falls prevented (n)	Hospital admissions prevented (n)	Total cost ($ M)	Cost per fall prevented ($)	Cost per hospital admission prevented ($)
Low uptake	6,685	10,049	201	8.32	828	41374
High uptake	8,170	12,282	246	10.16	828	41374
Low hospitalisation	7,427	11,166	156	9.24	828	59106
High hospitalisation	7,427	11,166	290	9.24	828	31826
More effective intervention	7,427	13,730	275	9.24	673	33648
Less effective intervention	7,427	7,481	150	9.24	1235	61756
More costly intervention	7,427	11,166	223	10.45	936	46784
Less costly intervention	7,427	11,166	223	9.24	828	41374

Modelling for: **New South Wales**

The estimated number of eligible people for the disciplinary, multi-factorial risk screening and intervention in New South Wales in 2009 is 21,892.

Base case prediction:

Outcome	Estimate
Eligible population who would uptake	12,128
Falls prevented (n)	18,232
Fall hospitalisations prevented (n)	365
Reduction in fall hospitalisation rate (%)	1.4*
Reduction in fall hospitalisation rate for community dwelling 65+ years (%)	1.7*
Total cost ($ million)	15.09
Cost per fall prevented ($)	828
Cost per fall hospitalisation prevented ($)	41,374

*Approximations only due to data limitations and trend predictions. Interpret with caution.

Other scenarios:

	People uptake (n)	Falls prevented (n)	Hospital admissions prevented (n)	Total cost ($ M)	Cost per fall prevented ($)	Cost per hospital admission prevented ($)
Low uptake	10,915	16,409	328	13.58	828	41374
High uptake	13,341	20,055	401	16.60	828	41374
Low hospitalisation	12,128	18,232	255	15.09	828	59106
High hospitalisation	12,128	18,232	474	15.09	828	31826
More effective intervention	12,128	22,419	448	15.09	673	33648
Less effective intervention	12,128	12,215	244	15.09	1235	61756
More costly intervention	12,128	18,232	365	17.06	936	46784
Less costly intervention	12,128	18,232	365	15.09	828	41374

Modelling for: **Victoria**

The estimated number of eligible people for the disciplinary, multi-factorial risk screening and intervention in Victoria in 2009 is 16,054.

Base case prediction:

Outcome	**Estimate**
Eligible population who would uptake	8,894
Falls prevented (n)	13,370
Fall hospitalisations prevented (n)	267
Reduction in fall hospitalisation rate (%)	1.3*
Reduction in fall hospitalisation rate for community dwelling 65+ years (%)	1.6*
Total cost ($ million)	11.06
Cost per fall prevented ($)	828
Cost per fall hospitalisation prevented ($)	41,374

*Approximations only due to data limitations and trend predictions. Interpret with caution.

Other scenarios:

	People uptake (n)	**Falls prevented (n)**	**Hospital admissions prevented (n)**	**Total cost ($ M)**	**Cost per fall prevented ($)**	**Cost per hospital admission prevented ($)**
Low uptake	8,005	12,033	241	9.96	828	41374
High uptake	9,783	14,707	294	12.17	828	41374
Low hospitalisation	8,894	13,370	187	11.06	828	59106
High hospitalisation	8,894	13,370	348	11.06	828	31826
More effective intervention	8,894	16,440	329	11.06	673	33648
Less effective intervention	8,894	8,958	179	11.06	1235	61756
More costly intervention	8,894	13,370	267	12.51	936	46784
Less costly intervention	8,894	13,370	267	11.06	828	41374

Modelling for: **Tasmania**

The estimated number of eligible people for the disciplinary, multi-factorial risk screening and intervention in Tasmania in 2009 is 1,724.

Base case prediction:

Outcome	**Estimate**
Eligible population who would uptake	955
Falls prevented (n)	1,436
Fall hospitalisations prevented (n)	29
Reduction in fall hospitalisation rate (%)	1.9*
Reduction in fall hospitalisation rate for community dwelling 65+ years (%)	2.3*
Total cost ($ million)	1.19
Cost per fall prevented ($)	828
Cost per fall hospitalisation prevented ($)	41,374

*Approximations only due to data limitations and trend predictions. Interpret with caution.

Other scenarios:

	People uptake (n)	**Falls prevented (n)**	**Hospital admissions prevented (n)**	**Total cost ($ M)**	**Cost per fall prevented ($)**	**Cost per hospital admission prevented ($)**
Low uptake	860	1,292	26	1.07	828	41374
High uptake	1,051	1,579	32	1.31	828	41374
Low hospitalisation	955	1,436	20	1.19	828	59106
High hospitalisation	955	1,436	37	1.19	828	31826
More effective intervention	955	1,765	35	1.19	673	33648
Less effective intervention	955	962	19	1.19	1235	61756
More costly intervention	955	1,436	29	1.34	936	46784
Less costly intervention	955	1,436	29	1.19	828	41374

Modelling for: **South Australia**
The estimated number of eligible people for the disciplinary, multi-factorial risk screening and intervention in South Australia in 2009 is 5,625.

Base case prediction:

Outcome	Estimate
Eligible population who would uptake	3,116
Falls prevented (n)	4,685
Fall hospitalisations prevented (n)	94
Reduction in fall hospitalisation rate (%)	1.6*
Reduction in fall hospitalisation rate for community dwelling 65+ years (%)	1.9*
Total cost ($ million)	3.88
Cost per fall prevented ($)	828
Cost per fall hospitalisation prevented ($)	41,374

*Approximations only due to data limitations and trend predictions. Interpret with caution.

Other scenarios:

	People uptake (n)	Falls prevented (n)	Hospital admissions prevented (n)	Total cost ($ M)	Cost per fall prevented ($)	Cost per hospital admission prevented ($)
Low uptake	2,805	4,216	84	3.49	828	41374
High uptake	3,428	5,153	103	4.26	828	41374
Low hospitalisation	3,116	4,685	66	3.88	828	59106
High hospitalisation	3,116	4,685	122	3.88	828	31826
More effective intervention	3,116	5,760	115	3.88	673	33648
Less effective intervention	3,116	3,139	63	3.88	1235	61756
More costly intervention	3,116	4,685	94	4.39	936	46784
Less costly intervention	3,116	4,685	94	3.88	828	41374

Modelling for: **Western Australia**

The estimated number of eligible people for the disciplinary, multi-factorial risk screening and intervention in Western Australia in 2009 is 5,703.

Base case prediction:

Outcome	**Estimate**
Eligible population who would uptake	3,159
Falls prevented (n)	4,750
Fall hospitalisations prevented (n)	95
Reduction in fall hospitalisation rate (%)	1.6*
Reduction in fall hospitalisation rate for community dwelling 65+ years (%)	2.0*
Total cost ($ million)	3.93
Cost per fall prevented ($)	828
Cost per fall hospitalisation prevented ($)	41,374

*Approximations only due to data limitations and trend predictions. Interpret with caution.

Other scenarios:

	People uptake (n)	**Falls prevented (n)**	**Hospital admissions prevented (n)**	**Total cost ($ M)**	**Cost per fall prevented ($)**	**Cost per hospital admission prevented ($)**
Low uptake	2,844	4,275	85	3.54	828	41374
High uptake	3,475	5,225	104	4.32	828	41374
Low hospitalisation	3,159	4,750	66	3.93	828	59106
High hospitalisation	3,159	4,750	123	3.93	828	31826
More effective intervention	3,159	5,840	117	3.93	673	33648
Less effective intervention	3,159	3,182	64	3.93	1235	61756
More costly intervention	3,159	4,750	95	4.44	936	46784
Less costly intervention	3,159	4,750	95	3.93	828	41374

Modelling for: **Northern Territory**

The estimated number of eligible people for the disciplinary, multi-factorial risk screening and intervention in the Northern Territory in 2009 is 224.

Base case prediction:

Outcome	Estimate
Eligible population who would uptake	124
Falls prevented (n)	187
Fall hospitalisations prevented (n)	4
Reduction in fall hospitalisation rate (%)	1.8*
Reduction in fall hospitalisation rate for community dwelling 65+ years (%)	2.1*
Total cost ($ million)	0.15
Cost per fall prevented ($)	828
Cost per fall hospitalisation prevented ($)	41,374

*Approximations only due to data limitations and trend predictions. Interpret with caution.

Other scenarios:

	People uptake (n)	Falls prevented (n)	Hospital admissions prevented (n)	Total cost ($ M)	Cost per fall prevented ($)	Cost per hospital admission prevented ($)
Low uptake	112	168	3	0.14	828	41374
High uptake	137	205	4	0.17	828	41374
Low hospitalisation	124	187	3	0.15	828	59106
High hospitalisation	124	187	5	0.15	828	31826
More effective intervention	124	229	5	0.15	673	33648
Less effective intervention	124	125	2	0.15	1235	61756
More costly intervention	124	187	4	0.17	936	46784
Less costly intervention	124	187	4	0.15	828	41374

Modelling for: **Australian Capital Territory**
The estimated number of eligible people for the disciplinary, multi-factorial risk screening and intervention in the Australian Capital Territory in 2009 is 761.

Base case prediction:

Outcome	**Estimate**
Eligible population who would uptake	422
Falls prevented (n)	634
Fall hospitalisations prevented (n)	13
Reduction in fall hospitalisation rate (%)	Not available
Reduction in fall hospitalisation rate for community dwelling 65+ years (%)	Not available
Total cost ($ million)	0.52
Cost per fall prevented ($)	828
Cost per fall hospitalisation prevented ($)	41,374

Other scenarios:

	People uptake (n)	**Falls prevented (n)**	**Hospital admissions prevented (n)**	**Total cost ($ M)**	**Cost per fall prevented ($)**	**Cost per hospital admission prevented ($)**
Low uptake	379	570	11	0.47	828	41374
High uptake	464	697	14	0.58	828	41374
Low hospitalisation	422	634	9	0.52	828	59106
High hospitalisation	422	634	16	0.52	828	31826
More effective intervention	422	779	16	0.52	673	33648
Less effective intervention	422	425	8	0.52	1235	61756
More costly intervention	422	634	13	0.59	936	46784
Less costly intervention	422	634	13	0.52	828	41374

ASSOCIATED INFORMATION

Underlying assumptions

- The reduction in falls risk from the Close et al. trial[2] is generalisable to the sections of Australian population with comparable characteristics to those who participated in the trial
- The Close et al. trial[2] results can only be generalised to community dwelling older people 65+ years with similar levels of fitness and mobility to those in the trial itself
- Uptake of the intervention within the eligible population would be the same as that observed in the trial
- Compliance with the intervention delivered to the population will be the same as that achieved in the trial, resulting in the same level of falls reduction
- The intervention does not affect the probability of admission to hospital should a fall occur.
- The intervention did not reduce serious falls injury to a greater extent than the reduction in falls
- The frequency (and rate) of falls in people who are offered an intervention, but do not adopt it, is the same as that amongst people who are not offered the intervention (control group)
- The rate of falls hospital admissions in Australia (and the states and territories) will not change significantly from the average rate for the four year period 2002/03 – 2005/06
- The proportion of falls among older people that require admission to hospital will be the same in 2009, as was observed in the time period from which this estimate was calculated
- The proportion of Victorians who either presented or were admitted due to a fall in 2006 is similar to the national proportion
- The proportion of Victorians who presented or were admitted due to a fall in 2006 will not have changed to any great extent in 2009
- Implementation via general practitioners would be as effective as implementation by the hospital in the research setting
- The mix of specific falls prevention measures observed in the Close et al (1999) trial will remain constant if the intervention were widely implemented.

Timing of expenditure and benefits

Expenditure would be required over the full 12-month period of intervention delivery, at a relatively even rate. Known falls benefits would occur in the 12 month period shortly after commencement for each person receiving the intervention. Hence the period of benefit from intervention delivery during 2009 would extend into 2010. The likelihood of maintaining a lower fall rate among the participants after the initial 12 month period is unknown. Some of the changes made as a result of the intervention are likely to have some effect beyond the initial 12 months eg., medication changes, new glasses, changes to the home environment.

Other potential benefits

Other health benefits of this intervention could include improved management of cardiovascular or circulatory problems, improved management of chronic disease, improved vision, improved mobility, and decreased impairment. These other health benefits have not been included in this model.

Capacity building and workforce training
A concerted effort to deliver this intervention would result in increased demand for general and specialist medical care, multidisciplinary falls clinics, optometry services, physiotherapy, occupational therapy, nursing, and group based exercise programs. Some of these services already have waiting lists, and there is a shortage of allied health professionals in Australia.

Infrastructure requirements
The model assumes that the increased demand for services would be delivered within existing infrastructure, which may not be possible in some areas. Good communication would be required between the presenting hospital and local general practitioners. General practitioners would be the initiators of the intervention delivery within a service provision models currently included under Medicare arrangements.

Acceptability
There is little evidence on which to base conclusions regarding the acceptability of this intensive intervention. Older people who have already had a fall may be more willing to accept intervention than those who have not yet, or not recently, had a fall.

Feasibility
National implementation would require delivery of the multifactorial intervention to 39,717 people across Australia.

Equity
This intervention may be more accessible to those who have private health insurance or an ability to access private, rather than public, services. Inability to access appropriate transport, either due to financial or physical limitations, or lack of transport options, may also disproportionately inhibit participation. Language may be a barrier to uptake. Implementation may be more difficult, and more expensive, in regional and rural areas.

Sustainability
Some benefits resulting from the initial 12-month program may last for several years. Additional expenditure would be required to make this intervention available to additional people on an ongoing basis beyond one year.

Costed inputs for economic analysis
This intervention involves three key components which require costing: an assessment of falls risk factors, an occupational therapy home visit, and referral to a range of other services as determined by the results of the assessment. In the trial, the assessment was conducted in the recruiting hospital as part of the research project, and referrals were made as necessary[2]. For the purposes of costing the intervention if it were to be delivered on a widespread basis, we opted for a model of delivery through general practitioners. The treating hospital could identify eligible patients and write to both them and their general practitioner, and follow up patients by telephone as in the trial to encourage them to participate. The assessment and management plan could be undertaken by the general practitioner, under the current annual health check procedures.

Item	Lower cost option- $AUS*	Higher cost option- $AUS*
Hospital register check and referral to GP	23.06	23.06
Medical assessment, plan development and discussion	313.85	352.85
Hospital outpatient dept visit (weighted for 36% participants)	52.80	52.80
Multidisciplinary falls clinic (weighted for 21% participants)	372.86	396.05
GP visit for medication review (weighted for 18% participants)	7.56	19.44
Optometrist visit (weighted for participants 15%)	61.30	61.30
Occupational therapy home visit (all)	412.52	501.09
Total	**1243.95**	**1406.59**

The costing of the referral component was made using the published proportions of the trial participants requiring referral to various services: hospital outpatient department (36%), multidisciplinary day hospital (21%), the general practitioner (18%), and optician (15%) (Close et al., 1999). In addition, 100% received the occupational therapy home visit. The hospital outpatient department, general practitioner and optician referrals were all costed on the basis of standard consultations, with an estimate of any additional treatment costs where possible. The multidisciplinary day hospital was costed as treatment in multidisciplinary falls and balance clinic, using published data relating to operation of these clinics in Australia.[4,5] The costs estimated for the occupational therapy intervention were also used here. Note the total is an average cost and may differ depending on the scale of intervention and the proportion who receive each component.

Acknowledgements

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We are grateful for advice and data provided by Dr Jacqueline Close, Prince of Wales Medical Research Institute, AUST

This project was funded by:

The Australian Government Department of Health and Ageing, and the Australian National Health and Medical Research Council

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MONASH University
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Modelling the impact, costs and benefits of falls prevention measures to support policy-makers and program planners

Intervention: Withdrawal of psychotropic medication[1]

Brief description: Gradual reduction of dose of psychotropic medication over a period of 14 weeks using the following regime: 80% of original dose after 2 weeks, 60% after five weeks, 40% after eight weeks, 20% after 11 weeks, zero by 14 weeks. This program has been tested in a randomised trial[1] and has been noted as highly likely to be beneficial in the Cochrane review of falls interventions[2].

***Modelling for*:** Australia

***Time period*:** Benefits in 2009 of intervention delivered in 2009

***Target group*:** Community dwelling men and women 65+ years, ambulatory in their own home, not receiving physiotherapy, currently taking a benzodiazepine, any other hypnotic, or any antidepressant or major tranquilliser, and thought by their general practitioner to benefit from psychotropic medication withdrawal. People were excluded from the study if they were cognitively impaired. Participants were invited to participate by a letter from their general practitioner. To estimate the size of this target group, we used estimates of the number of community dwelling older people from the Australian Bureau of Statistics, and subtracted the number estimated to be profoundly limited in, and requiring assistance with, core activities of communication, mobility and self care (14.4%) by the Disability, Ageing and Carers Survey.[3]

An estimate of number of community dwelling people aged 65+ years and reporting the use of a psychotropic medication (sleeping tablets or capsules, tablet or capsules or anxiety or nerves, tranquillisers and antidepressants) was obtained from the 2004/5 ABS National Health Survey (20.5%).[4] The estimated number of people eligible for this intervention in Australia in 2009 is 515,375.

***Setting*:** includes metropolitan and rural population

Base case prediction:

Outcome	Estimate
Eligible population who would uptake	97,406
Falls prevented (n)	117,208
Fall hospitalisations prevented (n)	2,344
Reduction in fall hospitalisation rate for 65+ years older people (%)	3.1*
Reduction in fall hospitalisation rate for community dwelling 65+ years (%)	3.9*
Total cost ($AUS million)	58.82
Cost per fall prevented ($AUS)	502
Cost per fall hospitalisation prevented ($AUS)	25,092

*Approximations only due to data limitations and trend predictions. Interpret with caution.

Key data inputs:

Parameter	Base case value	Range	Sources for value and range
Uptake – letter from general practitioner (%)	18.9	17.0 – 20.8	Campbell et al., 1999[2]
Average falls rate per person year (no intervention)	1.82	1.11 – 3.04	Campbell et al., 1999[2]
Average falls rate per person year (intervention)	0.62	0.36 – 1.07	Campbell et al., 1999[2]
Hospitalised falls-same value for both groups (%)	2.0	1.4 – 2.6	Tiedemann et al[5], and Day, unpublished data, prospective falls data from Australian trials involving community dwelling older people
Cost per participant-reformulation of medication ($)	604	798	Resources required based on Campbell et al., 1999[2]; unit costs obtained from published sources; higher cost option is associated with higher salary levels for some professionals (see table on page 4)
Cost per participant-"off-the-shelf" medication ($)		251	Resources required based on Campbell et al., 1999[2]; unit costs obtained from published sources

Data inputs have been derived to a large extent from the trial[2], which was conducted in New Zealand, supplemented with Australian sources[5]. The extent to which the New Zealand study is generalisable to those in the Australian population who meet the eligibility criteria is likely to be high, and this obviously underpins the degree of confidence in the model results. We considered two different modes for intervention delivery: reformulation by a community pharmacist (high and low cost options), and "off-the-shelf" dosage reduction using venlafaxine as an example of one of the few common psychotropic medications for which a range of dosages are available. The reformulation low cost option was used for the base case scenario.

Other scenarios:

	People uptake (n)	Falls prevented (n)	Hospital admissions prevented (n)	Total cost ($AUS mill)	Cost per fall prevented ($AUS)	Cost per hospital admission prevented ($AUS)
Low uptake	87,665	105,487	2,110	52.94	502	25,092
High uptake	107,147	128,929	2,579	64.70	502	25,092
Low hospitalisation	97,406	117,208	1,641	58.82	502	35,846
High hospitalisation	97,406	117,208	3,047	58.82	502	19,302
More effective intervention	97,406	142,696	2,854	58.82	412	20,610
Less effective intervention	97,406	73,220	1,464	58.82	803	40,167
Reformulation higher cost option	97,406	117,208	2,344	77.72	663	33,154
"Off-the-shelf"dosage reduction option	97,406	117,208	2,344	22.84	195	9,743

All scenarios vary one parameter, and keep the values from the base case for the other parameters. Low and high uptake and hospitalisation scenarios use the lower and upper ranges shown in the key data inputs table above. The more and less effective intervention scenarios use the average falls rate per person year without the intervention, and the lower and upper ranges, respectively, of the average falls rate per person year with the intervention. The different cost options keep the values from the base case, and vary the intervention cost. There are no costs included for GP education which would be required regardless of the intervention delivery mode, and are likely to significantly increase the costs.

Modelling for: **Queensland**

The estimated number of eligible people for the withdrawal of psychotropic medication intervention in Queensland in 2009 is 92,244.

Base case prediction:

Outcome	**Estimate**
Eligible population who would uptake	17,812
Falls prevented (n)	21,433
Fall hospitalisations prevented (n)	429
Reduction in fall hospitalisation rate for 65+ older people (%)	Not available
Reduction in fall hospitalisation rate for community dwelling 65+ yrs(%)	Not available
Total cost ($AUS million)	10.76
Cost per fall prevented ($AUS)	502
Cost per fall hospitalisation prevented ($AUS)	25,092

Other scenarios:

	People uptake (n)	**Falls prevented (n)**	**Hospital admissions prevented (n)**	**Total cost ($AUS mill)**	**Cost per fall prevented ($AUS)**	**Cost per hospital admission prevented ($AUS)**
Low uptake	16,031	19,290	386	9.68	502	25092
High uptake	19,593	23,577	472	11.83	502	25092
Low hospitalisation	17,812	21,433	300	10.76	502	35846
High hospitalisation	17,812	21,433	557	10.76	502	19302
More effective intervention	17,812	26,094	522	10.76	412	20610
Less effective intervention	17,812	13,389	268	10.76	803	40167
Reformulation higher cost option	17,812	21,433	429	14.21	663	33154
"Off-the-shelf"dosage reduction option	17,812	21,433	429	4.18	195	9743

Modelling for: **New South Wales**

The estimated number of eligible people for the withdrawal of psychotropic medication intervention in New South Wales in 2009 is 177,602.

Base case prediction:

Outcome	**Estimate**
Eligible population who would uptake	33,567
Falls prevented (n)	40,391
Fall hospitalisations prevented (n)	808
Reduction in fall hospitalisation rate for 65+ older people (%)	3.0*
Reduction in fall hospitalisation rate for community dwelling 65+ yrs(%)	3.9*
Total cost ($AUS million)	20.27
Cost per fall prevented ($AUS)	502
Cost per fall hospitalisation prevented ($AUS)	25,092

*Approximations only due to data limitations and trend predictions. Interpret with caution.

Other scenarios:

	People uptake (n)	**Falls prevented (n)**	**Hospital admissions prevented (n)**	**Total cost ($AUS mill)**	**Cost per fall prevented ($AUS)**	**Cost per hospital admission prevented ($AUS)**
Low uptake	30,210	36,352	727	18.24	502	25092
High uptake	36,923	44,430	889	22.30	502	25092
Low hospitalisation	33,567	40,391	565	20.27	502	35846
High hospitalisation	33,567	40,391	1,050	20.27	502	19302
More effective intervention	33,567	49,174	983	20.27	412	20610
Less effective intervention	33,567	25,232	505	20.27	803	40167
Reformulation higher cost option	33,567	40,391	808	26.78	663	33154
"Off-the-shelf"dosage reduction option	33,567	40,391	808	7.87	195	9743

Modelling for: **Victoria**

The estimated number of eligible people for the withdrawal of psychotropic medication intervention in Victoria in 2009 is 127,947.

Base case prediction:

Outcome	**Estimate**
Eligible population who would uptake	24,182
Falls prevented (n)	29,098
Fall hospitalisations prevented (n)	582
Reduction in fall hospitalisation rate for 65+ older people (%)	2.8*
Reduction in fall hospitalisation rate for community dwelling 65+ yrs(%)	3.6*
Total cost ($AUS million)	14.60
Cost per fall prevented ($AUS)	502
Cost per fall hospitalisation prevented ($AUS)	25,092

*Approximations only due to data limitations and trend predictions. Interpret with caution.

Other scenarios:

	People uptake (n)	**Falls prevented (n)**	**Hospital admissions prevented (n)**	**Total cost ($AUS mill)**	**Cost per fall prevented ($AUS)**	**Cost per hospital admission prevented ($AUS)**
Low uptake	21,764	26,188	524	13.14	502	25092
High uptake	26,600	32,008	640	16.06	502	25092
Low hospitalisation	24,182	29,098	407	14.60	502	35846
High hospitalisation	24,182	29,098	757	14.60	502	19302
More effective intervention	24,182	35,426	709	14.60	412	20610
Less effective intervention	24,182	18,178	364	14.60	803	40167
Reformulation higher cost option	24,182	29,098	582	19.29	663	33154
“Off-the-shelf”dosage reduction option	24,182	29,098	582	5.67	195	9743

Modelling for: **Tasmania**

The estimated number of eligible people for the withdrawal of psychotropic medication intervention in Tasmania in 2009 is 13,761.

Base case prediction:

Outcome	**Estimate**
Eligible population who would uptake	2,601
Falls prevented (n)	3,130
Fall hospitalisations prevented (n)	63
Reduction in fall hospitalisation rate for 65+ older people (%)	4.2*
Reduction in fall hospitalisation rate for community dwelling 65+ yrs(%)	5.1*
Total cost ($AUS million)	1.57
Cost per fall prevented ($AUS)	502
Cost per fall hospitalisation prevented ($AUS)	25,092

*Approximations only due to data limitations and trend predictions. Interpret with caution.

Other scenarios:

	People uptake (n)	**Falls prevented (n)**	**Hospital admissions prevented (n)**	**Total cost ($AUS mill)**	**Cost per fall prevented ($AUS)**	**Cost per hospital admission prevented ($AUS)**
Low uptake	2,341	2,817	56	1.41	502	25092
High uptake	2,861	3,443	69	1.73	502	25092
Low hospitalisation	2,601	3,130	44	1.57	502	35846
High hospitalisation	2,601	3,130	81	1.57	502	19302
More effective intervention	2,601	3,810	76	1.57	412	20610
Less effective intervention	2,601	1,955	39	1.57	803	40167
Reformulation higher cost option	2,601	3,130	63	2.08	663	33154
“Off-the-shelf”dosage reduction option	2,601	3,130	63	0.61	195	9743

Modelling for: **South Australia**

The estimated number of eligible people for the withdrawal of psychotropic medication intervention in South Australia in 2009 is 44,539.

Base case prediction:

Outcome	**Estimate**
Eligible population who would uptake	8,418
Falls prevented (n)	10,129
Fall hospitalisations prevented (n)	203
Reduction in fall hospitalisation rate for 65+ older people (%)	3.4*
Reduction in fall hospitalisation rate for community dwelling 65+ yrs(%)	4.2*
Total cost ($AUS million)	5.08
Cost per fall prevented ($AUS)	502
Cost per fall hospitalisation prevented ($AUS)	25,092

*Approximations only due to data limitations and trend predictions. Interpret with caution.

Other scenarios:

	People uptake (n)	**Falls prevented (n)**	**Hospital admissions prevented (n)**	**Total cost ($AUS mill)**	**Cost per fall prevented ($AUS)**	**Cost per hospital admission prevented ($AUS)**
Low uptake	7,576	9,116	182	4.57	502	25092
High uptake	9,260	11,142	223	5.59	502	25092
Low hospitalisation	8,418	10,129	142	5.08	502	35846
High hospitalisation	8,418	10,129	263	5.08	502	19302
More effective intervention	8,418	12,332	247	5.08	412	20610
Less effective intervention	8,418	6,328	127	5.08	803	40167
Reformulation higher cost option	8,418	10,129	203	6.72	663	33154
“Off-the-shelf”dosage reduction option	8,418	10,129	203	1.97	195	9743

Modelling for: **Western Australia**

The estimated number of eligible people for the withdrawal of psychotropic medication intervention in Western Australia in 2009 is 48,563.

Base case prediction:

Outcome	Estimate
Eligible population who would uptake	9,178
Falls prevented (n)	11,044
Fall hospitalisations prevented (n)	221
Reduction in fall hospitalisation rate for 65+ older people (%)	3.6*
Reduction in fall hospitalisation rate for community dwelling 65+ yrs(%)	4.6*
Total cost ($AUS million)	5.54
Cost per fall prevented ($AUS)	502
Cost per fall hospitalisation prevented ($AUS)	25,092

*Approximations only due to data limitations and trend predictions. Interpret with caution.

Other scenarios:

	People uptake (n)	Falls prevented (n)	Hospital admissions prevented (n)	Total cost ($AUS mill)	Cost per fall prevented ($AUS)	Cost per hospital admission prevented ($AUS)
Low uptake	8,261	9,940	199	4.99	502	25092
High uptake	10,096	12,149	243	6.10	502	25092
Low hospitalisation	9,178	11,044	155	5.54	502	35846
High hospitalisation	9,178	11,044	287	5.54	502	19302
More effective intervention	9,178	13,446	269	5.54	412	20610
Less effective intervention	9,178	6,899	138	5.54	803	40167
Reformulation higher cost option	9,178	11,044	221	7.32	663	33154
"Off-the-shelf"dosage reduction option	9,178	11,044	221	2.15	195	9743

Modelling for: **Northern Territory**

The estimated number of eligible people for the withdrawal of psychotropic medication intervention in the Northern Territory in 2009 is 1,961.

Base case prediction:

Outcome	**Estimate**
Eligible population who would uptake	371
Falls prevented (n)	446
Fall hospitalisations prevented (n)	9
Reduction in fall hospitalisation rate for 65+ older people (%)	4.1*
Reduction in fall hospitalisation rate for community dwelling 65+ yrs(%)	4.8*
Total cost ($AUS million)	0.22
Cost per fall prevented ($AUS)	502
Cost per fall hospitalisation prevented ($AUS)	25,092

*Approximations only due to data limitations and trend predictions. Interpret with caution.

Other scenarios:

	People uptake (n)	**Falls prevented (n)**	**Hospital admissions prevented (n)**	**Total cost ($AUS mill)**	**Cost per fall prevented ($AUS)**	**Cost per hospital admission prevented ($AUS)**
Low uptake	334	401	8	0.20	502	25092
High uptake	408	491	10	0.25	502	25092
Low hospitalisation	371	446	6	0.22	502	35846
High hospitalisation	371	446	12	0.22	502	19302
More effective intervention	371	543	11	0.22	412	20610
Less effective intervention	371	279	6	0.22	803	40167
Reformulation higher cost option	371	446	9	0.30	663	33154
"Off-the-shelf"dosage reduction option	371	446	9	0.09	195	9743

Modelling for: **Australian Capital Territory**

The estimated number of eligible people for the withdrawal of psychotropic medication intervention in the Australian Capital Territory in 2009 is 6,318.

Base case prediction:

Outcome	Estimate
Eligible population who would uptake	1,194
Falls prevented (n)	1,437
Fall hospitalisations prevented (n)	29
Reduction in fall hospitalisation rate for 65+ older people (%)	Not available
Reduction in fall hospitalisation rate for community dwelling 65+ yrs(%)	Not available
Total cost ($AUS million)	0.72
Cost per fall prevented ($AUS)	502
Cost per fall hospitalisation prevented ($AUS)	25,092

Other scenarios:

	People uptake (n)	Falls prevented (n)	Hospital admissions prevented (n)	Total cost ($AUS mill)	Cost per fall prevented ($AUS)	Cost per hospital admission prevented ($AUS)
Low uptake	1,075	1,293	26	0.65	502	25092
High uptake	1,314	1,581	32	0.79	502	25092
Low hospitalisation	1,194	1,437	20	0.72	502	35846
High hospitalisation	1,194	1,437	37	0.72	502	19302
More effective intervention	1,194	1,749	35	0.72	412	20610
Less effective intervention	1,194	898	18	0.72	803	40167
Reformulation higher cost option	1,194	1,437	29	0.95	663	33154
"Off-the-shelf"dosage reduction option	1,194	1,437	29	0.28	195	9743

ASSOCIATED INFORMATION

Underlying assumptions

- The reduction in falls risk from the Campbell et al trial[2] is generalisable to the sections of Australian population with comparable characteristics to those who participated in the trial
- The Campbell et al. trial[2] results can only be generalised to community dwelling older people over 65+ years with similar levels of fitness and mobility to those in the trial itself
- Uptake of the intervention within the eligible population would be the same as that observed in the trial
- Compliance with the intervention delivered to the population will be the same as that achieved in the trial, resulting in the same level of falls reduction
- The intervention does not affect the probability of admission to hospital should a fall occur.
- The intervention did not reduce serious falls injury to a greater extent than the reduction in falls
- The frequency (and rate) of falls in people who are offered an intervention, but do not adopt it, is the same as that amongst people who are not offered the intervention (control group)
- The rate of falls hospital admissions in Australia (and the states and territories) will not change significantly from the average rate for the four year period 2002/03 – 2005/06
- The proportion of falls among older people that require admission to hospital will be the same in 2009, as was observed in the time period from which this estimate was calculated
- The proportion of community dwelling older people with restrictions in their core activities has not changed greatly from 2003 to 2009
- The proportion of people on psychotropic medication in 2009 does not differ to proportion in 2004/5.

Timing of expenditure and benefits

Expenditure would be required over the full 12-month period of intervention delivery, at a relatively even rate. Known falls benefits could start to occur during the initial 14 week withdrawal period for each person, but most of the benefit would occur in next nine months. Hence the period of benefit from intervention delivery during 2009 would extend into 2010. The maintenance of a lower fall rate after the initial 12-month intervention period depends on the extent to which people remained off the psychotropic medication. One month after study completion, almost half (47%) of participants from the intervention group who had taken the placebo only capsules for the full period, had re-commenced their psychotropic medication.[2] It is possible then, that some fall prevention benefit may remain for some people, but the length of time is unknown. It is important to note, that despite the fact that some people in the intervention group did not remain off their medication for the full 12 months, there was still a very large reduction in falls over the 12 month period.

Other potential benefits

There may be a reduction in the side effects of psychotropic medications, particularly for those people who do not re-commence medication use. It is also possible that some people may have an adverse mental health outcome as a result of reducing their medication, although none were reported in the trial.[2] Close monitoring by general practitioners would be required.

Capacity building and workforce training
This intervention would be delivered mainly by general practitioners. Some guidelines regarding contra-indications for psychotropic medication withdrawal may be required to support this intervention.

Infrastructure requirements
The intervention would not require additional infrastructure.

Acceptability
This intervention is likely to have a relatively low level of acceptability among older people who are established on psychotropic medication. This is reflected in the relatively low uptake.

Feasibility
Medication re-formulation might not be readily available in all areas, and without it would be very difficult to implement, as most of these medications not readily available in "step-down" doses. An alternative implementation strategy might involve designing a "step-down" regimen for each person to approximate that in the trial, which may involve cutting tablets (where tablet rather than capsule form is available), or taking the medication on alternate days, or a combination of these. This could perhaps be achieved by a practice nurse in consultation with the general practitioner and pharmacist. The practice nurse could then educate the patient and supervise the withdrawal. This could be a more labour intensive delivery mechanism, although there would be some efficiencies in designing "step-down" regimens for the more common psychotropic medications.

Equity
This intervention may be more accessible to those with access to a bulk-billing general practitioner, or those who have the ability to pay the gap between the Medicare and AMA consultation rates. Similarly, unless the reformulation cost was borne by the government, those with more financial resources would have better access to the intervention. Inability to access appropriate transport, either due to financial or physical limitations, or lack of transport options, may also disproportionately inhibit participation. Implementation may be more difficult in regional and rural areas if pharmacists are not available to undertake the reformulation.

Sustainability
Some benefit may continue for a period of time for those who do not re-commence their psychotropic medication. A higher level of compliance might be achieved if some additional support was provided during the withdrawal stage eg., alternative strategies to improve sleep quality. This would add to the cost, but if cost/participant low and benefit was medium-high, then could improve the cost-effectiveness of this intervention. Additional expenditure would be required to make this intervention available to additional people on an ongoing basis beyond one year.

Costed inputs for economic analysis

Item	Reformulation mode, lower cost option- $AUS	Reformulation mode, higher cost option- $AUS	"Off-the-shelf" dosage reduction $AUS
Identification of suitable patients by GP	23.25	23.25	23.25
6 visits to GP	126.00 (MBS rate)	324.00 (AMA rate)	126.00 (MBS rate)
14 weeks at average medication cost	54.62	54.62	101.92*
Reformulation of medication (4 times)	400.00	400.00	N/a
Total	**603.87**	**797.87**	**251.17**

*Based on venlafaxine as an example of one of the few psychotropic medications for which a range of doses is readily available

Acknowledgements

Project Team:

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Research Team:	Dr Wendy Watson (Monash University) Ms Effie Hoareau (Monash University) Ms Mary Alice O'Hare (Monash University) Mr Tom Bolton (University of South Australia)
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We are extremely grateful to Dr Claire Robertson from the University of Otago for her generosity in sharing data from the original research trials for use in the models, along with her insights regarding implementation of this intervention. A/Prof Jennifer Marriott, Monash University, also provided useful advice regarding implementation and feasibility.

This project was funded by:

The Australian Government Department of Health and Ageing, and the Australian National Health and Medical Research Council

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MONASH University
Accident Research Centre

Modelling the impact, costs and benefits of falls prevention measures to support policy-makers and program planners

Intervention: Cardiac pacing among fallers with cardio-inhibitory carotid sinus hypersensitivity (CSH)[1]

Brief description: CSH is an age-related condition rarely diagnosed in those younger than 50 years. It causes recurrent syncope (fainting) and dizziness and is therefore associated with frequent falls.[1] It can be treated by insertion of an artificial pacemaker, usually under a local anaesthetic and involving a one or two-day hospital stay.[2] This intervention has been tested in a randomised trial[1] and has been noted as highly likely to be beneficial in the Cochrane review of falls interventions[3].

***Modelling for*:** Australia

***Time period*:**
(1) Benefits in 2009 of intervention delivered in 2009
(2) Benefits 2009-2013 of intervention delivered in 2009

Target group: Men and women 50+ years and over, presenting to a hospital emergency department following a non-accidental fall (i.e., one which has no external cause) for which there was no medical explanation, and not cognitively impaired. Following initial screening using the emergency department registration data base, a clinical assessment is carried out to diagnose the condition through carotid sinus massage, among people without a contra-indication. To estimate the size of this target group, we combined data from the trial (the proportion of those presenting who were diagnosed), the Victorian Injury Surveillance Unit and ABS projected populations. The estimated number of people in this group in Australia in 2009 is 706.

Setting: includes metropolitan and rural population

Base case prediction:

Outcome	Estimate 2009	Estimate benefit over 2009-2013
Eligible population who would uptake	567	567
Falls prevented (n)	2,947	14,735
Fall hospitalisations prevented (n)	59	295
Reduction in fall hospitalisation rate for 65+ older people (%)	0.08*	Not calculated
Reduction in fall hospitalisation rate for community dwelling 65+ older people (%)	0.1*	Not calculated
Total cost ($AUS million)	7.67	7.67
Cost per fall prevented ($AUS)	2,601	520
Cost per fall hospitalisation prevented ($AUS)	130,058	26,012

*Approximations only due to data limitations and trend predictions. Interpret with caution.

Key data inputs:

Parameter	Base case value	Range	Sources for value and range
Uptake - (%)	80.0	72.0 – 88.0	Kenny et al., 2001[1]
Average falls rate per person year (no intervention)	9.3	6.17 - 13.87	Kenny et al., 2001[1]
Average falls rate per person year (intervention)	4.1	2.69 - 6.29	Kenny et al., 2001[1]
Hospitalised falls- same value for both groups (%)	2.0	1.4 – 2.6	Tiedemann et al[4], and Day, unpublished data, prospective falls data from Australian trials involving community dwelling older people
Cost per participant ($AUS)	13,526	13,744	Resources required based on Kenny et al., [1]; higher cost option is associated with higher salary levels for some professionals (see later table); unit costs obtained from published sources

Data inputs have been derived to a large extent from the trial[1], which was conducted in England, supplemented with Australian sources. The extent to which the English study is generalisable to those in the Australian population who meet the eligibility criteria obviously underpins the degree of confidence in the model results.

Other scenarios:

	People uptake (n)	Falls prevented (n)	Hospital admissions prevented (n)	Total cost ($AUS mill)	Cost per fall prevented ($AUS)	Cost per hospital admission prevented ($AUS)
Low uptake	510	2,652	53	6.90	2,601	13,0058
High uptake	623	3,242	65	8.43	2,601	13,0058
Low hospitalisation	567	2,947	41	7.67	2,601	18,5798
High hospitalisation	567	2,947	77	7.67	2,601	10,0045
More effective intervention	567	3,748	75	7.67	2,046	10,2276
Less effective intervention	567	1,708	34	7.67	4,487	22,4373
Higher cost intervention	567	2,947	59	7.79	2,643	13,2154

All scenarios vary one parameter, and keep the values from the base case for the other parameters. Low and high uptake and hospitalisation scenarios use the lower and upper ranges shown in the key data inputs table above. The more and less effective intervention scenarios use the average falls rate per person year without the intervention, and the lower and upper ranges, respectively, of the average falls rate per person year with the intervention. The higher cost option keeps the values from the base case, while varying the intervention cost.

Modelling for: **Queensland**

The estimated number of eligible people for the Cardiac pacing intervention among fallers with CSH in Queensland in 2009 is 138.

Base case prediction:

Outcome	Estimate 2009	Estimate benefit over 2009-2013
Eligible population who would uptake	111	111
Falls prevented (n)	576	2880
Fall hospitalisations prevented (n)	12	58
Reduction in fall hospitalisation rate for 65+ older people (%)	Not available	Not available
Reduction in fall hospitalisation rate for community dwelling 65+ older people (%)	Not available	Not available
Total cost ($AUS million)	1.50	1.50
Cost per fall prevented ($AUS)	2,601	520
Cost per fall hospitalisation prevented ($AUS)	130,058	26012

Other scenarios:

	People uptake (n)	Falls prevented (n)	Hospital admissions prevented (n)	Total cost ($AUS mill)	Cost per fall prevented ($AUS)	Cost per hospital admission prevented ($AUS)
Low uptake	100	518	10	1.35	2601	130058
High uptake	122	634	13	1.65	2601	130058
Low hospitalisation	111	576	8	1.50	2601	185798
High hospitalisation	111	576	15	1.50	2601	100045
More effective intervention	111	733	15	1.50	2046	102276
Less effective intervention	111	334	7	1.50	4487	224373
Higher cost intervention	111	576	12	1.52	2643	132154

Modelling for: **New South Wales**

The estimated number of eligible people for the Cardiac pacing intervention among fallers with CSH in New South Wales in 2009 is 236.

Base case prediction:

Outcome	Estimate 2009	Estimate benefit over 2009-2013
Eligible population who would uptake	189	189
Falls prevented (n)	985	4926
Fall hospitalisations prevented (n)	20	99
Reduction in fall hospitalisation rate for 65+ older people (%)	0.1*	Not calculated
Reduction in fall hospitalisation rate for community dwelling 65+ older people (%)	0.1*	Not calculated
Total cost ($AUS million)	2.56	2.56
Cost per fall prevented ($AUS)	2,601	520
Cost per fall hospitalisation prevented ($AUS)	130,058	26012

*Approximations only due to data limitations and trend predictions. Interpret with caution.

Other scenarios:

	People uptake (n)	Falls prevented (n)	Hospital admissions prevented (n)	Total cost ($AUS mill)	Cost per fall prevented ($AUS)	Cost per hospital admission prevented ($AUS)
Low uptake	171	887	18	2.31	2601	130058
High uptake	208	1,084	22	2.82	2601	130058
Low hospitalisation	189	985	14	2.56	2601	185798
High hospitalisation	189	985	26	2.56	2601	100045
More effective intervention	189	1,253	25	2.56	2046	102276
Less effective intervention	189	571	11	2.56	4487	224373
Higher cost intervention	189	985	20	2.60	2643	132154

Modelling for: **Victoria**

The estimated number of eligible people for the Cardiac pacing intervention among fallers with CSH in Victoria in 2009 is 174.

Base case prediction:

Outcome	**Estimate 2009**	**Estimate benefit over 2009-2013**
Eligible population who would uptake	140	140
Falls prevented (n)	726	3632
Fall hospitalisations prevented (n)	15	73
Reduction in fall hospitalisation rate for 65+ older people (%)	0.1*	Not calculated
Reduction in fall hospitalisation rate for community dwelling 65+ older people (%)	0.1*	Not calculated
Total cost ($AUS million)	1.89	1.89
Cost per fall prevented ($AUS)	2,601	520
Cost per fall hospitalisation prevented ($AUS)	130,058	26012

*Approximations only due to data limitations and trend predictions. Interpret with caution.

Other scenarios:

	People uptake (n)	**Falls prevented (n)**	**Hospital admissions prevented (n)**	**Total cost ($AUS mill)**	**Cost per fall prevented ($AUS)**	**Cost per hospital admission prevented ($AUS)**
Low uptake	126	654	13	1.70	2601	130058
High uptake	154	799	16	2.08	2601	130058
Low hospitalisation	140	726	10	1.89	2601	185798
High hospitalisation	140	726	19	1.89	2601	100045
More effective intervention	140	924	18	1.89	2046	102276
Less effective intervention	140	421	8	1.89	4487	224373
Higher cost intervention	140	726	15	1.92	2643	132154

Modelling for: **Tasmania**

The estimated number of eligible people for the Cardiac pacing intervention among fallers with CSH in Tasmania in 2009 is 18.

Base case prediction:

Outcome	**Estimate 2009**	**Estimate benefit over 2009-2013**
Eligible population who would uptake	14	14
Falls prevented (n)	75	376
Fall hospitalisations prevented (n)	2	8
Reduction in fall hospitalisation rate for 65+ older people (%)	0.1*	Not calculated
Reduction in fall hospitalisation rate for community dwelling 65+ older people (%)	0.2*	Not calculated
Total cost ($AUS million)	0.20	0.20
Cost per fall prevented ($AUS)	2,601	520
Cost per fall hospitalisation prevented ($AUS)	130,058	26012

*Approximations only due to data limitations and trend predictions. Interpret with caution.

Other scenarios:

	People uptake (n)	**Falls prevented (n)**	**Hospital admissions prevented (n)**	**Total cost ($AUS mill)**	**Cost per fall prevented ($AUS)**	**Cost per hospital admission prevented ($AUS)**
Low uptake	13	68	1	0.18	2601	130058
High uptake	16	83	2	0.21	2601	130058
Low hospitalisation	14	75	1	0.20	2601	185798
High hospitalisation	14	75	2	0.20	2601	100045
More effective intervention	14	96	2	0.20	2046	102276
Less effective intervention	14	44	1	0.20	4487	224373
Higher cost intervention	14	75	2	0.20	2643	132154

Modelling for: **South Australia**
The estimated number of eligible people for the Cardiac pacing intervention among fallers with CSH in South Australia in 2009 is 58.

Base case prediction:

Outcome	Estimate 2009	Estimate benefit over 2009-2013
Eligible population who would uptake	47	47
Falls prevented (n)	242	1211
Fall hospitalisations prevented (n)	5	24
Reduction in fall hospitalisation rate for 65+ older people (%)	0.1*	Not calculated
Reduction in fall hospitalisation rate for community dwelling 65+ older people (%)	0.1*	Not calculated
Total cost ($AUS million)	0.63	0.63
Cost per fall prevented ($AUS)	2,601	520
Cost per fall hospitalisation prevented ($AUS)	130,058	26012

*Approximations only due to data limitations and trend predictions. Interpret with caution.

Other scenarios:

	People uptake (n)	Falls prevented (n)	Hospital admissions prevented (n)	Total cost ($AUS mill)	Cost per fall prevented ($AUS)	Cost per hospital admission prevented ($AUS)
Low uptake	42	218	4	0.57	2601	130058
High uptake	51	266	5	0.69	2601	130058
Low hospitalisation	47	242	3	0.63	2601	185798
High hospitalisation	47	242	6	0.63	2601	100045
More effective intervention	47	308	6	0.63	2046	102276
Less effective intervention	47	140	3	0.63	4487	224373
Higher cost intervention	47	242	5	0.64	2643	132154

Modelling for: **Western Australia**

The estimated number of eligible people for the Cardiac pacing intervention among fallers with CSH in Western Australia in 2009 is 69.

Base case prediction:

Outcome	**Estimate 2009**	**Estimate benefit over 2009-2013**
Eligible population who would uptake	55	55
Falls prevented (n)	288	1440
Fall hospitalisations prevented (n)	6	29
Reduction in fall hospitalisation rate for 65+ older people (%)	0.1*	Not calculated
Reduction in fall hospitalisation rate for community dwelling 65+ older people (%)	0.1*	Not calculated
Total cost ($AUS million)	0.75	0.75
Cost per fall prevented ($AUS)	2,601	520
Cost per fall hospitalisation prevented ($AUS)	130,058	26012

*Approximations only due to data limitations and trend predictions. Interpret with caution.

Other scenarios:

	People uptake (n)	**Falls prevented (n)**	**Hospital admissions prevented (n)**	**Total cost ($AUS mil)**	**Cost per fall prevented ($AUS)**	**Cost per hospital admission prevented ($AUS)**
Low uptake	50	259	5	0.67	2601	130058
High uptake	61	317	6	0.82	2601	130058
Low hospitalisation	55	288	4	0.75	2601	185798
High hospitalisation	55	288	7	0.75	2601	100045
More effective intervention	55	366	7	0.75	2046	102276
Less effective intervention	55	167	3	0.75	4487	224373
Higher cost intervention	55	288	6	0.76	2643	132154

Modelling for: **Northern Territory**
The estimated number of eligible people for the Cardiac pacing intervention among fallers with CSH in the Northern Territory in 2009 is 5.

Base case prediction:

Outcome	Estimate 2009	Estimate benefit over 2009-2013
Eligible population who would uptake	4	4
Falls prevented (n)	21	104
Fall hospitalisations prevented (n)	<1	2
Reduction in fall hospitalisation rate for 65+ older people (%)	Not applicable	Not calculated
Reduction in fall hospitalisation rate for community dwelling 65+ older people (%)	Not applicable	Not calculated
Total cost ($AUS million)	0.05	0.05
Cost per fall prevented ($AUS)	Not applicable	520
Cost per fall hospitalisation prevented ($AUS)	Not applicable	26012

Other scenarios:

	People uptake (n)	Falls prevented (n)	Hospital admissions prevented (n)	Total cost ($AUS mill)	Cost per fall prevented ($AUS)	Cost per hospital admission prevented ($AUS)
Low uptake	4	19	<1	0.05	Not applicable	Not applicable
High uptake	4	23	<1	0.06	Not applicable	Not applicable
Low hospitalisation	4	21	<1	0.05	Not applicable	Not applicable
High hospitalisation	4	21	1	0.05	2601	100045
More effective intervention	4	27	1	0.05	2046	102276
Less effective intervention	4	12	<1	0.05	Not applicable	Not applicable
Higher cost intervention	4	21	<1	0.06	Not applicable	Not applicable

Modelling for: **Australian Capital Territory**
The estimated number of eligible people for the Cardiac pacing intervention among fallers with CSH in the Australian Capital Territory in 2009 is 10.

Base case prediction:

Outcome	**Estimate 2009**	**Estimate benefit over 2009-2013**
Eligible population who would uptake	8	8
Falls prevented (n)	42	209
Fall hospitalisations prevented (n)	1	4
Reduction in fall hospitalisation rate for 65+ older people (%)	Not available	Not available
Reduction in fall hospitalisation rate for community dwelling 65+ older people (%)	Not available	Not available
Total cost ($AUS million)	0.11	0.11
Cost per fall prevented ($AUS)	2,601	520
Cost per fall hospitalisation prevented ($AUS)	130,058	26012

Other scenarios:

	People uptake (n)	**Falls prevented (n)**	**Hospital admissions prevented (n)**	**Total cost ($AUS mill)**	**Cost per fall prevented ($AUS)**	**Cost per hospital admission prevented ($AUS)**
Low uptake	7	38	1	0.10	2601	130058
High uptake	9	46	1	0.12	2601	130058
Low hospitalisation	8	42	1	0.11	2601	185798
High hospitalisation	8	42	1	0.11	2601	100045
More effective intervention	8	53	1	0.11	2046	102276
Less effective intervention	8	24	<1	0.11	Not applicable	Not applicable
Higher cost intervention	8	42	1	0.11	2643	132154

ASSOCIATED INFORMATION

Underlying assumptions

- The reduction in falls risk from the Kenny et al trial[1] is generalisable to the sections of Australian population with comparable characteristics to those who participated in the trial
- Uptake of the intervention within the eligible population would be the same as that observed in the trial
- Compliance with the intervention delivered to the population will be the same as that achieved in the trial, resulting in the same level of falls reduction
- The intervention does not affect the probability of admission to hospital should a fall occur.
- The intervention did not reduce serious falls injury to a greater extent than the reduction in falls
- The frequency (and rate) of falls in people who are offered an intervention, but do not adopt it, is the same as that amongst people who are not offered the intervention (control group)
- The rate of falls hospital admissions in Australia (and the states and territories) will not change significantly from the average rate for the four year period 2002/03 – 2005/06
- The proportion of falls among older people that require admission to hospital will be the same in 2009, as was observed in the time period from which this estimate was calculated
- The prevalence of CSH in the trial is generalisable to Australians 50+ years presenting to hospital emergency departments following a fall
- The pattern of emergency department presentations following a fall among those 50+ years in Victoria is generalisable to Australia.

Timing of expenditure and benefits

Expenditure would be required over the full 12-month period of intervention delivery, at a relatively even rate. Falls benefits would start immediately after pacemaker insertion and continue for at least 12 months for each person. Hence some benefit from this initial 12-month intervention period would occur in 2010. However, it is highly likely that the fall reducing benefit of this initial intervention would be sustained over the life of the pacemaker (usually at least 5 years).

Other potential benefits

Other health benefits would include an improved quality of life, and reduction of any long term adverse effects of CSH. These other health benefits have not been included in this model.

Capacity building and workforce training

The intervention requires a highly trained workforce, which currently exists, to deliver.

Infrastructure requirements

The model assumes that the increased demand for cardiac pacing services would be delivered within existing infrastructure.

Acceptability

Since the insertion of a pacemaker is now a relatively routine procedure with minimal adverse effects, this intervention is likely to be highly acceptable to older people with

CSH, particularly if available under the public health care system, or private system for those with health insurance.

Feasibility
National implementation would require an additional 567 cardiac pacing procedures over a 12 month period across Australia. The MBS Item Report function indicates that 6,200 procedures for insertion of permanent cardiac pacemakers were performed in Australia in 2007, excluding those undertaken for Department of Veteran Affairs clients.

Equity
People accessing this intervention through the public health care system may have to wait for a period of time before the procedure could be performed, unlike those with private health insurance. Language is unlikely to be a barrier as interpreter services are available at most hospitals. Access for those in regional and rural areas may be restricted due to lack of cardiac pacing services.

Sustainability
Each pacemaker inserted is likely to have at least a five-year lifespan and this falls prevention benefits could be expected to continue for this period, without additional expenditure. Additional expenditure would be required to make this intervention available to additional people on an ongoing basis beyond one year.

Costed inputs for economic analysis

Item	**Lower cost option- $AUS***	**Higher cost option- $AUS***
Carotid screening	1271.25	1271.25
Initial specialist consultation	77.25	250.00
Pacemaker insertion	12,138.77	12,138.77
Post-pacemaker insertion visit	38.80	114.00
Total	**13,526.07**	**13,744.02**

The intervention includes the cost of screening to identify suitable recipients and the cost of the inserting the pacemaker. Screening occurs in two stages:

- an initial screen, based on a review of demographic, clinical and falls related data collected on falls patients who presented at Emergency Department,
- a second carotid screen based on a detailed clinical assessment, with eligible patients referred for pacemaker insertion.

It is assumed that the initial screen would be based on information collected routinely at ED; and as such has not been costed as part of this intervention. If this information is not collected routinely, this intervention will involve an additional cost. In relation to clinician costs, two alternative scenarios are costed; one based on the Australian Medical Association (AMA) suggested fees and the other the Medicare Benefits Schedule (MBS) fees. Results are provided as a high or low option reflecting the two scenarios.

Acknowledgements

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This project was funded by:

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APPENDIX 3

STATE AND TERRITORY MODELLING SUMMARY TABLES

Table A 5 Summary comparison of falls interventions for Queensland

	Tai chi	Muscle-strengthening and balance re-training		OT home hazard assess and modification	Multi-dis. multi-factor. risk screening	Psychotropic medication withdrawal	Cardiac pacing	
Target group	70+ years, community dwelling, mobile	80+ years, community dwelling, mobile		65+ years, hospital inpatient not receiving OT visit as routine care, fall in previous 12 mths	65+ years, presenting to hospital ED for fall	65+ years, community dwelling, taking psychotropic medication	50+ years, presenting to hospital ED for fall, cardioinhibitory carotid sinus hypersensitivity	
		Year 1	Over 2 years				Year 1	Over 5 years
Uptake (% eligible population)	1.9	39.4	-	55.4	55.4	18.9	80.0	-
Population uptake (n)	5,624	32,694	-	26,481	7,427	17,812	111	111
Falls reduction (%)	48.9	27.7	27.7	44.2	57.2	65.9	55.9	55.9
Cost per participant ($)	470	1,091	1,310	413	1,244	604 [a]	13,526	13,526
Falls prevented (n)	2,448	8,507	13,696	26,216	11,166	21,433	576	927
Hospital admissions averted (n)	49	552	889	524	1,117	429	12	19
Reduction in fall-related hospital admission rate for 65+ years (%)	Not available	Not available	Not available	Not available	Not available	Not available	Not available	Not available
Reduction in fall-related hospital admission rate for community dwelling 65+ years (%)	Not available	Not available	Not available	Not available	Not available	Not available	Not available	Not available
Total cost ($M)	2.64	35.65	40.02	10.92	9.24	10.76 [a]	1.50	1.50
Cost/fall prevented ($)	1079	4,191	2,922	417	828	502 [a]	2,601	1,632
Cost/hospital admission averted ($)	53,974	64,542	44,997	20,834	41,374	25,092 [a]	130,058	81,579

[a] additional implementation costs likely

Table A 6 Summary comparison of falls interventions for New South Wales

	Tai chi	Muscle-strengthening and balance re-training		OT home hazard assess and modification	Multi-dis. multi-factor. risk screening	Psychotropic medication withdrawal	Cardiac pacing	
Target group	70+ years, community dwelling, mobile	80+ years, community dwelling, mobile		65+ years, hospital inpatient not receiving OT visit as routine care, fall in previous 12 mths	65+ years, presenting to hospital ED for fall	65+ years, community dwelling, taking psychotropic medication	50+ years, presenting to hospital ED for fall, cardioinhibitory carotid sinus hypersensitivity	
		Year 1	Over 2 years				Year 1	Over 5 years
Uptake (% eligible population)	1.9	39.4	-	55.4	55.4	18.9	80.0	-
Population uptake (n)	11,169	75,478	-	48,382	12,128	33,567	189	189
Falls reduction (%)	48.9	27.7	27.7	44.2	57.2	65.9	55.9	55.9
Cost per participant ($)	470	1,091	1,310	413	1,244	604 [c]	13,526	13,526
Falls prevented (n)	4,861	19,639	31,619	47,898	18,232	40,391	985	4,926
Hospital admissions averted (n)	97	1,275	2,053	958	365	808	20	99
Reduction in fall-related hospital admission rate for 65+ years (%)	0.4	4.8[a]	2.8 [b]	3.6	1.4	3.0	0.1	Not calculated
Reduction in fall-related hospital admission rate for community dwelling 65+ years (%)	0.5	6.1[a]	3.6 [b]	4.6	1.7	3.9	0.1	Not calculated
Total cost ($M)	5.25	82.31	92.39	19.96	15.09	20.27 [c]	2.56	2.56
Cost/fall prevented ($)	1079	4,191	2,922	417	828	502 [c]	2,601	1,632
Cost/hospital admission averted ($)	53,974	64,542	44,997	20,834	41,374	25,092 [c]	130,058	81,579

[a] reductions for 80+ yrs and community dwelling 80+ yrs were 7.4% and 10.3% respectively
[b] for second year only, not years 1 and 2 combined; [c] additional implementation costs likely

Table A 7 Summary comparison of falls interventions for Victoria

	Tai chi	Muscle-strengthening and balance re-training		OT home hazard assess and modification	Multi-dis. multi-factor. risk screening	Psychotropic medication withdrawal	Cardiac pacing	
Target group	70+ years, community dwelling, mobile	80+ years, community dwelling, mobile		65+ years, hospital inpatient not receiving OT visit as routine care, fall in previous 12 mths	65+ years, presenting to hospital ED for fall	65+ years, community dwelling, taking psychotropic medication	50+ years, presenting to hospital ED for fall, cardioinhibitory carotid sinus hypersensitivity	
		Year 1	Over 2 years				Year 1	Over 5 years
Uptake (% eligible population)	1.9	39.4	-	55.4	55.4	18.9	80.0	-
Population uptake (n)	8,038	51,436	-	35,520	8,894	24,182	140	140
Falls reduction (%)	48.9	27.7	27.7	44.2	57.2	65.9	55.9	55.9
Cost per participant ($)	470	1,091	1,310	413	1,244	604 [c]	13,526	13,526
Falls prevented (n)	3,498	13,384	21,548	35,165	13,370	29,098	726	3,632
Hospital admissions averted (n)	70	869	1,399	703	267	582	15	73
Reduction in fall-related hospital admission rate for 65+ years (%)	0.3	4.1 [a]	2.4 [b]	3.3	1.3	2.8	0.1	Not calculated
Reduction in fall-related hospital admission rate for community dwelling 65+ years (%)	0.4	5.4 [a]	3.2 [b]	4.3	1.6	3.6	0.1	Not calculated
Total cost ($M)	3.78	56.09	62.96	14.65	11.06	14.6 [c]	1.89	1.89
Cost/fall prevented ($)	1079	4,191	2,922	417	828	502 [c]	2,601	1,632
Cost/hospital admission averted ($)	53,974	64,542	44,997	20,834	41,374	25,092 [c]	130,058	81,579

[a] reductions for 80+ yrs and community dwelling 80+ yrs were 6.2% and 9.0% respectively
[b] for second year only, not years 1 and 2 combined; [c] additional implementation costs likely

Table A 8 Summary comparison of falls interventions for Tasmania

	Tai chi	Muscle-strengthening and balance re-training		OT home hazard assess and modification	Multi-dis. multi-factor. risk screening	Psychotropic medication withdrawal	Cardiac pacing	
Target group	70+ years, community dwelling, mobile	80+ years, community dwelling, mobile		65+ years, hospital inpatient not receiving OT visit as routine care, fall in previous 12 mths	65+ years, presenting to hospital ED for fall	65+ years, community dwelling, taking psychotropic medication	50+ years, presenting to hospital ED for fall, cardioinhibitory carotid sinus hypersensitivity	
		Year 1	Over 2 years				Year 1	Over 5 years
Uptake (% eligible population)	1.9	39.4		55.4	55.4	18.9	80.0	
Population uptake (n)	846	5,464	-	3,720	955	2,601	14	14
Falls reduction (%)	48.9	27.7	27.7	44.2	57.2	65.9	55.9	55.9
Cost per participant ($)	470	1,091	1,310	413	1,244	604 [c]	13,526	13,526
Falls prevented (n)	368	1,422	2,289	3,682	1,436	3,130	75	376
Hospital admissions averted (n)	7	92	149	74	29	63	2	8
Reduction in fall-related hospital admission rate for 65+ years (%)	0.5	6.1[a]	3.6 [b]	4.9	1.9	4.2	0.1	Not calculated
Reduction in fall-related hospital admission rate for community dwelling 65+ years (%)	0.6	7.4 [a]	4.4 [b]	6.0	2.3	5.1	0.2	Not calculated
Total cost ($M)	0.40	5.96	6.69	1.53	1.19	1.57 [c]	0.20	0.20
Cost/fall prevented ($)	1079	4,191	2,922	417	828	502 [c]	2,601	1,632
Cost/hospital admission averted ($)	53,974	64,542	44,997	20,834	41,374	25,092 [c]	130,058	81,579

[a] reductions for 80+ yrs and community dwelling 80+ yrs were 9.6% and 12.7% respectively
[b] for second year only, not years 1 and 2 combined; [c] additional implementation costs likely

Table A 9 Summary comparison of falls interventions for South Australia

	Tai chi	Muscle-strengthening and balance re-training		OT home hazard assess and modification	Multi-dis. multi-factor. risk screening	Psychotropic medication withdrawal	Cardiac pacing	
Target group	70+ years, community dwelling, mobile	80+ years, community dwelling, mobile		65+ years, hospital inpatient not receiving OT visit as routine care, fall in previous 12 mths	65+ years, presenting to hospital ED for fall	65+ years, community dwelling, taking psychotropic medication	50+ years, presenting to hospital ED for fall, cardioinhibitory carotid sinus hypersensitivity	
		Year 1	Over 2 years				Year 1	Over 5 years
Uptake (% eligible population)	1.9	39.4	-	55.4	55.4	18.9	80.0	
Population uptake (n)	2,862	20,264	-	12,053	3,116	8,418	47	47
Falls reduction (%)	48.9	27.7	27.7	44.2	57.2	65.9	55.9	55.9
Cost per participant ($)	470	1,091	1,310	413	1,244	604 [c]	13,526	13,526
Falls prevented (n)	1,246	5,273	8,489	11,933	4,685	10,129	242	1,211
Hospital admissions averted (n)	25	342	551	239	94	203	5	24
Reduction in fall-related hospital admission rate for 65+ years (%)	0.4	5.6 [a]	3.4 [b]	3.9	1.6	3.4	0.1	Not calculated
Reduction in fall-related hospital admission rate for community dwelling 65+ years (%)	0.5	7.0 [a]	4.1 [b]	4.9	1.9	4.2	0.1	Not calculated
Total cost ($M)	1.34	22.10	24.81	4.97	3.88	5.08 [c]	0.63	0.63
Cost/fall prevented ($)	1079	4,191	2,922	417	828	502 [c]	2,601	1,632
Cost/hospital admission averted ($)	53,974	64,542	44,997	20,834	41,374	25,092 [c]	130,058	81,579

[a] reductions for 80+ yrs and community dwelling 80+ yrs were 8.4% and 11.3% respectively
[b] for second year only, not years 1 and 2 combined; [c] additional implementation costs likely

Table A 10 Summary comparison of falls interventions for Western Australia

	Tai chi	Muscle-strengthening and balance re-training		OT home hazard assess and modification	Multi-dis. multi-factor. risk screening	Psychotropic medication withdrawal	Cardiac pacing	
Target group	70+ years, community dwelling, mobile	80+ years, community dwelling, mobile		65+ years, hospital inpatient not receiving OT visit as routine care, fall in previous 12 mths	65+ years, presenting to hospital ED for fall	65+ years, community dwelling, taking psychotropic medication	50+ years, presenting to hospital ED for fall, cardioinhibitory carotid sinus hypersensitivity	
		Year 1	Over 2 years				Year 1	Over 5 years
Uptake (% eligible population)	1.9	39.4	-	55.4	55.4	18.9	80.0	
Population uptake (n)	2,952	19,668	-	13,063	3,159	9,178	55	55
Falls reduction (%)	48.9	27.7	27.7	44.2	57.2	65.9	55.9	55.9
Cost per participant ($)	470	1,091	1,310	413	1,244	604 [c]	13,526	13,526
Falls prevented (n)	1,285	5,118	8,240	12,933	4,750	11,044	288	1440
Hospital admissions averted (n)	26	332	535	259	95	221	6	29
Reduction in fall-related hospital admission rate for 65+ years (%)	0.4	5.4[a]	3.2 [b]	4.2	1.6	3.6	0.1	Not calculated
Reduction in fall-related hospital admission rate for community dwelling 65+ years (%)	0.5	6.9 [a]	4.0 [b]	5.3	2.0	4.6	0.1	Not calculated
Total cost ($M)	1.39	21.45	24.08	5.39	3.93	5.54 [c]	0.75	0.75
Cost/fall prevented ($)	1079	4,191	2,922	417	828	502 [c]	2,601	1,632
Cost/hospital admission averted ($)	53,974	64,542	44,997	20,834	41,374	25,092 [c]	130,058	81,579

[a] reductions for 80+ yrs and community dwelling 80+ yrs were 8.3% and 11.5% respectively

[b] for second year only, not years 1 and 2 combined; [c] additional implementation costs likely

Table A 11 Summary comparison of falls interventions for Northern Territory

	Tai chi	Muscle-strengthening and balance re-training		OT home hazard assess and modification	Multi-dis. multi-factor. risk screening	Psychotropic medication withdrawal	Cardiac pacing	
Target group	70+ years, community dwelling, mobile	80+ years, community dwelling, mobile		65+ years, hospital inpatient not receiving OT visit as routine care, fall in previous 12 mths	65+ years, presenting to hospital ED for fall	65+ years, community dwelling, taking psychotropic medication	50+ years, presenting to hospital ED for fall, cardioinhibitory carotid sinus hypersensitivity	
		Year 1	Over 2 years				Year 1	Over 5 years
Uptake (% eligible population)	1.9	39.4	-	55.4	55.4	18.9	80.0	-
Population uptake (n)	95	456	-	537	124	371	4	4
Falls reduction (%)	48.9	27.7	27.7	44.2	57.2	65.9	55.9	55.9
Cost per participant ($)	470	1,091	1,310	413	1,244	604 [c]	13,526	13,526
Falls prevented (n)	41	119	191	531	187	446	21	104
Hospital admissions averted (n)	1	8	12	11	4	9	0	2
Reduction in fall-related hospital admission rate for 65+ years (%)	0.5	3.6[a]	2.2 [b]	5.0	1.8	4.1	Not applicable	Not calculated
Reduction in fall-related hospital admission rate for community dwelling 65+ years (%)	0.5	4.3 [a]	2.6 [b]	5.9	2.1	4.8	Not applicable	Not calculated
Total cost ($M)	0.04	0.50	0.56	0.22	0.15	0.22 [c]	0.05	0.05
Cost/fall prevented ($)	1079	4,191	2,922	417	828	502 [c]	2,601	1,632
Cost/hospital admission averted ($)	53,974	64,542	44,997	20,834	41,374	25,092 [c]	130,058	81,579

[a] reductions for 80+ yrs and community dwelling 80+ yrs were 7.7% and 10.1% respectively
[b] for second year only, not years 1 and 2 combined; [c] additional implementation costs likely

Table A 12 Summary comparison of falls interventions for Australian Capital Territory

	Tai chi	Muscle-strengthening and balance re-training		OT home hazard assess and modification	Multi-dis. multi-factor. risk screening	Psychotropic medication withdrawal	Cardiac pacing	
Target group	70+ years, community dwelling, mobile	80+ years, community dwelling, mobile		65+ years, hospital inpatient not receiving OT visit as routine care, fall in previous 12 mths	65+ years, presenting to hospital ED for fall	65+ years, community dwelling, taking psychotropic medication	50+ years, presenting to hospital ED for fall, cardioinhibitory carotid sinus hypersensitivity	
		Year 1	Over 2 years				Year 1	Over 5 years
Uptake (% eligible population)	1.9	39.4	-	55.4	55.4	18.9	80.0	-
Population uptake (n)	377	2,390	-	1,728	422	1,194	8	8
Falls reduction (%)	48.9	27.7	27.7	44.2	57.2	65.9	55.9	55.9
Cost per participant ($)	470	1,091	1,310	413	1,244	604 [a]	13,526	13,526
Falls prevented (n)	164	622	1,001	1,711	634	1,437	42	209
Hospital admissions averted (n)	3	40	65	34	13	29	1	4
Reduction in fall-related hospital admission rate for 65+ years (%)	Not available	Not available	Not available	Not available	Not available	Not available	Not available	Not calculated
Reduction in fall-related hospital admission rate for community dwelling 65+ years (%)	Not available	Not available	Not available	Not available	Not available	Not available	Not available	Not calculated
Total cost ($M)	0.18	2.61	2.93	0.71	0.52	0.72 [a]	0.11	0.11
Cost/fall prevented ($)	1079	4,191	2,922	417	828	502 [a]	2,601	1,632
Cost/hospital admission averted ($)	53,974	64,542	44,997	20,834	41,374	25,092 [a]	130,058	81,579

[a] additional implementation costs likely